DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

April 15, 2021

DAIN-ODB-LO

Ms. Lauren Poulos
U.S. Environmental Protection Agency
1201 Elm Street, Suite 500
Dallas, TX 75270-2002

Re: Final Remedial Action Completion Report, LHAAP-16 Landfill 16, Longhorn Army Ammunition Plant, Karnack, Texas, April 2021

Dear Ms. Poulos,

An electronic copy of the above referenced document has been added to the project portal's "Documents" folder at the following address for your records: (https://docs.cbifederalservices.com/sites/501032/regulators/Shared%20Documents/Forms/AllItems.aspx). An electronic copy of this letter and download instructions for the electronic file have been sent via email. The USEPA comments dated September 22, 2020 and the TCEQ comments dated September 28, 2020 were resolved via the Draft Final report published on October 30, 2020. TCEQ accepted the Draft Final report in an email dated November 23, 2020 and USEPA accepted the Draft Final report in an email dated December 7, 2020.

The document was prepared by Bhate Environmental Associates, Inc., (Bhate) team, on behalf of the Army as part of Bhate's Performance Based Remediation contract for the facility. I ask that Kim Nemmers, Bhate's Project Manager, be copied on any communications related to the project.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil.

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Copies furnished:
A. Palmie, TCEQ, Austin, TX (electronic/online)
P. Bruckwicki, Caddo Lake NWR, TX (1 hard copy/1 CD)
R. Smith USACE, Tulsa District, OK (electronic/online)
A. Williams, USACE, Tulsa District, OK (electronic/online)

A. Maly USAEC, San Antonio, TX (1 CD)
K. Nemmers, Bhate, Lakewood, CO (electronic/online)
P. Srivastav, APTIM, Houston, TX (electronic/online)

DEPARTMENT OF THE ARMY
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RATCLIFF, AR 72951

April 15, 2021

DAIN-ODB-LO

Ms. April Palmie
Texas Commission on Environmental Quality
Superfund Section, MC-136
12100 Park 35 Circle, Bldg D
Austin, TX 78753

Re: Final Remedial Action Completion Report, LHAAP-16 Landfill 16, Longhorn Army Ammunition Plant, Karnack, Texas, April 2021

Dear Ms. Palmie,

An electronic copy of the above referenced document has been added to the project portal's "Documents" folder at the following address for your records: (https://docs.cbifederalservices.com/sites/501032/regulators/Shared%20Documents/Forms/AllItems.aspx). An electronic copy of this letter and download instructions for the electronic file have been sent via email. The USEPA comments dated September 22, 2020 and the TCEQ comments dated September 28, 2020 were resolved via the Draft Final report published on October 30, 2020. TCEQ accepted the Draft Final report in an email dated November 23, 2020 and USEPA accepted the Draft Final report in an email dated December 7, 2020.

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Rose M. Zeiler, Ph.D.
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K. Nemmers, Bhate, Lakewood, CO
P. Srivastav, APTIM, Houston, TX

Final

Remedial Action Completion Report, LHAAP-16 Landfill

Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers, Tulsa District
Contracting Division
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Acronyms and Abbreviations

µg/L	micrograms per liter
ABC+™	Anaerobic BioChem Plus
ABC™	Anaerobic BioChem
APTIM	Aptim Federal Services, LLC
bgs	below ground surface
Bhate	Bhate Environmental Associates, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	contaminant of concern
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DO	dissolved oxygen
DPT	direct-push technology
EDS-ER™	electron donor solution–extended release
ESD	Explanation of Significant Differences
EVO	emulsified vegetable oil
GWTP	groundwater treatment plant
IRA	interim remedial action
ISB	in situ bioremediation
IWWP	Installation-Wide Work Plan
Jacobs	Jacobs Engineering Group, Inc.
LHAAP	Longhorn Army Ammunition Plant
LTM	long-term monitoring
LUC	land use control
mg/L	milligrams per liter
MNA	monitored natural attenuation
mV	millivolts
No.	number
OHM	OHM Remediation Services Corporation
ORP	oxidation-reduction potential
PVC	polyvinyl chloride
RA	remedial action
RACR	Remedial Action Completion Report
RAOs	remedial action objectives
RAWP	Remedial Action Work Plan
RD	Remedial Design
Rev	revision
ROD	Record of Decision

Acronyms and Abbreviations *(continued)*

ROI	radius of influence
SCLs	sample collection logs
SDC-9™	APTIM's dechlorinating culture
SOP	standard operating procedure
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TOC	total organic carbon
U.S.	United States
U.S. Army	U.S. Department of the Army
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
ZVI	zero valent iron

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1.0 INTRODUCTION

The United States (U.S.) Army Corps of Engineers (USACE), Tulsa District, contracted Bhate Environmental Associates, Inc. (Bhate), under the Omaha Multiple Environmental Government Acquisition National Small Business Multiple Award Task Order Contract Environmental Remediation Services with Military Munitions Response Program, Task Order No. W9128BV17F0150 to conduct environmental restoration of LHAAP-16 at Longhorn Army Ammunition Plant (LHAAP). The Bhate Team is composed of Bhate and Aptim Federal Services, LLC (APTIM). APTIM conducted the Remedial Action (RA) for LHAAP-16. LHAAP is an inactive, government owned formerly contractor operated and maintained Department of Defense facility located in central east Texas (**Figure 1-1**). This Remedial Action Completion Report (RACR) describes remedial actions taken to address risks associated with contaminated groundwater at LHAAP-16. Specifically, this RACR describes activities associated with field implementation of an in situ bioremediation (ISB) remedy in accordance with the Remedial Design (RD) (AECOM 2017) and Remedial Action Work Plan (RAWP) (Bhate 2018a) for LHAAP-16. The RD and RAWP for LHAAP-16 were finalized in January 2017 and June 2018, respectively.

1.1 Organization of Remedial Action Completion Report

This RACR is composed of the following sections:

- **Section 1.0:** "Introduction" summarizes the site description, remedial action objectives (RAOs), the contaminants of concern (COCs) and their respective cleanup levels, the selected remedy, and associated the land use control (LUC) plan.
- **Section 2.0:** "Well Installation" describes the drilling and construction of wells that were added to the previously existing well network for the purpose of injecting ISB amendments or monitoring the effects of ISB.
- **Section 3.0:** "Pre-Remedy Sampling" describes the sampling activities that were conducted prior to ISB injections and presents the associated results.
- **Section 4.0:** "In Situ Bioremediation" describes the injection of amendments to enhance microbial degradation of contaminants.
- **Section 5.0:** "Design Effectiveness Sampling" presents analytical results for samples collected to evaluate the local distribution of amendments and changes in geochemical parameters during the first few months after the injections.

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- **Section 6.0**: "LUC Implementation" identifies activities that were performed to implement the LUCs in accordance with the LUC Plan in the RD and RAWP.
- **Section 7.0:** "References" provides a list of references cited in the document.

This RACR also includes the following appendices to support the text:

- **Appendix A** provides:
  - The Notice of LUCs recorded at the Harrison County Courthouse and the Survey Plat and Legal Description of the parcel subject to the LUCs.
  - The notice of LUCs for Soil and Groundwater Contamination letter provided to the landowners and occupants, federal, state, and local officials, and the Texas Department of Licensing and Registration for notification to water well drillers, as required by the LUC Plan.
  - Example LUC Inspection Checklist and Certification Forms.
- **Appendix B** consists of the Survey Report, boring logs, and construction diagrams for the injection and monitoring wells installed in 2018 and 2019 specifically to support the ISB effort.
- **Appendix C** contains sample collection logs (SCLs) associated with groundwater samples collected at wells during the Pre-Remedy and Design Effectiveness events.
- **Appendix D** includes the laboratory analytical reports for those samples that were collected during implementation of the ISB.
- **Appendix E** is the Quality Control Summary Report for the laboratory analyses.
- **Appendix F** presents potentiometric surface maps for well gauging events associated with the remediation.
- **Appendix G** consists of photographs of the field work.

1.2 Site Description

LHAAP-16 is a capped landfill covering approximately 20 acres in the south-central portion of the former LHAAP (**Figure 1-2**). Harrison Bayou is located along the eastern edge of the LHAAP-16 and flows into Caddo Lake, northeast of the former LHAAP. The landfill covered approximately 13 acres prior to cap construction. It was established in the 1940s for the disposal of solid and industrial wastes, and was used until the 1980s, when disposal activities were terminated.

The geology and hydrogeology of LHAAP-16 has been described in several documents (Jacobs 2000, Jacobs 2002, U.S. Army 2016a, AECOM 2017) and is summarized below:

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- The surface soil (outside the landfill cap) at LHAAP-16 consists of fine sandy loam.
- The subsurface is composed of medium plastic sandy silt, fine sands, and clay. The clay layers tend to separate the groundwater into shallow, intermediate, upper deep and deep zones.
- Depth to groundwater in the shallow zone ranges from approximately 4 to 25 feet below ground surface (bgs).
- An intermediate groundwater zone containing fewer fines than the shallow zone extends from 35 to 62 feet bgs.
- The upper deep groundwater zone extends from approximately 80 to 151 feet bgs.
- The lower deep groundwater zone extends below 220 feet bgs.
- Flow is primarily horizontal in the groundwater zones, but vertical interaction between the shallow and intermediate zones has been evidenced by pumping test results as well as the presence of contamination in both zones.
- Based on potentiometric data collected for the remedial investigation (Jacobs 2000), the groundwater flow direction is northeast in the shallow, intermediate and deep zones, while flow direction is southeast in the upper deep groundwater zone. More recent documents frequently show shallow and intermediate flow toward the east and southeast.
- Between 1996 and the beginning of the ISB documented in this RACR, groundwater flow between the landfill and Harrison Bayou was influenced by the operation of a groundwater extraction system.

The contaminated media at LHAAP-16 includes buried source material (landfill waste under the cap) and the shallow and intermediate groundwater beneath and downgradient of the landfill. The U.S. Army and the U.S. Environmental Protection Agency (USEPA) signed an Interim Record of Decision (ROD) (U.S. Army 1995), and the Texas Water Commission (now the Texas Commission on Environmental Quality [TCEQ]) concurred in 1995 approving an interim remedial action (IRA) for LHAAP-16 to mitigate potential risks posed by buried source material at the site. The IRA included the construction of a landfill cap, which is considered a component of the final remedy for the site. Construction of the multilayer cap was completed in 1998. The Interim ROD also specified that the U.S. Army would be required to "perform long-term maintenance of the cap" (U.S. Army 1995). LUCs, such as future use restrictions, would also be required. LUCs are discussed further in **Section 1.5**. The landfill cap prevents rainfall from infiltrating and leaching contaminants from principal threat wastes within the landfill; however, groundwater in contact with the buried waste material still provides a mechanism for transport of contaminants away from the landfill (Jacobs 2000).

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The groundwater extraction system was voluntarily installed by the U.S. Army in 1996 and 1997 as a treatability study to prevent the groundwater plume from migrating to Harrison Bayou (OHM 1998). Two extraction wells were installed in the shallow zone in 1996; two additional shallow zone extraction wells and four intermediate zone extraction wells were installed in 1997. The extraction system was shut down in August 2012 due to operational issues including damage to the power feed to the system, but operation was restored in November 2012. The extraction system was inoperable from December 26, 2018, to September 3, 2019, due to damage to the main LHAAP electrical transformer caused by power surges during storms. Following transformer replacement, the extraction system operated from September 4–27, 2019 (i.e., until completion of the ISB injections for the Bayou Biobarrier as discussed in **Section 4.5.1** of this RACR).

The Final ROD for LHAAP-16 (including the impacted groundwater) was issued in September 2016 and describes the final selected remedy for the site (U.S. Army 2016a). The groundwater COCs identified in the Final ROD include chlorinated volatile organic compounds (CVOCs) (trichloroethene [TCE], cis-1,2-dichloroethene [DCE], 1,1-DCE; 1,2-dichloroethane, vinyl chloride [VC], 1,1,2-trichloroethane, and methylene chloride), perchlorate, and metals (arsenic, chromium, manganese, nickel and thallium) in the shallow and/or intermediate groundwater. **Figure 1-3** shows the approximate lateral extent of perchlorate and TCE in the shallow and intermediate groundwater zones at LHAAP-16, based on comprehensive groundwater sampling performed in May 2013 (U.S. Army 2016a). While metals have been sporadically detected at elevated concentrations, metals results do not appear to reflect widespread contamination from the landfill.

As established in the ROD, groundwater and surface water cleanup levels are presented in **Table 1-1**. The Final RD was issued in January 2017 (AECOM 2017) and presents the design, the inspection and maintenance requirements, and the LUC requirements associated with LHAAP-16. The RAWP was reviewed by TCEQ and EPA and finalized in June 2018 (Bhate 2018a).

1.3 Remedial Action Objectives (RAOs)

The RAOs developed for LHAAP-16 and outlined in the Final LHAAP-16 ROD (U.S. Army 2016a) are:

- Protection of human health and the environment by preventing exposure to landfill contents.
- Protection of human health and the environment by reducing leaching and migration of landfill hazardous substances into the groundwater.

- Protection of human health by preventing human exposure to the contaminated groundwater.
- Protection of human health and the environment by preventing COCs and COC by-products from migrating into Harrison Bayou at levels that cause surface water in Harrison Bayou to exceed surface water criteria.
- Return of groundwater to its potential beneficial uses as drinking water, wherever practicable.

1.4 Selected Remedy

The RA at LHAAP-16 comprises the following elements (U.S. Army 2016a):

- Maintenance of the existing landfill cap to preserve its integrity and minimize or prevent infiltration through the landfill.
- Installation of two biobarriers in the shallow groundwater, one located adjacent to the landfill, and the other located near Harrison Bayou.
- ISB in the most contaminated portion of the shallow and intermediate groundwater zones in conjunction with phased shut down of the existing groundwater extraction system.
- Performance Monitoring of both shallow and intermediate groundwater zones in the active treatment areas to monitor degradation of CVOCs and perchlorate.
  - Follow-up injections will be conducted in the ISB treatment areas if deemed necessary based on the criteria presented in Section 4.7.4 of the RAWP (Bhate 2018a).
- Monitored natural attenuation (MNA) monitoring of both the shallow and intermediate groundwater zones outside the active treatment area. MNA includes:
  - Evaluation of MNA after 2 years quarterly monitoring.
  - Per the ROD, if MNA is found to be ineffective, a contingency remedy of bio-amendment injections outside the active treatment areas will be implemented following documentation in an Explanation of Significant Differences (ESD).
- Long-term monitoring (LTM) semiannually for 3 years, then annually thereafter until recommended otherwise by the five-year review. LTM will not be initiated until MNA performance monitoring establishes the effectiveness of MNA.
- The LUC prohibiting intrusive activities (e.g., digging) within the landfill boundary will remain in place as long as landfill waste remains or until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.

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- The LUC for prohibition of groundwater use (except for monitoring and testing) shall be implemented and shall remain in place at the Site until the levels of COCs in surface and subsurface soil and groundwater are reduced below levels that would support unlimited use and unrestricted exposure.
- The LUC to prohibit non-residential use will remain in place until it is demonstrated that surface and subsurface soil and groundwater COCs are at levels that allow for unlimited use and unrestricted exposure.
- The LUC objectives include maintaining the integrity of any current or future remedial or monitoring systems and preventing the use of groundwater contaminated above cleanup levels as a potable water source. The groundwater treatment and LTM remedial components include a groundwater monitoring system that will be used to characterize the condition of the groundwater during the period the groundwater remedy is in place until the groundwater remediation goals are achieved, and to demonstrate achievement of the groundwater remediation goals when the groundwater remedy is complete. As a part of this groundwater remedy, the Army will maintain the remedial and monitoring systems associated with the groundwater remedies until these components of the remedy are no longer needed to achieve cleanup levels, and cleanup levels have been achieved. During the period of operation of the groundwater remedy, if any of the elements of the remedial and groundwater monitoring systems are damaged, destroyed, or become ineffective, they will be repaired or replaced with suitable components to assure that the remedial and groundwater monitoring systems are able to provide data of the quality necessary to determine the progress of and eventual completion of the remedy.

Within 21 days of the issuance of the ROD, the Army proposed deadlines for completion of the RD Work Plan, RD, and RAWP. The documents were prepared and submitted to the EPA and the TCEQ pursuant to the Federal Facility Agreement. The LUC RD contained implementation and maintenance actions, including periodic inspections. The LTM plan was also presented in the RD. The Notice of Land Use Controls, including a description of the LUCs, the Survey Plat and Legal Description of the parcel subject to the LUCs was recorded in Harrison County on March 22, 2021.

The LUC Plan was incorporated into the Comprehensive LUC Management Plan (U.S. Army 2019) in the October 2019 revision. The Notice of Land Use Controls recordation is included in **Appendix A**. Letters providing initial notice of LUCs for Soil and Groundwater Contamination were sent to landowners and occupants, federal, state, and local officials and the Texas Department of Licensing and Registration on December 8, 2016 (U.S. Army 2016b), within 90 days of signature of the ROD, as required. A notification letter was also sent to

federal, state, and local officials and to the Texas Department of Licensing and Regulation (Water Well Drillers and Pump Installers Section) on February 23, 2021 showing the area covered by the final groundwater use restriction LUC (**Appendix A**). Annual inspections of the Landfill Cover and LUCs, and CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) five-year reviews of the remedy will continue until levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.

1.5 Deviations from the Work Plan

This RACR documents the field implementation of ISB at LHAAP-16. That work was performed in general accordance with the RAWP (Bhate 2018a). Those activities that deviated from the work plan are listed below:

- Two injection wells did not perform properly and were replaced by direct-push technology (DPT) points. See **Section 2.1** for details.
- Two wells installed on the east side of Harrison Bayou were classified as intermediate zone wells rather than shallow zone wells. See **Section 2.2**.
- Rather than a single pre-remedy sampling event, two different sampling events were conducted, separated by 11 months. Sampling was interrupted because excessive rainfall pushed back the completion of some wells and a power outage (caused by a transformer failure) shut down the LHAAP-16 groundwater extraction system for approximately 8 months. The second pre-remedy sampling event included a subset of the wells sampled during the first event to determine if the prolonged shutdown of the system had caused significant changes to the contaminant plumes. See **Section 3.0**.
- Three DPT locations (DPT-26 through DPT-28) at the Bayou Biobarrier had to be relocated due to the presence of a ravine. See **Section 4.3**.
- The actual sequence of injection and recirculation activities in the various treatment areas closely followed the sequence presented in the RAWP. However, injection in Biobarrier #3 overlapped with recirculation in the intermediate zone of the Mid-Plume Area, which was not specifically mentioned in the RAWP. See **Section 4.5.1**.
- Per the RAWP, extraction at the mid-plume intermediate area was to occur following injection, and the extraction wells were to be redeveloped prior to injection. Extraction was initially attempted while injection was ongoing and prior to redevelopment of the extraction wells. The extraction was stopped, and the four extraction wells were redeveloped prior to their subsequent use for both extraction and injection. See **Section 4.5.5.2**.

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- In the intermediate zone of the Mid-Plume Area, extraction was shut down, with regulatory approval, prior to seeing full bromide break-through at the extraction wells. See **Section 4.5.5.2**.
- The RAWP indicated that the first round of Design Effectiveness samples should be collected by 30 days after the injections, and a second round by 60 days after the injections. First round samples were collected from 26 to 33 days after injections. The second round of Design Effectiveness samples was collected in March 2020, more than 2 months after injections See **Section 5.0**.
- During well purging, all field-measured parameters were not fully stabilized in accordance with the Installation Wide Work Plan (IWWP) (Bhate 2018b) requirements for a few of the pre-remedy and post-injection samples. While no impact to the sample results was specifically identified, future sampling will be conducted in accordance with the IWWP, or, where full compliance cannot be achieved, documented in the field log.

1.6 Land Use Control Plan

The Final ROD (U.S. Army 2016a) indicated that the U.S. Army or its representative will be responsible for LUC implementation, certification, reporting, and enforcement. The U.S. Army will address any LUC problems within its control that are likely to impact remedy integrity as soon as practicable. The details of LUC components are provided in the RD (AECOM 2017). The continued successful implementation of LUCs will be documented in annual remedial action operation reports.

The Comprehensive LUC Management Plan (U.S. Army 2019) provides a repository for LUC plans for sites throughout the former LHAAP. The LUC Plan for LHAAP-16 can be found within the Comprehensive LUC Management Plan. That document includes blank copies of the Inspection and Maintenance Checklist and the Land Use Control Compliance Inspection Form.

The LUC Plan includes restrictions on the landfill cap and on land and groundwater use. **Appendix A** presents the Notice of LUCs and the Survey Plat and Legal Description that were filed with Harrison County. The preliminary LUC boundaries proposed in the ROD (U.S. Army 2016a) have been revised to extend farther to the east (**Figure 1-4**) due to groundwater analytical results that indicate that the plume is present beyond Harrison Bayou. Implementation of the LUC Plan will include annual inspections that are recorded on the Inspection and Maintenance Checklist and the Land Use Control Compliance Certification Form. The Checklist and the Certification Form are provided within **Appendix A**.

1.7 Performance Monitoring and Follow-up Activities

While this RACR documents the implementation of ISB, the RAWP (Bhate 2018a) describes several activities, briefly described below, that are to be conducted following ISB. The RAWP should be referenced for detailed information (including reporting requirements) regarding the following activities:

- **Performance Monitoring Year 1 and Year 2:** Quarterly sampling will be conducted to determine geochemical conditions, volatile organic compound (VOC) concentrations, and perchlorate concentrations. Any recommendations to modify the sampling frequency, analytical parameters, or wells will be made in the Annual Remedial Action Operation Report. Additionally, the results will be used to evaluate the impacts of biodegradation reactions.
- **Follow-up Injections in Biobarriers:** As specified in the ROD, follow up injections for the biobarriers will be implemented based on evaluation of the groundwater monitoring results. The decision to reinject will be based on detailed criteria presented in the RAWP.
- **MNA Evaluation:** After two years of quarterly performance monitoring, MNA will be evaluated. The wells and analyses selected for performance monitoring for MNA evaluation are specified in the RAWP.
- **Contingency Action for MNA Areas:** A contingency remedy, involving the application of bioamendments, will be implemented for MNA areas outside the active remediation areas if the required MNA criteria are not met. The area and elements of contingency remedy will be selected based on the entire data set available. If the contingency remedy is required, it will be documented in an ESD.
- **LTM Year 3 to Next Five Year Review:** LTM will be initiated if MNA is found to be effective based on the first two years of performance monitoring. Per the Final ROD, LTM will be implemented at a semiannual frequency for three years, and then annually until the next five-year review.
- **Surface Water Monitoring:** Surface water monitoring will be conducted during quarterly performance monitoring events to ensure that concentrations do not exceed surface water standards for contaminants.
- **Metals Groundwater Monitoring:** The ROD indicates monitoring for metals will be evaluated at the first five year review to determine if any further monitoring for metals is warranted (U.S. Army 2016a). As part of the next five year review after remedy implementation, groundwater samples will be collected and analyzed for the remaining metal COCs (chromium, arsenic, nickel and/or manganese).

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2.0 WELL INSTALLATION

Between April 2018 and August 2019, 28 wells were installed at LHAAP-16 in preparation for ISB injection activities and to define the nature and extent of the groundwater contamination immediately prior to ISB. **Table 2-1** provides a list of those wells, including the purpose (injection or performance monitoring), the screen interval, and other construction details. These wells supplemented the pre-existing wells at LHAAP-16. **Figure 2-1** shows the location of the wells specifically added to support the RA (the green symbols for wells installed in 2018 and 2019) as well as the previously existing wells and piezometers (black symbols). Most of the newer wells were installed in two phases in 2018: 1) April 19 thru May 4, and 2) October 11 thru November 1. Repeated heavy rainfall events prevented access to some of the locations for months after that. Wells 16WW49, 16WW57, and 16WW58 could not be installed until August 2–7, 2019.

The wells were installed by firms with Texas-licensed drillers (Best Drilling and ETTL Engineers & Consultants, Inc.). All drilling and well installation activities were supervised by a Texas-licensed professional geologist. The well locations were surveyed by a Professional Surveyor licensed in Texas. The surveying report, boring logs, and well construction diagrams are provided in **Appendix B**.

2.1 Injection Wells

All injection wells were constructed with 2-inch diameter, schedule 40 polyvinyl chloride (PVC) risers and screens. The screens were 10 feet in length with 0.010-inch slot size. The wells were screened at the depth intervals shown in **Table 2-1**.

The six injection wells in the intermediate groundwater zone were constructed with 10-inch diameter Schedule 40 PVC isolation casing set in a clay layer at depths that varied from 20 to 35 feet bgs. The isolation casing served to confine groundwater to its zone of origin in accordance with Section 3.2 of the IWWP (Bhate 2018b). During the ISB injections, these wells were fitted with injection connections for attachment of the injection system.

Two of the intermediate zone injection wells (16IW27 and 16IW28) did not perform properly during their initial use for ISB injections on September 27, 2019. During those initial injections, when pressure was applied to the well, a mixture that appeared to contain grout, bentonite, and possibly sand began exiting from beneath the well pad at 16IW27 and up through the steel protective casing at 16IW28. While the exact cause of these grout seal failures could not be determined, there are a number of possible explanations, including flowing sands creating unstable borehole margins adjacent to the grout plug during placement, failure of the grout to set properly (potentially due to excess bentonite or water or insufficient Portland

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cement in the mixture), breakdowns due to pressure fluctuations, or heaving of flowing sands into the grout while it was curing. Both wells were abandoned on October 11, 2019. The injections at those locations were subsequently conducted through temporary injection points that were installed with DPT and grouted immediately following completion of the injections.

2.2 Monitoring Wells

Monitoring wells were constructed of 4-inch diameter, schedule 40 PVC risers and screens. The well screens were 10 feet in length with 0.010-inch slot size. A filter pack consisting of 10/20 filter sand was placed around the screen from the bottom of the borehole to at least 2 feet above the screen. After the filter pack had been placed, a minimum 2-foot bentonite seal was introduced into the well above the filter pack. The bentonite seal was placed in 1-foot lifts, each hydrated for 30 minutes. After placement of the final bentonite lift, the bentonite seal was saturated with potable water and allowed to hydrate for at least an additional two hours before grouting began (per IWWP [Bhate 2018b], Section 3.2 and Standard Operating Procedure [SOP] A7.3.6). After the bentonite seal had hydrated, the remaining annulus was grouted using a Type I/II Portland cement/bentonite slurry.

Two wells were installed in different groundwater zones than proposed in the RAWP (Bhate 2018a). 16WW57 and 16WW58 were installed in the intermediate groundwater zone (rather than the shallow zone) with screen intervals of 26 to 36 and 28 to 38 feet bgs, respectively. Both wells are located on the east side of Harrison Bayou, while the LHAAP-16 landfill is west of the bayou. No shallow zone was encountered during the drilling of these wells. The wells were installed at the first water bearing zone encountered; based on depth and comparison of elevations of geologic strata with other wells, that water bearing zone correlated to the intermediate groundwater zone.

Piezometer 16PZ06 was damaged when the 2-inch diameter PVC stick-up was struck by moving equipment following construction of intermediate well 16WW49. It was repaired by cutting the broken PVC pipe to create a clean surface and then adding a new piece of PVC casing using a coupling. The location of piezometer 16PZ06 is shown in **Figure 2-1**.

2.3 Well Development

After each newly installed well had been complete for at least 24 hours, the well was developed in accordance with Section 3.2.2 of the IWWP (Bhate 2018b). Development logs are included in **Appendix B**.

Nine existing wells associated with the semi-passive biobarrier (16IW01/03/05/07 and 16EW11/12B/13/14B/15) and four existing wells at the mid-plume intermediate zone (16EW05/06/07/08) were redeveloped without being formally logged. Those existing wells were developed by pumping until the water was visibly clear and the field parameters

(temperature, pH, specific conductivity, and turbidity measured in a flow-through cell) had stabilized.

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3.0 PRE-REMEDY SAMPLING

The RAWP (Bhate 2018a) presented a pre-remedy sampling plan that encompassed both the shallow and intermediate groundwater zones at LHAAP-16 as well as surface water from Harrison Bayou. The pre-remedy sampling of the groundwater was conducted to characterize the CVOC and perchlorate concentrations and geochemical conditions that existed prior to the ISB injections. The pre-remedy sampling results provide a baseline against which future performance monitoring results may be compared.

Pre-remedy groundwater and surface water sampling were performed in accordance with Sections 3.4 and 3.6, respectively, of the IWWP (Bhate 2018b). Groundwater sampling used low-flow methods, and the associated data were recorded on SCLs. Those SCLs are provided in **Appendix C**. Field parameters (pH, conductivity, oxidation-reduction potential [ORP], and turbidity) were recorded on the SCLs; chemical analyses were performed at offsite laboratories. The analytical results from the offsite laboratories are provided in **Appendix D**, and the Quality Control Summary Report is provided in **Appendix E**.

The pre-remedy sampling locations included wells inside and outside of the plumes and wells located upgradient of, within, and downgradient of the ISB areas. As presented in the RAWP, pre-remedy sampling was to be performed at 26 wells in the shallow zone, 19 wells in the intermediate zone, and one well in the upper deep zone. Also, three surface water sample locations were planned.

The pre-remedy sampling began in October 2018 before all wells were installed. The remaining well installations were delayed by heavy rainfall and saturated ground conditions that persisted through the spring of 2019. The final wells were installed in August 2019. Overlapping with this time period, the groundwater extraction system was inoperable from December 26, 2018 to September 3, 2019, due to damage to the main LHAAP electrical transformer as discussed in **Section 1.2**. After groundwater extraction resumed on September 4, 2019, the extraction system was run for approximately two weeks prior to sampling to allow aquifer hydraulic conditions to stabilize. To address the possibility that the October 2018 results might not be representative of conditions at the start of ISB, the September pre-remedy sampling consisted of a subset of the sampling network from the RAWP (Bhate 2018a), with concurrence from TCEQ and USEPA (TCEQ 2019, USEPA 2019), that included 16 shallow wells and 12 intermediate wells. Those groundwater samples were collected September 16–19, 2019.

Depths to groundwater were measured in conjunction with the pre-remedy sampling. Those depth-to-groundwater observations were used to create potentiometric surface maps that are

provided in **Appendix F**. Maps for the shallow and intermediate groundwater zones are provided for both October 2018 and September 2019. The extraction wells were operating during both of these pre-remedy sampling events. To provide a comparison to a time without extraction pumping, depths to groundwater were measured in June 2019 and the associated potentiometric surface maps are also included in **Appendix F**. The overall flow direction in these maps is from northwest to southeast for both the shallow and intermediate groundwater zone. This contrasts with the northeast flow direction that was mentioned in earlier documents as summarized in **Section 1.2**.

3.1 Shallow Groundwater

Pre-remedy samples were collected from 29 shallow zone wells. Of the 29 wells, 25 were sampled in October 2018 and 16 were sampled in September 2019. The parameters varied across the sampling events as shown in **Table 3-1**.

The analytical results for shallow groundwater locations are presented in **Table 3-2**. VOCs were detected above cleanup levels at 15 shallow wells at LHAAP-16. **Figure 3-1** presents the most recent pre-remedy TCE result for each well. Detections above cleanup levels were inside the 2013 plume boundaries used in the RD (AECOM 2017), indicating that the extent of contamination was not adversely affected by the shutdown of the extraction system due to the electrical outage. The wells with the highest concentrations of VOCs were (from west to east) 16WW16, 16WW36, and 16EW02, all of which contained TCE concentrations over 10,000 micrograms per liter (µg/L).

Perchlorate was detected above cleanup levels at five shallow wells. Detections of perchlorate were also inside the plume boundaries identified in 2013 (as shown on **Figure 3-2**), indicating that the extent of contamination was not adversely affected by the shutdown of the extraction system due to the electrical outage. The wells with the highest concentrations of perchlorate were 16WW16 and 16WW55, which had detections over 400 µg/L.

3.2 Intermediate and Upper Deep Groundwater

Pre-remedy samples were collected from 19 intermediate wells. Of the 19 wells, 15 were sampled in October 2018, 5 were sampled in February 2019, 2 were sampled in August 2019, and 12 were sampled in September 2019. The parameters varied across the sampling events as shown in **Table 3-3**.

The analytical results for 19 intermediate groundwater wells and one upper deep groundwater well are presented in **Table 3-4**. Pre-remedy VOC results exceeded the cleanup levels at 12 intermediate wells at LHAAP-16. The well with the highest concentrations of VOCs was 16WW35, which contained 21,000 µg/L of TCE and 19,000 µg/L of cis-1,2-DCE when sampled in October 2018. When 16WW35 was sampled again in September 2019, the

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concentrations were 13,000 µg/L of TCE and 8,800 µg/L of cis-1,2-DCE. **Figure 3-3** presents the most recent TCE result for each well. As shown in that figure, of the 12 intermediate wells with TCE above cleanup levels, 10 were inside the 2013 plume boundaries used in the RD (AECOM 2017). The other two wells that exceeded cleanup levels were newly installed wells 16WW57 and 16WW58, which are located on the east side of Harrison Bayou, outside the plume boundaries used to develop the RD. The revised TCE plume (which incorporates the 2019 results at wells 16WW57 and 16WW58) is provided in **Figure 1-4**, Final LUC Boundaries.

Perchlorate was detected above cleanup levels at four intermediate wells. Detections of perchlorate were inside the plume boundaries identified in 2013 (as shown on **Figure 3-4**). The well with the highest concentration of perchlorate was 16WW35, which contained a concentration of over 400 µg/L.

One well in the upper deep groundwater zone, 16WW21, was sampled for the pre-remedy sampling and is included in **Table 3-3** and **Table 3-4**. It was sampled in October 2018. The results for perchlorate and the selected VOCs were all below detection limits.

3.3 Surface Water

Pre-remedy surface water samples were also collected in October 2018 from three locations in Harrison Bayou: 16SW01, 16SW02, and 16SW03. The locations are shown on **Figure 3-5**. As shown in the figure, 16SW02 was collected in the portion of Harrison Bayou that may intersect the groundwater plumes. Since Harrison Bayou flows from south to north, 16SW03 is the upstream sampling location, and 16SW01 is the downstream sampling location.

In accordance with the RAWP, these samples were analyzed for specific VOCs, perchlorate, inorganics, and field parameters as noted in **Table 3-5**. The field parameters included dissolved oxygen (DO), pH, ORP, conductivity, and temperature.

The analytical results for the three sample locations are presented in **Table 3-6**. Perchlorate and the VOCs were not detected at any of the three locations.

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4.0 IN SITU BIOREMEDIATION

ISB was conducted at LHAAP-16 to remediate groundwater impacted with VOCs and perchlorate. As planned in the RD (AECOM 2017) and RAWP (Bhate 2018a), the following six ISB systems were implemented to treat the VOC and perchlorate impacted groundwater:

- A "Bayou Biobarrier" in the shallow groundwater zone near Harrison Bayou
- A biogrid in the shallow groundwater zone in the Mid-Plume Area
- A biobarrier in the intermediate groundwater zone in the Mid-Plume Area
- Landfill Biobarrier #1 in the shallow groundwater zone southwest of the Mid-Plume Area and adjacent to the landfill
- Landfill Biobarrier #2 in the shallow groundwater zone adjacent to the landfill at the location of the past Semi-Passive Biobarrier Demonstration
- Landfill Biobarrier #3 in the shallow groundwater zone adjacent to the landfill and immediately north of Landfill Biobarrier #2

The locations of the six ISB systems at LHAAP-16 are shown in **Figure 4-1**.

In addition to injection of bioaugmentation and biostimulation amendments, the implementation of ISB involved activities prior to and following the injections. The sections below describe the major steps, from notifications through demobilization, in approximate chronological order. Photographs of various aspects of the field work are included in **Appendix G**.

4.1 Notification

On April 24, 2018, U.S. Army transmitted a memorandum for record regarding "LHAAP-16 Underground Injection Control Substantive Requirements Notification" to TCEQ (Bhate 2018c). The memorandum addressed the injection of emulsified vegetable oil (EVO), APTIM's dechlorinating culture (SDC-9™), zero valent iron (ZVI), and microbial nutrients at 92 injection locations—79 DPT injection wells, 9 new injection wells, and 4 existing extraction wells.

TCEQ and USEPA were apprised of upcoming field activities via monthly meetings with U.S. Army representatives throughout the project. On August 21, 2019, the regulatory agencies were specifically notified that ISB injection activities would commence in mid-September 2019 (Bhate 2019).

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4.2 Utility Clearance

Utility location and clearance for intrusive activities were conducted prior to drilling and in accordance with Section 3.1 of the IWWP (Bhate 2018b). Utility clearance tasks included the following:

- Contacting the Texas Excavation Safety System, Inc. utility notification service.
- Verifying that all known underground installations had been located and marked, as needed, for avoidance.
- Holding safety meetings and completing job safety analyses with all personnel who were involved in intrusive activities.

4.3 Site Clearance and Staking Locations

Prior to the ISB injection, the sites were cleared of aboveground hazards. The DPT injection point locations were staked out relative to specific locations—either surveyed points or existing wells. Due to field obstructions and the global positioning system interference caused by overhead canopy obstruction in some parts of LHAAP-16, some newly installed well locations differed from the locations proposed in the RAWP. In those instances, the DPT locations were field adjusted to more closely align with the planned location and length of the treatment zone. Additionally, at the Bayou Biobarrier, three DPT locations (DPT-26 thru DPT-28) had to be relocated due to a deep ravine present in the planned locations that was not accessible to the tracked DPT rig; the points were shifted 15 feet due east to locations that the DPT rig could access.

4.4 Mobilization

Personnel and equipment were mobilized and demobilized as needed for different aspects of the injection work from September thru December 2019.

The following major pieces of equipment were mobilized over the course of the injections:

- DPT drill rig
- Injection systems
  - One trailer-mounted system was mobilized specifically for the injections at the Bayou Biobarrier
  - A temporary injection/recirculation system was assembled on site for activities at the mid-plume intermediate zone biobarrier
  - A second trailer-mounted system was mobilized for the remaining areas

- Two 20,000 gallon fractionation tanks for mixing and storage of the amendment solution for LHAAP-16 as a whole
- One mobile 4,000 gallon tank for holding amendment solution during the injection at each area within LHAAP-16
- One vertical 1,500 gallon tank for collection of extracted groundwater prior to recirculation

Amendments were delivered directly to site LHAAP-16 and stored on site. The carbon substrate and the nutrients were delivered in caged 275-gallon IBC containers. Buffer was delivered in 55-pound bags. The ZVI was contained in 5-gallon buckets. The microbial consortium was delivered in pressurized 5-gallon stainless steel cannisters and stored in a refrigerated state until used.

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4.5 Injections

The injections were performed as six different systems:

- One biobarrier in the shallow groundwater zone near Harrison Bayou
- One biogrid in the shallow groundwater zone in the Mid-Plume Area
- One biobarrier in the intermediate groundwater zone in the Mid-Plume Area
- Three landfill biobarriers in the shallow groundwater zone adjacent to the landfill

The implementation of the biobarriers and the biogrid involved the injection of an electron donor and a microbial consortium capable of biodegrading CVOCs and perchlorate. The injection amendments and locations were based on the Final RD (AECOM 2017) as detailed in the RAWP (Bhate 2018a).

The primary biodegradation pathway for chlorinated ethenes, such as tetrachloroethene and TCE, is reductive dechlorination, which occurs under highly reducing anaerobic conditions. During reductive dechlorination, chlorinated ethenes are used instead of oxygen as respiratory substrates by the anaerobic microorganisms that reduce the chlorinated ethenes to harmless by-products. Favorable aquifer conditions are established and/or maintained by adding a carbon source, such as EVO, to act as an electron donor. Details of the activities for each of the systems are described in the following sections.

4.5.1 Overall Sequence of Injections

The RD (AECOM 2017) called for the ISB injections in the most contaminated portions of the shallow and intermediate groundwater zones to be implemented in conjunction with phased shut down of the existing groundwater extraction system. Due to electrical power problems at

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LHAAP, the eight groundwater extraction pumps at LHAAP-16 did not operate from approximately late December 2018 until September 4, 2019. Starting September 4, 2019, the pumps were run for two weeks before groundwater samples were collected at the subset of wells selected for the final round of pre-remedy sampling (see **Section 3.0**). The system continued to run until September 27, 2019. Thus, the groundwater extraction system was withdrawing groundwater from both the shallow and intermediate zones in the vicinity of the proposed mid-plume injection area during most of September. The ISB activities were implemented in the following sequence:

1) While groundwater continued to be extracted from the Mid-Plume Area, amendments were injected at the Bayou Biobarrier from September 24–26, 2019. These injection points formed a barrier just west and upgradient of Harrison Bayou to treat contaminants migrating eastward from the landfill and toward the bayou. This phase of the ISB injection was conducted before shutting down extraction at the Mid-Plume Area. This timing was intended to limit contaminant migration to the creek that might otherwise have occurred in the absence of the hydraulic control provided by the groundwater extraction system. Unlike the other injections, the amendments for the Bayou Biobarrier included microscale ZVI, a reducing agent, in addition to a carbon substrate (**Table 4-1**). The ZVI was added to accelerate remediation at LHAAP-16 by promoting abiotic degradation of CVOCs.
2) The extraction of groundwater from the shallow and intermediate zones in the Mid-Plume Area was shut down on September 27, 2019.
3) Amendments were initially injected into the intermediate zone of the Mid-Plume Area from September 27–29, 2019. Grout was dislodged from two of the injection wells (see **Section 2.1**); therefore, injection at those two locations was finished using DPT injection points on October 9–14, 2019. Groundwater was recirculated in the intermediate zone from September 27 to November 14, 2019. Then further amendment injections were conducted November 16–22, 2019.
4) Amendments were injected into the shallow groundwater zone in the Mid-Plume Area from September 30 to October 11, 2019. As noted above, groundwater was being recirculated in the intermediate zone within the Mid-Plume Area at this time.
5) Amendments were injected at Landfill Biobarrier #1 from October 15–18, 2019. As noted above, groundwater was being recirculated in the intermediate zone within the Mid-Plume Area at this time.
6) Amendments were injected at Landfill Biobarrier #3 on October 19, 2019, while groundwater recirculation continued in the intermediate zone within the Mid-Plume Area.

7) Amendments were injected at Landfill Biobarrier #2 on December 3–4 and 20–21, 2019. Extraction was conducted from December 3–18, 2019. The extracted water was reinjected from December 11–19, 2019.

The actual sequence of injection and recirculation activities in the various treatment areas did not differ significantly from the sequence presented in the RAWP (Bhate 2018a). Injection in Biobarrier #3 did overlap with recirculation in the intermediate zone of the Mid-Plume Area. The RAWP did not specifically address this possibility, but it did allow injection in Biobarrier #1 during that recirculation period. Biobarrier #1 is in the shallow zone like Biobarrier #3 but the northern portion of Biobarrier #1 is closer to the Mid-Plume Area than Biobarrier #3. Therefore, the timing of injection at Biobarrier #3, like Biobarrier #1, is not thought to have been problematic.

During the injections, bromide was added to the ISB amendment mixture to act as a tracer of the amendment mixture as groundwater was being extracted to enhance the distribution of the injectate. Bromide proved difficult to recover; however, any changes in the sequence of injection and extraction, are not thought to have affected the ability to recover bromide. Once bromide is in the aquifer it is expected to move along with the prevailing groundwater flow. However, bromide moves more easily with groundwater than the carbon substrate due to less retention on the aquifer material. During extraction a significant increase in bromide was not observed, which suggests that the extraction wells may not have created a sufficient drawdown to capture the bromide and it may have moved quicker downgradient. It is also possible that switching extraction between different intermediate zone wells, as required by the RAWP, may have pulled the injectate and bromide in different directions, thus diminishing the chances of bromide being detected in certain extraction wells. Therefore, groundwater was also analyzed for total organic carbon (TOC) as TOC has a higher retention to the aquifer material. Elevated levels of TOC were observed, and it was determined that the carbon substrate had been distributed.

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4.5.2 Amendment Preparation

Approximately 24 hours prior to the start of each injection cycle, the solution of ISB amendments was prepared in a 20,000-gallon mixing tank at LHAAP-16. The water was obtained from Leigh Water Supply in Karnack, Texas, and transported to the mixing tank in a water truck. The solution was prepared by adding the required volume of carbon substrate, dilution water (1:10 mixing ratio), nutrients, and a small volume of a dechlorinating microbial consortium into the mixing tank (**Table 4-1**). During mixing, a conservative tracer sodium bromide (at a target concentration of 500 milligrams per liter [mg/L]) was added to the solution as a possible means of evaluating the distribution of amendments. The microbes consumed the available oxygen in the mixing tank, creating an anaerobic medium. When the solution was

verified to be anaerobic, based on a DO meter reading of less than 1.0 mg/L, the remaining bioaugmentation culture was added to the mixing tank and recirculated.

Table 4-1 presents the approximate amounts of all components that were mixed to prepare the amendment solution for each injection area. As shown on that table, the primary injection components were the carbon source and SDC-9™. The same carbon source (an EVO known as electron donor solution–extended release [EDS-ER™] from Tersus Environmental, LLC) was used for all injection mixtures except for that used at the Bayou Biobarrier. EDS-ER™ was supplied as a water mixable oil that contains no water; therefore, it was mixed with water in the field. The EDS-ER™ is an EVO, which should not require replenishment for 3 to 5 years (AECOM 2017). At the Bayou Biobarrier, the amendment mixture used Anaerobic BioChem Plus (ABC+™), which comprises microscale ZVI and a carbon source (ABC™) formulated to be mixed on site with the ZVI. The ZVI was intended to supplement the other amendments and accelerate degradation of the site COCs. The masses of the components of the amendment mixture were based on the information presented in the RD (AECOM 2017) and RAWP (Bhate 2018a).

4.5.3 Injection Process

After the anaerobic solution containing each of the amendments had been prepared, the amendments were transported in the water truck to the mobile 4,000 gallon tank and injected into the subsurface using the system shown schematically in **Figure 4-2**.

Amendments were injected into the subsurface through either DPT injection points or previously installed wells:

- Eighty injection points were installed using a DPT rig. This included 78 points per the original RAWP (Bhate 2018a) (DPT-01 thru DPT-35 and DPT-37 thru DPT-79) plus two temporary injection points at the Intermediate Zone Mid-Plume (16TIP27 and 16TIP28) to replace 16IW27 and 16IW28. DPT drilling was conducted in accordance with the procedures presented in the IWWP (Bhate 2018b). Prior to DPT use, locations were hand dug or probed to 5 feet to check for underground obstructions/utilities. The DPT rig would then push to the required depth, and amendment was injected through the probe rod, proceeding upward from the bottom. At the Bayou Biobarrier, the amendment was injected in 2-foot intervals until the target interval was covered. At all other DPT locations, the initial injection was in the bottom 1- or 2-foot interval followed by 4-foot intervals thereafter. After injections had been implemented up the entire target interval, the probe was withdrawn and the DPT point was abandoned by filling with grout. No soil cuttings were generated using DPT.

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- A total of 22 previously installed wells were used to inject amendments, including 9 extraction wells (16EW05-08, 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15) and 13 injection wells (16IW01, 16IW03, 16IW05, 16IW07, 16IW09, 16IW10, 16IW20, and 16IW25-30). As noted earlier, two of the injection wells (16IW27 and 16IW28) did not function properly and were abandoned. DPT points 16TIP27 and 16TIP28 were used to implement the injections at those two locations.

The previously installed wells were also used for recirculation at two areas. At the Mid-Plume Intermediate Zone Biobarrier, groundwater was extracted from wells 16EW05-08 and later reinjected into wells 16IW25-26 and 16IW29-30. At Landfill Biobarrier #2, groundwater was extracted from wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15 and reinjected into wells 16IW01, 16IW03, 16IW05, and 16IW07.

The injection, extraction, and recirculation volumes at each of the six areas are provided in **Table 4-2**.

The injection system allowed injection at up to four wells or DPT points simultaneously under low pressure (i.e., less than 40 pounds per square inch). The injection system included individual volume and pressure gauges for each outlet from the injection manifold so that pressure and flow rates could be controlled independently, and amendment volume could be recorded for each injection location. The injection system was connected to the wells or to DPT probes with hoses. During the injection and recirculation activities, field personnel performed the following:

- Checked the injection system gauges to monitor pressure, volume, and flow rate into each injection point (DPT or well).
- Recorded injection interval, volume, time, flowrate, and pressure.
- Monitored injection pressures for sudden decreases that might indicate the loss of amendment in the subsurface (possibly due to fracturing induced by the injection or encountering a high-permeability zone).
- Monitored the injection/recirculation locations visually for surfacing of injected material (it was such monitoring that identified the problems at 16IW27 and 16IW28 described above).
- Monitored Harrison Bayou for visual changes and changes in DO concentration during injections at the Bayou Biobarrier.

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4.5.4 Bayou Biobarrier

The Bayou Biobarrier was installed west of Harrison Bayou by injecting the amendment mixture into thirteen DPT points (DPT-26 thru DPT-35 and DPT-37 thru DPT-39) and one injection well (16IW20) as shown in **Figure 4-3**. As identified in **Table 4-1**, the amendment mixture comprised ABC+™ (carbon substrate plus microscale ZVI), SDC-9™ and sodium bromide tracer. **Table 4-2** provides the volume of amendment mixture injected at each injection point. A slow injection rate was used to reduce chances of surfacing and reaching the bayou. Monitoring wells 16WW40 and 16WW56 were used as injection control wells and were visually monitored hourly during injections to determine if injectate was reaching these wells, which were intended to be outside the radius of influence (ROI).

In conjunction with ISB injections at the Bayou Biobarrier, field staff measured DO concentrations in Harrison Bayou and visually checked for evidence of injectate reaching the bayou. The DO concentrations and visual observations were recorded and are presented in **Table 4-3**. DO readings were collected using a hand-held field instrument to get a direct measurement of DO in the bayou. If the injectate had reached the bayou, organisms in the bayou could have utilized the DO in the bayou water to metabolize the injected carbon (EVO) and caused a decrease of DO in the bayou. Such a decrease of DO could have potentially created anaerobic conditions in the water and adversely impacted the aquatic life in the bayou. Visual observations were intended to identify any changes in the appearance of the water in the bayou (e.g., murkiness) that might indicate that the injectate was entering the surface water. No significant changes in DO were recorded during or after the injections at the Bayou Biobarrier. Also, evidence of injected amendments was never observed in the bayou.

4.5.5 Mid-Plume Area

ISB in the Mid-Plume Area included injections in both the shallow and intermediate groundwater zones. The injected amendment was a mixture of EDS-ER™, nutrients, SDC-9™, and sodium bromide (as a tracer) as presented in **Table 4-1**.

4.5.5.1 Shallow Groundwater

To treat the VOC and perchlorate impacted groundwater in the shallow groundwater aquifer, a biogrid was installed by injecting amendments into forty DPT points (DPT-40 thru DPT-79) as shown in **Figure 4-4**. Prior to these injections, the shallow zone extraction wells in the Mid-Plume Area (16EW01, 16EW02, 16EW03, and 16EW04) were shut down. **Table 4-2** lists the volume of amendment mixture injected at each injection point as well as the injection interval.

4.5.5.2 Intermediate Zone Biobarrier in Mid-Plume Area

To treat the intermediate groundwater zone, a biobarrier was created. The biobarrier was installed through a phased approach:

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- Initially, the amendment was injected into six newly installed injection wells. As discussed in **Section 2.0**, the six new injection wells had been installed in the intermediate zone to recirculate groundwater for ISB. The wells had been installed as pairs between existing extraction wells:
  - Injection wells16IW25 and 16IW26 were installed between existing extraction wells 16EW05 and 16EW06.
  - Injection wells 16IW27 and 16IW28 were installed between existing extraction wells 16EW06 and 16EW07. These injection wells did not perform properly. Temporary injection points 16TIP27 and 16TIP were later used for the injections.
  - Injection wells 16IW29 and 16IW20 were installed between existing extraction wells 16EW07 and 16EW08.

  Injection at the 16IW25/16IW26 and 16IW29/16IW30 was performed between September 27 and October 1, 2019. Injection at the two temporary injection points was implemented on October 9–14, 2019.

- Following the injections, the RAWP called for the four existing extraction wells (16EW05 through 16EW08) to be used to draw groundwater away from the injection wells and towards the extraction wells until an increase in bromide was detected in the extraction wells. Extraction from wells 16EW05 through 16EW08 was attempted from September 27 to October 1 at the same time that injections were on-going. This was unsuccessful due to operational problems with the extraction pumps and silt in at least one of the wells. The four extraction wells had also not yet been redeveloped. Therefore, extraction was postponed until the injections were completed and the wells were redeveloped, bringing the activity into accord with the RAWP. The pump problems were also resolved during that time, and extraction resumed three days after the amendment injection was completed. The extracted groundwater was temporarily stored in the onsite tank and then recirculated back into injection wells 16IW25, 16IW26, 16IW29, and 16IW30. Injection wells 16IW27 and 16IW28 could not be used for recirculation as proposed in the RAWP; they were plugged and abandoned due to earlier performance issues. The extraction and reinjection wells were alternated every 3 days and samples of groundwater were collected from extraction wells and tested for bromide and TOC every 3 days to evaluate whether the injected amendments were being drawn to the extraction wells. Bromide and TOC results are provided in **Table 4-4**. When bromide was detected significantly above pre-remedy concentrations in an extraction well, extraction from that well was to be shut down. Recirculation of the mid-plume intermediate bio-barrier was discontinued after four weeks, with regulatory approval. Definitive increases in bromide or TOC concentrations did not occur at all wells, but the regulators concurred that the

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extraction had continued long enough and that continued reinjection of extracted water could have resulted in dilution of the intended biobarrier formation.

- After extraction was shut down in all the extraction wells, amendment mixture was injected into the four extraction wells.

The well locations are shown on **Figure 4-5**. **Table 4-2** specifies the volume of amendment mixture injected at each injection point along with the amendment mixture quantities.

4.5.6 Landfill Biobarriers

Three landfill biobarriers were installed to control the migration of VOCs and perchlorate in shallow groundwater immediately downgradient of the landfill. As noted in the RD (AECOM 2017), the location of the barriers was designed to fully intercept the shallow groundwater plumes of chlorinated VOCs and perchlorate above their respective cleanup levels. The injection solution was a mixture of EDS-ER™, nutrients, SDC-9™, and sodium bromide (as a tracer) as presented in **Table 4-1**.

4.5.6.1 Landfill Biobarrier #1

Landfill Biobarrier #1 was installed by injecting the injection solution into 18 DPT points (DPT01 thru DPT18) and one injection well (16IW09) as shown in **Figure 4-6**. A spacing of 15 feet between injection locations was used based on the ROI presented in the ROD (U.S. Army 2016a). **Table 4-2** shows the volume of amendment injected at each injection point/well. The injections at this area proceeded according to plan and were completed in one week, from October 10–17, 2019.

4.5.6.2 Landfill Biobarrier #2

Installation of Landfill Biobarrier #2 involved two phases—injection and recirculation. Both phases utilized existing wells installed during the Environmental Security Technology Certification Program study (Geosyntec 2009). Prior to using the pilot test wells for injections, the wells were redeveloped as discussed in **Section 2.3**. The injection locations are shown on **Figure 4-7**. **Table 4-2** identifies the injection locations and the volume of amendment mixture injected at each location.

Phase 1 involved injecting amendment into injection wells 16IW01, 16IW03, 16IW05, and 16IW07. Water was then extracted from wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15 and recirculated in the injection wells to enhance cross gradient distribution of the amendment mixture. Pumps and piping were temporarily installed for the extraction. The extracted groundwater was stored in the empty mixing tank. Once the amendment design volume was injected, samples of the extracted groundwater were collected from extraction wells and tested for bromide and TOC. Bromide and TOC results are provided in **Table 4-5**.

When TOC results were above pre-remedy levels, the extraction and recirculation were stopped. During Phase 2 of the injections, the extraction and recirculation were shut down. Phase 2 used the remaining extracted groundwater collected in the onsite tank. The water accumulated from Phase 1 was used to make the amendment mixture for Phase 2. The extracted groundwater was mixed with the amendment mixture and injected back into the five extraction wells. One part of the concentrated EVO solution was mixed with 10 parts of extracted groundwater and injected into extraction wells 16EW11, 16EW12B, 16EW13, 16EW14B, and 16EW15. The amendment mixture quantities and injection volumes are shown on **Table 4-1** and **Table 4-2**, respectively.

The Phase 1 injection at 16IW01/03/05/07 was performed on December 3–4, 2019. Water was extracted at 16EW/11/12B/13/14B/15 from December 3–18, 2019 and recirculated into the four injections wells from December 11–19, 2019. The Phase 2 injection at 16EW/11/12B/13/14B/15 was performed on December 20, 2019.

4.5.6.3 Landfill Biobarrier #3

Biobarrier #3 was installed by injecting the amendment mixture in seven DPT points (DPT19 thru DPT25) and one injection well (16IW10). A spacing of 15 feet between injection locations was used based on the ROI presented in the ROD (U.S. Army 2016a). The seven DPT points and one injection well are shown in **Figure 4-8**. **Table 4-2** provides the volumes of amendment mixture injected at each injection point/well. The injections at this area proceeded according to plan and were completed on October 19, 2019.

4.6 Management of Remediation Derived Waste

During the activities described above and in **Section 3**, various types of waste were generated. Those wastes are identified in the chart provided below. The table also summarizes the storage and disposal for each waste type.

Waste Type	Storage and Disposal *
Soil cuttings from installation of new monitoring and injection wells	Collected in drums and held at the well site pending analytical results. The cuttings were sampled at the frequency of one sample per 20 drums. Analytical results (provided in **Appendix D**) showed that the cuttings were not contaminated, so the cuttings were spread on site at the well locations.
Groundwater from development of new and existing wells	Collected in drums and transported to the GWTP for disposal.
Groundwater from purging of wells prior to sampling	Collected in 5-gallon containers and transported to the GWTP for disposal.
Disposable personal protective equipment, disposable supplies, and trash	Disposed as municipal solid waste.

* GWTP refers to the Groundwater Treatment Plant at site LHAAP-18/24.

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4.7 Demobilization

After completion of the final injections, which were at Landfill Biobarrier #2 on December 19, 2019, the injection rig and amendment tanks were demobilized from LHAAP-16.

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5.0 DESIGN EFFECTIVENESS MONITORING

Groundwater samples were collected approximately one month after the ISB injection at each of the six treatment areas and analyzed to evaluate design effectiveness. Effectiveness is evaluated based on whether the injections successfully distributed amendments within the design ROI and achieved the goal of creating conditions conducive for reductive dechlorination of the COCs. The successful distribution of amendments was based on changes in TOC and bromide concentrations. Conditions conducive to reductive dechlorination were considered to be ORP less than -50 millivolts (mV) and DO less than 1 mg/L.

The first round of design effectiveness samples was collected from wells identified in the RAWP (Bhate 2018a). The first round was collected approximately one month after completion of injection in each area. As discussed below, the results were mixed. The RAWP indicated that a second round of design effectiveness sampling might be performed if the first round was inconclusive. The RAWP indicated that both rounds of samples would be collected "within the first two months of remedy implementation". However, the areas were completed sequentially, so the first-round data was collected over several weeks. That timing, plus additional time to evaluate and discuss the first-round results with regulatory agency representatives, rendered impractical the collection of the second round of samples within the two-month time frame mentioned in the RAWP. The second- round samples were collected in March 2020 once the project team arrived at a consensus on the list of wells needing a second round of sampling. This section provides a discussion of the results for TOC, bromide, DO, ORP, and pH. Where available, results are presented for samples before, during, and after the ISB injections. The results are provided for each of the six injection areas as follows:

Injection Area	Design Effectiveness Results	Figure Showing Sample Locations
Bayou Biobarrier	**Table 5-1**	**Figure 4-3**
Mid-Plume Shallow Zone Biogrid	**Table 5-2**	**Figure 4-4**
Mid-Plume Intermediate Zone Biobarrier	**Table 5-3**	**Figure 4-5**
Landfill Biobarrier #1	**Table 5-4**	**Figure 4-6**
Landfill Biobarrier #2	**Table 5-5**	**Figure 4-7**
Landfill Biobarrier #3	**Table 5-6**	**Figure 4-8**

Of the wells designated for design effectiveness sampling, most are at distances from the reaction zones such that geochemical changes due to the ISB may not be detectable immediately but require additional time. Few of the wells were within the 15 feet design ROI, where changes should have been detectable within the time frames of the design effectiveness sampling events. Nonetheless, within each of the six injection areas, there were results that

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demonstrated the successful distribution of amendments and the start of changing geochemical conditions to support reductive dechlorination.

5.1 Bayou Biobarrier

At the Bayou Biobarrier, the two key wells located within the barrier, near the injection points, were 16IW20 and 16RW11. Neither location had a pre-remedy sample collected, but both locations showed effects from the injections. Amendments were injected at the Bayou Biobarrier between September 24–26, 2019. On October 22, 2019, the TOC (3,290 mg/L) and bromide (213 mg/L) results at 16RW11 clearly indicated that the location was within the injection radius of the nearby injection points. In October 2019, 16IW20 did not have high TOC and bromide values, but this location did have low DO (0.04 mg/L), and negative ORP (-182 mV), which indicate geochemical conditions that are supportive of reductive dechlorination. Injection well 16IW20 was sampled again on March 9, 2020; the DO had increased (2.6 mg/L), but the ORP decreased further (-230 mV). The ORP at well 16RW12 (slightly downgradient of the biobarrier) decreased from 163.3 mV about one week before the injections to -37 mV four weeks afterwards, while the ORP at well 16WW12 (slightly upgradient of the biobarrier) decreased from 159 mV four weeks after the injections to 7 mV in March 2020. Neither of these wells, nor wells further from the reaction zone, showed significant increases in TOC or bromide.

5.2 Mid-Plume Shallow Biogrid

One of the four extraction well locations used for design effectiveness sampling (16EW03) was within the design ROI from the DPT injection locations shown on **Figure 4-4**. The results from 16EW03 show slightly elevated TOC (22.6 mg/L) and bromide (5.3 mg/L) relative to the other sampling locations in the shallow Mid-Plume Area and the DO (0.39 mg/L) and ORP (-110.1 mV) are supportive of reductive dechlorination. These results indicate the presence of injected amendments and improving geochemical conditions. At the only location with a pre-remedy sample collected (16EW02), ORP readings in November 2019 and March 2020 were slightly lower than the pre-remedy concentrations, but DO values were inconsistent. The other two wells are outside and cross-gradient from the treated area, and their results did not indicate any impact from the injections.

5.3 Mid-Plume Intermediate Biobarrier

The mid-plume intermediate zone wells (16EW05, 16EW06, 16EW07, and 16EW08) were used as part of a recirculation system attempting to enhance the distribution of amendments in the intermediate zone. Following several weeks of recirculation with mixed results depicted in the sampling data, each of the locations was used as an injection location to add additional amendments per the RAWP. As a result, all four of the wells showed significantly elevated TOC and bromide. The DO at each location was below 0.1 mg/L and the ORP at each location

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was negative, indicating that the injections impacted the geochemical conditions in the Mid-Plume Area.

5.4 Landfill Biobarrier #1

The key locations within Landfill Biobarrier #1 are 16IW09 and 16RW03. At 16IW09, the high bromide (70.7 mg/L) and TOC (7,820 mg/L) indicate clearly that the injection location received amendments, and the low ORP (-88 mV) and DO (0.04 mg/L) are supportive of biodegradation. Monitoring well 16RW03 was slightly farther from the injection locations and did not show any significant impact from the amendments or geochemical changes. Monitoring well 16RW05 downgradient shows significant impact from bromide (75.4 mg/L) and TOC (791 mg/L), as well as geochemical conditions conducive for reductive dechlorination (DO 0.05 mg/L and ORP -178 mV), which may indicate some degree of localized preferential flow from the injections. Design effectiveness samples were collected at 16RW04, 16WW26, 16RW03, and 16WW42 in both November 2019 and March 2020, but none of these locations had elevated TOC or bromide results. Additionally, the locations with pre-remedy results for the field parameters (16WW26 and 16WW42) did not present any indication of ISB effects in either round of design effectiveness sampling.

5.5 Landfill Biobarrier #2

The key locations within Landfill Biobarrier #2 are 16IW03 and 16IW04. At injection location 16IW03, the bromide was not significantly elevated (0.66 mg/L), but the elevated TOC (222 mg/L) indicated that the injection location received sufficient carbon source to support biodegradation. The low ORP (-78 mV) and DO (0.04 mg/L) were supportive of biodegradation as well. 16IW04 was approximately 15 feet from an injection location, but neither the January nor March results showed definitively elevated TOC or bromide. The four downgradient monitoring locations (16PM06, 16PM09, 16PM14, and 16WW36) did not show any definitively elevated bromide or TOC, but the low DO values indicated conditions that may be supportive of reductive dechlorination.

5.6 Landfill Biobarrier #3

The key locations within Landfill Biobarrier #3 were 16RW08 and 16IW10. At 16IW10, the TOC (1,850 mg/L) and bromide (201 mg/L) clearly reflected its use as an injection location. Monitoring well 16RW08 did not show clear indication that it had been reached by amendments (bromide was 6.06 mg/L in November 2019 and 5.10 mg/L in March 2020), and the ORP (90 mV in November 2019 and 28 mV in March 2020) remained higher than desired. The low DO values (<1 mg/L) at all the design effectiveness sample locations indicated that conditions at and downgradient of the injection area may be trending in the right direction.

5.7 Future Performance Monitoring

As noted in **Section 1.7**, this RACR documents the implementation of ISB, but activities that follow the ISB are described in the RAWP (Bhate 2018a). **Section 1.7** provides a brief description of those activities, but the RAWP should be referenced for detailed information. The next document for LHAAP-16 will be the Annual Remedial Action Operations Report, which will present and evaluate data from the first four quarters of performance monitoring.

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6.0 LUC IMPLEMENTATION

The actions required to implement the LUCs for LHAAP-16 are described below. An initial notice of LUCs for Soil and Groundwater Contamination was completed on December 8, 2016, within 90 days of ROD signature as required (U.S. Army 2016b). The Notice of LUCs, including the final LUC boundary survey plat and legal description of the LUC boundary filed with Harrison County on March 22, 2021, is included in **Appendix A**. A second Notice of LUCs for Soil and Groundwater Contamination was sent to federal, state, and local officials, and to the Texas Department of Licensing and Regulation (Water Well Drillers and Pump Installers Section) on February 23, 2021, showing the final area covered by the groundwater use restriction LUC (**Appendix A**).

The following actions were performed to implement LUCs for LHAAP-16:

- Finalize the boundaries of the LUCs as part of the remedial action (See **Figure 1-4** and **Appendix A**).
- Survey the LUC boundaries. The final boundaries were surveyed by a State of Texas licensed surveyor. Legal descriptions of the surveyed areas accompany the survey plat.
- Record the Notice of LUCs at Harrison County. The LUC plats and legal descriptions and LUC restriction language were recorded at the Harrison County Courthouse in accordance with Title 30 TAC §335.566 (**Appendix A**).
- Transmit the notice to federal, state, and local governments involved at LHAAP-16, and to owners and occupants of the property who are subject to restrictions and LUCs. The notice of the final boundaries for LUCs was sent to federal, state, and local officials including:
  - State Representatives, the Harrison County Judge, Harrison County Historical Commission, the City of Uncertain Mayor, and Caddo Lake and Leigh Water Supply Corporations' Presidents. Notice was also sent to the Caddo Lake National Wildlife Refuge Manager—as a representative of the U.S. Fish and Wildlife Service (the future transferee of the property), and the Water Well Driller and Pump Installers Program at the Texas Department of Licensing and Registration.

Following implementation of the LUCs, administrative maintenance is required to ensure LUCs remain in place and effective. Maintenance activities will include:

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- Annual field inspections of LHAAP-16 to confirm that no violations of the LUCs have occurred. Documentation of the inspection will be included on the Inspection and Maintenance Checklist (see **Appendix A**).
- Annual certifications that no LUC-restricted activities have been authorized and that LHAAP-16 conditions and use are consistent with the LUCs. The Annual LUC Compliance Certification Form is presented in **Appendix A**.
- Periodic transmittal of a LUC Notice to federal, state, and local authorities. The notice will include the land use restrictions referenced in the ROD, a written description of the LUCs, and a figure depicting the LUC boundaries. The transmittal will coincide with each Five Year Review and will be documented in the report.
- The Final LUC Boundaries and copies of filed notices have been added to the Comprehensive LUC Management Plan and the plan was provided to the owner or occupant of LHAAP-16. The update to the Comprehensive LUC Management Plan will be completed during the next annual update, which will be in 2021.

The U.S. Army will address LUC problems within its control that are likely to impact remedy integrity and shall address problems as soon as practicable.

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Tables

Table 1-1
Groundwater and Surface Water Cleanup Levels at LHAAP-16

COC	Cleanup Level (µg/L)
	MCL
Trichloroethene	5
cis-1,2-dichlorethene	70
1,1-dichloroethene	7
1,2-dichloroethane	5
Vinyl Chloride	2
1,1,2-trichloroethane	5
Methylene Chloride	5
Chromium	100
Arsenic	10
Thallium	2
	TRRP Tier 1 Groundwater Residential PCLs
Nickel	490
Perchlorate	17
Manganese	1,100 [a]

Notes:

[a] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese.

µg/L - micrograms per liter

COC - contaminant of concern

MCL - maximum contaminant level

PCL - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level.

UTL - upper tolerance limit

Table 2-1
Wells Added for Remedial Action at LHAAP-16

Well ID	Purpose		Northing (feet)	Easting (feet)	Top of Casing Elevation (ft amsl)	Surface Elevation (ft amsl)	Diameter (inches)	Screen Interval (feet bgs)	Groundwater Zone	Installation Completion Date
	Injection	Performance Monitoring								
16IW09	✓		6953396.09	3314160.35	181.41	178.08	2	8-18	Shallow	10/31/2018
16IW10	✓	✓	6953780.74	3314013.26	195.90	192.69	2	15-25	Shallow	4/25/2018
16IW20	✓		6953823.60	3314557.01	188.94	186.03	2	12-22	Shallow	5/3/2018
16IW25	✓		6953777.99	3314293.02	199.24	196.29	2	40.5-50.5	Intermediate	5/1/2018
16IW26	✓		6953754.86	3314304.29	198.97	195.66	2	39.5-49.5	Intermediate	5/2/2018
16IW27	✓		6953691.80	3314332.92	196.05	193.04	2	44.5-54.5	Intermediate	5/2/2018
16IW28	✓		6953655.99	3314347.06	189.50	186.62	2	38.5-48.5	Intermediate	5/1/2018
16IW29	✓		6953590.95	3314379.27	185.89	182.76	2	35.5-45.5	Intermediate	5/1/2018
16IW30	✓		6953570.27	3314398.21	184.74	181.72	2	30.5-40.5	Intermediate	4/30/2018
16RW01		✓	6953551.08	3314168.77	189.77	186.56	4	15-25	Shallow	10/31/2018
16RW02		✓	6953440.13	3314139.68	182.97	179.94	4	8-18	Shallow	10/12/2018
16RW03		✓	6953407.93	3314167.37	181.66	178.32	4	10-20	Shallow	10/11/2018
16RW04		✓	6953535.89	3314226.20	190.94	188.04	4	14-24	Shallow	10/31/2018
16RW05		✓	6953395.99	3314192.31	180.70	177.61	4	10-20	Shallow	10/11/2018
16RW06		✓	6953828.03	3313990.94	197.37	194.35	4	15.5-25.5	Shallow	4/23/2018
16RW07		✓	6953785.38	3313988.18	195.48	192.20	4	15-25	Shallow	4/20/2018
16RW08		✓	6953788.82	3314017.82	196.37	193.62	4	16.5-26.5	Shallow	4/19/2018
16RW09		✓	6953821.11	3314045.50	197.81	195.14	4	17-27	Shallow	4/19/2018
16RW10		✓	6953763.40	3314053.06	195.25	192.27	4	15-25	Shallow	4/19/2018
16RW11		✓	6953828.09	3314545.02	189.95	187.46	4	12-22	Shallow	5/3/2018
16RW12		✓	6953887.58	3314501.01	196.22	193.23	4	22-32	Shallow	5/4/2018
16WW48		✓	6953695.43	3314485.33	184.41	181.46	4	10-20	Shallow	10/11/2018
16WW49		✓	6953750.74	3314402.85	190.69	187.66	4	42-52	Intermediate	8/2/2019
16WW51		✓	6953616.52	3314455.29	183.26	180.13	4	31-41	Intermediate	5/3/2018
16WW55		✓	6953802.81	3314115.62	194.03	191.11	4	17-27	Shallow	4/18/2018
16WW56		✓	6953958.38	3314545.68	198.61	195.35	4	21-31	Shallow	11/1/2018
16WW57		✓	6953896.70	3314654.99	177.06	173.12	2	26-36	Intermediate	8/5/2019
16WW58		✓	6953665.15	3314691.22	177.24	173.32	2	28-38	Intermediate	8/7/2019

Notes:

Northing & Easting are based on Texas State Plane coordinate system, North Central Zone (4202), 1983 North American Datum.

Elevations are based on 1988 North American Vertical Datum.

bgs - below ground surface

ft amsl - feet above mean sea level

Table 3-1
Summary of Pre-Remedy Sampling in Shallow Zone

Monitoring Location	Location Description	October 2018									September 2019		
		VOCs (SW8260B) [a]	Perchlorate (314)	Anions (E300.0) [b]	Dissolved Gases (RSK-175) [c]	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters [d]	VOCs (SW8260B) [a]	Perchlorate (314)	Field Parameters [d]
16EW02	Inside Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16EW11	Inside Landfill Biobarrier #2								✓	✓			
16EW12B	Inside Landfill Biobarrier #2								✓	✓			
16EW13	Inside Landfill Biobarrier #2								✓	✓			
16EW14B	Inside Landfill Biobarrier #2								✓	✓			
16EW15	Inside Landfill Biobarrier #2								✓	✓			
16WW12	Upgradient to Bayou Biobarrier	✓	✓						✓	✓	✓	✓	✓
16WW14	Upgradient to Landfill Biobarrier #3	✓	✓							✓	✓	✓	✓
16WW16	Upgradient to Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW22	Upgradient to Bayou Biobarrier	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW24	Cross-gradient to South of Plume	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW26	Downgradient to Landfill Biobarrier #1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW30	Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓	✓	✓	✓
16WW32	Cross-gradient Outside of Containment Area	✓	✓							✓			
16WW34	Cross-gradient Outside of Containment Area	✓	✓							✓			
16WW36	Downgradient to Landfill Biobarrier #2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW38	Upgradient to Landfill Biobarrier #2	✓	✓							✓			
16WW39	Downgradient of Mid-Plume ISB Area	✓	✓						✓	✓	✓	✓	✓
16WW40	Downgradient to Bayou Biobarrier	✓	✓						✓	✓	✓	✓	✓
16WW42	Downgradient to Landfill Biobarrier #1	✓	✓						✓	✓	✓	✓	✓
16WW43	Cross-gradient to South of Plume	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW44	Background	✓	✓							✓			
16WW46	Downgradient Outside of Contaminated Area	✓	✓							✓			
16WW48	Proposed Well and Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW55	Proposed Well Downgradient to Landfill Biobarrier #3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW56	Proposed Well and Downgradient to Bayou Biobarrier										✓	✓	✓

Notes:

[a] VOCs include TCE; cis-1,2-DCE; 1,1-DCE; 1,2-DCA; 1,1,2-TCA; VC; and methylene chloride.

[b] Anions include nitrate and sulfate.

[c] Dissolved gasses include ethene, ethane, and methane.

[d] Field Parameters include dissolved oxygen, oxidation reduction potential, and pH.

[e] Upper deep monitoring well

✓ Indicates that sample was collected and analyzed for the listed analyte.

DCA - dichloroethane

DCE - dichloroethene

DHC - Dehalococcoides (microbial analysis)

ISB - insitu bioremediation

qPCR - quantitative polymerase chain reaction

TCA - trichloroethane

TOC - total organic carbon

VC - vinyl chloride

VOCs - volatile organic compounds

Table 3-2
Pre-Remedy Results - Shallow Groundwater

		Location Code	16EW02				16EW11		16EW12B		16EW13		16EW14B		16EW15		16WW12				16WW14			
		Sample ID	16EW02-181009		16EW02-190918		16EW11-181013		16EW12B-181013		16EW13-181013		16EW14B-181013		16EW15-181013		16WW12-181012		16WW12-190918		16WW14-181010		16WW14-190916	
		Sample Date	10/9/2018		9/18/2019		10/13/2018		10/13/2018		10/13/2018		10/13/2018		10/13/2018		10/12/2018		9/18/2019		10/10/2018		9/16/2019	
		Sample Purpose	REG		REG		REG		REG		REG		REG		REG		REG		REG		REG		REG	
Parameter		Units	MCL/PCL/UTL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
DHC																									
	Dehalococcoides	cells/mL	NV	0.2	J																				
FIELD TESTS																									
	Dissolved oxygen	mg/L	NV	1.16		1.11		0.28		0.25		1.05		1.14		1.09		0.36		0.34		0.44		0.88	
	Oxidation-Reduction Potential	mV	NV	80.2		171		-79.2		-72.7		-43.2		4.8		-134		130.1		163.3		57.1		24	
	pH	pH units	NV	6.00		6.16		6.31		6.23		5.81		5.72		7.07		5.74		5.79		5.93		6.17	
GASES																									
	Ethane	µg/L	NV	1.16																					
	Ethylene	µg/L	NV	8.81																					
	Methane	µg/L	NV	33.6																					
GEN CHEMISTRY																									
	Alkalinity	mg/L	NV	438																					
	Bromide	mg/L	NV	2.66				4.68		3.82		2.91		1.4		1.86		3.9							
	Nitrate	mg/L	10	< 0.1	U																				
	Sulfate	mg/L	NV	2,130																					
	Total organic carbon	mg/L	NV	10.3																					
PERCHLORATE																									
	Perchlorate	µg/L	17	< 2	U	< 2	U											12		**120**		< 2	U	< 2	U
VOLATILES																									
	1,1,2-Trichloroethane	µg/L	NV	< 25	U	< 12	U											< 5	U	< 2.5	U	< 0.5	U	< 0.5	U
	1,1-Dichloroethene	µg/L	7	**100**		**110**												< 5	U	4.9	J	< 0.5	U	< 0.5	U
	1,2-Dichloroethane	µg/L	5	< 25	U	**51**												**16**		**9.2**		< 0.5	U	< 0.5	U
	cis-1,2-Dichloroethene	µg/L	70	**16,000**		**25,000**												**86**		52		2.6		0.79	J
	Methylene chloride	µg/L	NV	< 50	U	< 25	U											< 10	U	< 5	U	< 1	U	< 1	U
	Trichloroethene	µg/L	5	**24,000**		**42,000**												**4,100**		**2,100**		**42**		**25**	
	Vinyl chloride	µg/L	2	**470**		**650**												**12**		**5.5**		1.1		< 0.5	U

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentratoin Level

RAWP - Remedial Action Work Plan

REG - regular

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-2
Pre-Remedy Results - Shallow Groundwater

		Location Code	16WW16				16WW22				16WW24		16WW24				16WW26					
		Sample ID	16WW16-181010		16WW16-190916		16WW22-181010		16WW22-190917		16WW24-181009		16WW24-181009-FD		16WW24-190917		16WW26-181009		16WW26-190917		16WW26-190917-FD	
		Sample Date	10/10/2018		9/16/2019		10/10/2018		9/17/2019		10/9/2018		10/9/2018		9/17/2019		10/9/2018		9/17/2019		9/18/2019	
		Sample Purpose	REG		REG		REG		REG		REG		FD		REG		REG		REG		FD	
Parameter		Units	MCL/PCL/UTL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
DHC																							
	Dehalococcoides	cells/mL	NV	0.5	U			5.2				1.6						0.3	J				
FIELD TESTS																							
	Dissolved oxygen	mg/L	NV	0.96		0.28		0.89		0.23		0.17				0.44		0.66		0.44			
	Oxidation-Reduction Potential	mV	NV	193.6		58.9		68.3		-17.7		282.6				357		50.4		-1.6			
	pH	pH units	NV	6.10		6.12		5.86		6.05		3.54				3.76		5.08		5.21			
GASES																							
	Ethane	µg/L	NV	2.31				< 1	U			0.256	J	0.555	J			0.591	J				
	Ethylene	µg/L	NV	4.98				1.56				1.39	J	1.24				2.59					
	Methane	µg/L	NV	403				2.46				1.65		3.27				10.5					
GEN CHEMISTRY																							
	Alkalinity	mg/L	NV	362				239				< 5	U	< 5	U			12					
	Bromide	mg/L	NV	4.69				4.46				1.26		1.32				< 0.1	U				
	Nitrate	mg/L	10	< 0.1	U			< 0.1	U			< 0.1	U	< 0.1	U			< 0.1	U				
	Sulfate	mg/L	NV	722				772				905		898				1170					
	Total organic carbon	mg/L	NV	4.34				2.62				2.76		2.65				5.03					
PERCHLORATE																							
	Perchlorate	µg/L	17	**420**		**460**		5.5		< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
VOLATILES																							
	1,1,2-Trichloroethane	µg/L	NV	< 25	U	< 12	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 2.5	U	< 0.5	U	< 0.5	U
	1,1-Dichloroethene	µg/L	7	< 25	U	**25**		1.9		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 2.5	U	1.4		1.6	
	1,2-Dichloroethane	µg/L	5	< 25	U	**19**	J	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 2.5	U	< 0.5	U	< 0.5	U
	cis-1,2-Dichloroethene	µg/L	70	**8,500**		**6,600**		19		2.7		< 0.5	U	< 0.5	U	< 0.5	U	**290**		35		36	
	Methylene chloride	µg/L	NV	< 50	U	< 25	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 5	U	< 1	U	< 1	U
	Trichloroethene	µg/L	5	**21,000**		**13,000**		**150**		**34**		< 0.5	U	< 0.5	U	< 0.5	U	**2,400**		**380**		**440**	
	Vinyl chloride	µg/L	2	**330**		**220**		**4.5**		0.44	J	< 0.5	U	< 0.5	U	< 0.5	U	**5**	J	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentratoin Level

RAWP - Remedial Action Work Plan

REG - regular

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-2
Pre-Remedy Results - Shallow Groundwater

		Location Code	16WW30				16WW32		16WW34		16WW36				16WW38		16WW39				16WW40				
		Sample ID	16WW30-181012		16WW30-190918		16WW32-181011		16WW34-181010		16WW36-181009		16WW36-190916		16WW38-181010		16WW39-181010		16WW39-190917		16WW40-181012		16WW40-181012-FD		16WW4(
		Sample Date	10/12/2018		9/18/2019		10/11/2018		10/10/2018		10/9/2018		9/16/2019		10/10/2018		10/10/2018		9/17/2019		10/12/2018		10/12/2018		9/17/
		Sample Purpose	REG		REG		REG		REG		REG		REG		REG		REG		REG		REG		FD		RI
Parameter	Units	MCL/PCL/UTL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result
DHC																									
Dehalococcoides	cells/mL	NV									202														
FIELD TESTS																									
Dissolved oxygen	mg/L	NV	1.3		0.22		1.94		0.92		0.39		0.21		0.38		0.48		0.23		0.3				2.09
Oxidation-Reduction Potential	mV	NV	50.1		-54.3		115.4		13.2		116.1		87.4		-44.9		115.9		24.1		-44.1				7.8
pH	pH units	NV	5.83		6.14		5.64		6.15		6.07		5.98		5.94		5.74		5.97		5.90				5.88
GASES																									
Ethane	µg/L	NV									< 1	U													
Ethylene	µg/L	NV									12.3														
Methane	µg/L	NV									175														
GEN CHEMISTRY																									
Alkalinity	mg/L	NV									613														
Bromide	mg/L	NV	3.22								2.7						4.2				5.57		5.72		
Nitrate	mg/L	10									< 0.2	U													
Sulfate	mg/L	NV									6290														
Total organic carbon	mg/L	NV									33														
PERCHLORATE																									
Perchlorate	µg/L	17	< 2	U	< 2	U	< 2		< 2	U	< 2	U	< 2	U	< 2	U	**120**		**130**		< 2	U	< 2	U	< 2
VOLATILES																									
1,1,2-Trichloroethane	µg/L	NV	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 25	U	< 12	U	< 5	U	< 5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5
1,1-Dichloroethene	µg/L	7	< 0.5	U	0.82	J	< 0.5	U	< 0.5	U	**450**		**190**		**21**		< 5	U	2.7		3.5		3.5		3.7
1,2-Dichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	**34**	J	**13**	J	< 5	U	< 5	U	2		3.8		3.8		3.8
cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	**79**		< 0.5	U	< 0.5	U	**66,000**		**19,000**		**240**		**220**		**110**		**220**		**240**		**130**
Methylene chloride	µg/L	NV	< 1	U	< 1	U	< 1	U	< 1	U	< 50	U	< 25	U	< 10	U	< 10	U	< 1	U	< 1	U	< 1	U	< 1
Trichloroethene	µg/L	5	1.8		**360**		< 0.5	U	< 0.5	U	**22,000**		**15,000**		**4,400**		**3,900**		**1,200**		**660**		**640**		**740**
Vinyl chloride	µg/L	2	< 0.5	U	0.41	J	< 0.5	U	< 0.5	U	**610**		**230**		**160**		**15**		**7.1**		**4.5**		**4.2**		**3**

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentratoin Level

RAWP - Remedial Action Work Plan

REG - regular

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-2
Pre-Remedy Results - Shallow Groundwater

		Location Code		16WW42				16WW43				16WW44		16WW46		16WW48				16WW55				16WW56	
		Sample ID	D-190917	16WW42-181012		16WW42-190916		16WW43-181009		16WW43-190917		16WW44-181010		16WW46-181012		16WW48-181018		16WW48-190918		16WW55-181015		16WW55-190917		16WW56-190917	
		Sample Date	2019	10/12/2018		9/16/2019		10/9/2018		9/17/2019		10/10/2018		10/12/2018		10/18/2018		9/18/2019		10/15/2018		9/17/2019		9/17/2019	
		Sample Purpose	EG	REG		REG		REG		REG		REG		REG		REG		REG		REG		REG		REG	
Parameter		Units	MCL/PCL/UTL	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
DHC																										
	Dehalococcoides	cells/mL	NV						2.1								0.3	J			0.5	U				
FIELD TESTS																										
	Dissolved oxygen	mg/L	NV		1.21		1.89		1.46		0.09		1.8		0.49		0.98		0.25		2.08		0.2		0.22	
	Oxidation-Reduction Potential	mV	NV		113.6		-31.4		-1.7		42		53.5		43.9		173.1		124.7		319.9		90.7		33.7	
	pH	pH units	NV		5.27		6.10		6.12		5.92		5.99		6.24		5.75		5.80		6.19		6.17		6.05	
GASES																										
	Ethane	µg/L	NV						< 1	U							0.174	J			0.749	J				
	Ethylene	µg/L	NV						2.28								2.19				3.79					
	Methane	µg/L	NV						133								2.21				136					
GEN CHEMISTRY																										
	Alkalinity	mg/L	NV						104								259				347					
	Bromide	mg/L	NV		0.182				0.173								4.33				2.12					
	Nitrate	mg/L	10						< 0.1	U							< 0.2				< 0.1	U				
	Sulfate	mg/L	NV						6.35								1770				1110					
	Total organic carbon	mg/L	NV						9.46								8.78				7.32					
PERCHLORATE																										
	Perchlorate	µg/L	17	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	14		< 2	U	**400**		**480**		< 2	U
VOLATILES																										
	1,1,2-Trichloroethane	µg/L	NV	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5		< 2.5	U	< 5	U	< 5	U	< 0.5	U
	1,1-Dichloroethene	µg/L	7		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	**11**		7		< 5	U	**9.1**	J	< 0.5	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	**12**		**7**		< 5	U	**5.3**	J	< 0.5	U
	cis-1,2-Dichloroethene	µg/L	70		42		**240**		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	**2,600**		**1,800**		**540**		**310**		1.7	
	Methylene chloride	µg/L	NV	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1		< 5	U	< 10	U	< 10	U	< 1	U
	Trichloroethene	µg/L	5		**6**		**29**		< 0.5	U	< 0.5	U	< 0.5	U	3		**8,800**		**3,700**		**5,900**		**3,200**		**27**	
	Vinyl chloride	µg/L	2		< 0.5	U	1.1		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	**15**		**7.4**		< 5	U	**37**		0.41	J

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentratoin Level

RAWP - Remedial Action Work Plan

REG - regular

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-3
Pre-Remedy Sampling and Analyses in Intermediate and Upper Deep Zones

Monitoring Locations	ISB Area	October 2018									September 2019								
		VOCs (SW8260B) [a]	Perchlorate (314)	Anions (E300.0) [b]	Dissolved Gases (RSK-175) [c]	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters [d]	VOCs (SW8260B) [a]	Perchlorate (314)	Anions (E300.0) [b]	Dissolved Gases (RSK-175) [c]	Alkalinity (2320B)	TOC (SW9060)	DHC (qPCR)	Bromide (E300.0)	Field Parameters [d]
16EW05	Inside Mid-Plume ISB Area								✓	✓									
16EW06	Inside Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓
16EW07	Inside Mid-Plume ISB Area								✓	✓									
16EW08	Inside Mid-Plume ISB Area								✓	✓									
16WW13	Downgradient of Landfill	✓	✓						✓	✓	✓	✓							✓
16WW21 [e]	Upper deep zone; downgradient of Mid-Plume ISB Area	✓	✓						✓	✓									
16WW23	Downgradient of Landfill	✓	✓							✓	✓	✓							✓
16WW25	Upgradient of Mid-Plume ISB Area / Downgradient of Landfill Biobarrier #1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓
16WW27	Downgradient Outside of Contaminated Area	✓	✓							✓	✓	✓							✓
16WW29	Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓
16WW31	Cross-gradient Outside of Containment Area	✓	✓							✓									
16WW33	Cross-gradient Outside of Containment Area	✓	✓							✓									
16WW35	Upgradient of Mid-Plume ISB Area / Downgradient of Landfill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓
16WW37	Downgradient of Landfill / Upgradient of Landfill	✓	✓							✓									
16WW41	Downgradient of Mid-Plume ISB Area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓
16WW45	Background	✓	✓							✓									
16WW49	Proposed Well and Downgradient of Mid-Plume ISB Area										✓	✓							✓
16WW51	Proposed Well and Downgradient of Mid-Plume ISB Area										✓	✓							✓
16WW57	Across Harrison Bayou from Bayou Biobarrier										✓	✓	✓	✓	✓	✓	✓	✓	✓
16WW58	Across Harrison Bayou from Bayou Biobarrier										✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:

[a] VOCs include TCE; cis-1,2-DCE; 1,1-DCE; 1,2-DCA; 1,1,2-TCA; VC; and methylene chloride.

[b] Anions include nitrate and sulfate.

[c] Dissolved gasses include ethene, ethane, and methane.

[d] Field parameters include dissolved oxygen, oxidation reduction potential, and pH.

[e] Upper deep monitoring well. All other wells in this table are in the intermediate zone.

✓ Indicates that sample was collected and analyzed for the listed analyte.

DCE - dichloroethene
DCA - dichloroethane
DHC - Dehalococcoides (microbial analysis)
ISB - in situ bioremediation
qPCR - quantitative polymerase chain reaction
TCA - trichloroethane
TOC - total organic carbon
VC - vinyl chloride
VOCs - volatile organic compounds

Table 3-4
Pre-Remedy Results – Intermediate Groundwater

		Location Code		16EW05		16EW06		16EW06		16EW07		16EW08		16WW13		16WW13		16WW21[c]		16WW23		16WW23	
		Sample ID		16EW05-181011		16EW06-181009		16EW06-190918		16EW07-181013		16EW08-181013		16WW13-181012		16WW13-190918		16WW21-181012		16WW23-181012		16WW23-190917	
		Sample Date		10/11/2018		10/9/2018		9/18/2019		10/13/2018		10/13/2018		10/12/2018		9/18/2019		10/12/2018		10/12/2018		9/17/2019	
		Sample Purpose		REG		REG		REG		REG		REG		REG		REG		REG		REG		REG	
Parameter		**Units**	**MCL/PCL/UTL**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**
DHC																							
	Dehalococcoides	cells/mL	NV			1.7																	
FIELD TESTS																							
	Dissolved oxygen	mg/L	NV	0.74		0.95		0.53		1.62		0.48		1.02		0.16		0.82		1.23		0.14	
	Oxidation-Reduction Potential	mV	NV	189.9		59.3		58		-130.9		-16		225.7		190		166.4		13.2		8	
	pH	pH units	NV	6.17		5.84		6.18		7.12		6.23		4.68		5.52		5.52		5.49		6.07	
GASES																							
	Ethane	µg/L	NV			0.31	J																
	Ethylene	µg/L	NV			3.76																	
	Methane	µg/L	NV			8.39																	
GEN CHEMISTRY																							
	Alkalinity	mg/L	NV			438																	
	Bromide	mg/L	NV	3.1		3.38				2.14		1.11		0.929				0.218					
	Nitrate	mg/L	10			< 0.2	U																
	Sulfate	mg/L	NV			6,120																	
	Total organic carbon	mg/L	NV			31																	
PERCHLORATE																							
	Perchlorate	µg/L	17			< 2	U	**42**						< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
VOLATILES																							
	1,1,2-Trichloroethane	µg/L	NV			< 2.5	U	< 12	U					< 5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	1,1-Dichloroethene	µg/L	7			**25**		**22**	J					< 5	U	0.7	J	< 0.5	U	< 0.5	U	< 0.5	U
	1,2-Dichloroethane	µg/L	5			4.6	J	< 12	U					< 5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	cis-1,2-Dichloroethene	µg/L	70			**3,700**		**3,700**						**1,700**		**210**		< 0.5	U	< 0.5	U	< 0.5	U
	Methylene chloride	µg/L	NV			< 5	U	< 25	U					< 10	U	< 1	U	< 1	U	< 1	U	< 1	U
	Trichloroethene	µg/L	5			**5,500**		**6,500**						**4,400**		**630**		< 0.5	U	< 0.5	U	< 0.5	U
	Vinyl chloride	µg/L	2			**240**		**190**						**51**		**5.6**		< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentration Level

RAWP - Remedial Action Work Plan

REG - regular sample

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-4
Pre-Remedy Results – Intermediate Groundwater

		Location Code		16WW25						16WW27				16WW29				16WW31				16WW33	
		Sample ID		16WW25-181009		16WW25-190919		16WW25-190919-FD		16WW27-181012		16WW27-190917		16WW29-181015		16WW29-190918		16WW31-181010		16WW31-181010-FD		16WW33-181010	
		Sample Date		10/9/2018		9/19/2019		9/19/2019		10/12/2018		9/17/2019		10/15/2018		9/18/2019		10/10/2018		10/10/2018		10/10/2018	
		Sample Purpose		REG		REG		FD		REG		REG		REG		REG		REG		FD		REG	
Parameter		Units	MCL/PCL/UTL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
DHC																							
	Dehalococcoides	cells/mL	NV	0.5	U									0.5									
FIELD TESTS																							
	Dissolved oxygen	mg/L	NV	0.31		0.2				0.98		0.04		1.16		0.42		0.71				1.39	
	Oxidation-Reduction Potential	mV	NV	-13.4		-18.2				-11.4		-26		25.1		-39.1		219.1				132.3	
	pH	pH units	NV	5.95		5.68				5.54		5.99		6.19		5.85		5.32				6.49	
GASES																							
	Ethane	µg/L	NV	0.316	J									< 1	U								
	Ethylene	µg/L	NV	0.954	J									1.87									
	Methane	µg/L	NV	13.7										2.41									
GEN CHEMISTRY																							
	Alkalinity	mg/L	NV	69										45.9									
	Bromide	mg/L	NV	2.86										0.218									
	Nitrate	mg/L	10	< 0.1	U									< 0.1	U								
	Sulfate	mg/L	NV	5710										99.2									
	Total organic carbon	mg/L	NV	23.8										1.8									
PERCHLORATE																							
	Perchlorate	µg/L	17	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2		< 2	U	< 2	U	< 2	U	< 2	U
VOLATILES																							
	1,1,2-Trichloroethane	µg/L	NV	< 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-Dichloroethene	µg/L	7	< 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-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	< 0.5	U	< 0.5	U
	cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	8.4		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	Methylene chloride	µg/L	NV	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U	< 1	U
	Trichloroethene	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	3.3		2.7		< 0.5	U	< 0.5	U	< 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	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentration Level

RAWP - Remedial Action Work Plan

REG - regular sample

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-4
Pre-Remedy Results – Intermediate Groundwater

		Location Code	16WW35				16WW37		16WW41				16WW45		16WW49		16WW51		16WW57		16WW58			
		Sample ID	16WW35-181010		16WW35-190918		16WW37-181010		16WW41-181009		16WW41-190917		16WW45-181010		16WW49-190919		16WW51-190918		16WW57-190918		16WW58-190918		16WW58-190918-FD	
		Sample Date	10/10/2018		9/18/2019		10/10/2018		10/9/2018		9/17/2019		10/10/2018		9/19/2019		9/18/2019		9/18/2019		9/18/2019		9/18/2019	
		Sample Purpose	REG		REG		REG		REG		REG		REG		REG		REG		REG		REG		FD	
Parameter		Units	MCL/PCL/UTL	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
DHC																									
	Dehalococcoides	cells/mL	NV	33.9						0.5	U									35.3		17.8			
FIELD TESTS																									
	Dissolved oxygen	mg/L	NV	0.42		0.26		0.57		0.79		0.27		1.25		0.44		0		0.17		0.16			
	Oxidation-Reduction Potential	mV	NV	158.6		143		48.3		266		109.5		-25		-27.3		-90.8		13.6		-78.1			
	pH	pH units	NV	6.17		6.64		6.73		6.21		6.18		7.05		6.16		6.06		5.69		5.98			
GASES																									
	Ethane	µg/L	NV	0.644	J					0.281	J									0.246	J	0.332	J	0.318	J
	Ethylene	µg/L	NV	4.38						3.04										1.18		1.51		1.43	
	Methane	µg/L	NV	55						6.55										2.44		3.62		4.37	
GEN CHEMISTRY																									
	Alkalinity	mg/L	NV	969						951										133		94		107	
	Bromide	mg/L	NV	< 0.2	U					3.35										3.16		3.52		3.48	
	Nitrate	mg/L	10	< 0.2	U					< 0.2	U									< 0.1	U	< 0.1	U	< 0.1	U
	Sulfate	mg/L	NV	8,400						9,260										2,310		394		396	
	Total organic carbon	mg/L	NV	44						58										10.9		4.21		4.27	
PERCHLORATE																									
	Perchlorate	µg/L	17	**420**		**410**		< 2	U	**60**		< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U	< 2	U
VOLATILES																									
	1,1,2-Trichloroethane	µg/L	NV	< 25	U	< 12	U	< 0.5	U	< 5	U	< 5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 2.5	U	< 2.5	U
	1,1-Dichloroethene	µg/L	7	**190**		**120**		< 0.5	U	**17**		**11**		< 0.5	U	< 0.5	U	< 0.5	U	0.56	J	3.9	J	3.9	J
	1,2-Dichloroethane	µg/L	5	< 25	U	< 12	U	< 0.5	U	< 5	U	< 5	U	< 0.5	U	0.86	J	< 0.5	U	< 0.5	U	< 2.5	U	< 2.5	U
	cis-1,2-Dichloroethene	µg/L	70	**19,000**		**8,800**		5.2		**1,200**		**1,300**		< 0.5	U	**130**		9.1		< 0.5	U	**170**		**180**	
	Methylene chloride	µg/L	NV	< 50	U	< 25	U	< 1	U	< 10	U	< 10	U	< 1	U	< 1	U	< 1	U	< 1	U	< 5	U	< 5	U
	Trichloroethene	µg/L	5	**21,000**		**13,000**		**84**		**9,800**		**3,900**		< 0.5	U	**260**		**90**		**24**		**4,300**		**4,100**	
	Vinyl chloride	µg/L	2	**170**		**75**		< 0.5	U	**110**		**80**		< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U	< 2.5	U	< 2.5	U

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw, 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

[c] Well 16WW22 is in the Upper Deep groundwater zone, not the Intermediate.

µg/L - micrograms per liter

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

cells/mL - cells per milliliter

DHC - Dehalococcoides

FD - field duplicate

ID - identification

MCL - maximum contaminant limit

mg/L - milligrams per liter

mV - millivolt

NV - no value

PCL - Protective Concentration Level

RAWP - Remedial Action Work Plan

REG - regular sample

UTL - Upper Threshold Limit

Val Qual - validation qualifier

VOCs - volatile organic compounds

Table 3-5
Summary of Pre-Remedy Surface Water Sampling

Monitoring Location	Location Description	Analyses			
		VOCs [a] (SW8260B)	Perchlorate (6850)	Metals (6020A/7471B)	Field Parameters [b]
16SW01	Harrison Bayou, downstream of LHAAP-16	✓	✓	✓	✓
16SW02	Harrison Bayou, centered on LHAAP-16 contaminant plumes	✓	✓	✓	✓
16SW03	Harrison Bayou, upstream of LHAAP-16 contaminant plumes	✓	✓	✓	✓

Notes:

[a] VOCs include trichloroethene (TCE); cis-1,2-dichloroethene (DCE); 1,1-DCE; 1,2-dichloroethane (DCA); 1,1,2-trichloroethane (TCA); Vinyl Chloride (VC); and methylene chloride.

[b] Metals include arsenic, chromium, manganese, nickel and thallium.

[c] Field Parameters include dissolved oxygen, oxidation reduction potential, conductivity, temperature and

✓ Indicates that sample was collected and analyzed for the listed analyte.

VOCs - volatile organic compounds

Table 3-6

Pre-Remedy Results – Surface Water

			Location Code	16SW01				16SW02		16SW03	
			Sample ID	16SW01-181011		16SW01-181011-FD		16SW02-181011		16SW03-181011	
			Sample Date	10/11/2018		10/11/2018		10/11/2018		10/11/2018	
			Sample Purpose	REG		FD		REG		REG	
Parameter		**Units**	**MCL/PCL/UTL**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**	**Result**	**Val Qual**
Field Tests											
	Dissolved oxygen	mg/L	NV	3.74				3.44		4.4	
	Oxidation-Reduction Potential	mV	NV	199.2				173.6		185.4	
	pH	pH units	NV	6.97				6.67		7.16	
	Specific conductivity	µmhos/cm	NV	0.152				0.153		0.149	
	Temperature	C	NV	20.84				21.1		21.46	
Metals											
	Arsenic	mg/L	0.01	0.00204		0.00212		0.00198	J	0.00194	J
	Chromium	mg/L	0.1	0.000499	J	0.000515	J	< 0.001	U	< 0.001	U
	Manganese	mg/L	7.8 [b]	0.545		0.586		0.485		0.36	
	Nickel	mg/L	0.49 [a]	0.00756		0.00786		0.00725		0.00668	
	Thallium	mg/L	0.002	0.000418	J	< 0.001	U	< 0.001	U	< 0.001	U
Perchlorate											
	Perchlorate	µg/L	17 [a]	< 2	U	< 2	U	< 2	U	< 2	U
Volatiles											
	1,1,2-Trichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	1,1-Dichloroethene	µg/L	7	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	1,2-Dichloroethane	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	cis-1,2-Dichloroethene	µg/L	70	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	Methylene chloride	µg/L	5	< 1	U	< 1	U	< 1	U	< 1	U
	Trichloroethene	µg/L	5	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U
	Vinyl chloride	µg/L	2	< 0.5	U	< 0.5	U	< 0.5	U	< 0.5	U

Notes:

Blue highlighted/**bold** results indicate concentrations above the MCL/PCL.

[a] Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Level (PCL) for groundwater.

[b] 95% UTL value from Final Evaluation of Perimeter Well Data for Use as Groundwater Background (Shaw 2007) for Manganese is 7,820 µg/L, which is above the TRRP Tier 1 Groundwater Residential PCL; thus, the background value will be considered the Cleanup Level for Manganese per Table 1-1 of the Draft Final RAWP (APTIM 2018).

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

µg/L - micrograms per liter

µmhos/cm - micromhos per centimeter

Notes: (cont.)

C - degrees Celsius
DHC - Dehalococcoides
FD - field duplicate
ID - identifier
MCL - maximum contaminant limit
mg/L - milligrams per liter
mV - millivolts
NV - no value
RAWP - Remedial Action Work Plan
REG - regular sample
UTL - Upper Threshold Limit
Val Qual - validation qualifier
VOCs - volatile organic compounds

Table 4-1
In Situ Bioremediation Amendment Mixtures

Area	Total Volume (gal)	Water (gal)	Carbon Source			SDC-9™ (gal)	ZVI (lbs)	Sodium Bromide (lbs)
			Product	Mass (lbs)	Volume (gal)			
Bayou BioBarrier	3,794	3,366	ABC™	3,500	427	1.32	3,500	15.4
Mid Plume Shallow Zone Biogrid	41,627	37,467	EDS-ER™	28,414	4,107	53.10	0	171.6
Mid Plume Intermediate Zone Biobarrier	23,585	21,173	EDS-ER™	16,565	2,394	17.70	0	99.0
Landfill BioBarrier #1	7,241	6,510	EDS-ER™	5,041	729	1.59	0	30.4
Landfill BioBarrier #2	5,302	4,781	EDS-ER™	3,594	520	1.06	0	11.0
Landfill BioBarrier #3	3,377	3,039	EDS-ER™	2,333	337	0.79	0	13.2

Notes:

ABC™ Anaerobic Biochem. This carbon substrate is a proprietary mixture of lactates, fatty acids, alcohols and a phosphate buffer.

EDS-ER™ Electron Donor Solution - Extended Release. This is a carbon substrate that becomes an emulsified vegetable oil when mixed with water.

gal gallons

lbs pounds

SDC-9™ dechlorinating microbial consortium

ZVI zero valent iron

Table 4-2
Injection Volumes

Location	Target Interval (feet bgs)	Start Date	Completion Date	Volume Injected (gallons)	Volume Extracted (gallons)	Volume Recirculated (gallons)
Bayou BioBarrier						
16IW20[1]	14–24	9/24/2019	9/24/2019	271		
DPT-26	22–32	9/26/2019	9/26/2019	271		
DPT-27	22–32	9/26/2019	9/26/2019	271		
DPT-28	22–32	9/25/2019	9/25/2019	271		
DPT-29	22–32	9/25/2019	9/25/2019	271		
DPT-30	22–32	9/25/2019	9/25/2019	271		
DPT-31	22–32	9/25/2019	9/25/2019	271		
DPT-32	18–28	9/25/2019	9/25/2019	271		
DPT-33	18–28	9/25/2019	9/25/2019	271		
DPT-34	18–28	9/25/2019	9/25/2019	271		
DPT-35	18–28	9/24/2019	9/24/2019	271		
DPT-37	14–24	9/24/2019	9/24/2019	271		
DPT-38	14–24	9/24/2019	9/24/2019	271		
DPT-39	14–24	9/24/2019	9/24/2019	271		
Total Injected				**3,794**		
Mid Plume Shallow Zone Biogrid						
DPT-40	14–36	9/30/2019	9/30/2019	1,129		
DPT-41	14–36	9/30/2019	9/30/2019	1,272		
DPT-42	14–36	9/30/2019	9/30/2019	1,127		
DPT-43	14–36	10/1/2019	10/1/2019	1,027		
DPT-44	14–36	9/30/2019	9/30/2019	1,127		
DPT-45	14–36	10/1/2019	10/1/2019	1,027		
DPT-46	14–36	10/3/2019	10/3/2019	1,027		
DPT-47	14–36	10/1/2019	10/2/2019	1,027		
DPT-48	14–36	10/2/2019	10/2/2019	1,027		
DPT-49	14–36	10/4/2019	10/4/2019	1,027		
DPT-50	14–36	10/2/2019	10/2/2019	1,027		
DPT-51	14–36	10/1/2019	10/2/2019	1,027		
DPT-52	14–36	10/3/2019	10/4/2019	1,027		
DPT-53	14–36	10/1/2019	10/1/2019	1,027		
DPT-54	14–36	10/5/2019	10/6/2019	1,027		
DPT-55	14–36	10/3/2019	10/4/2019	1,027		
DPT-56	14–36	10/2/2019	10/3/2019	1,027		
DPT-57	14–36	10/3/2019	10/3/2019	1,027		
DPT-58	14–36	10/1/2019	10/2/2019	1,027		
DPT-59	14–36	10/2/2019	10/3/2019	1,027		
DPT-60	14–36	10/10/2019	10/10/2019	1,027		
DPT-61	14–36	10/10/2019	10/10/2019	1,027		
DPT-62	14–36	10/10/2019	10/11/2019	1,027		
DPT-63	14–36	10/8/2019	10/10/2019	1,027		

Table 4-2
Injection Volumes

Location	Target Interval (feet bgs)	Start Date	Completion Date	Volume Injected (gallons)	Volume Extracted (gallons)	Volume Recirculated (gallons)
DPT-64	14–36	10/5/2019	10/6/2019	1,027		
DPT-65	14–36	10/8/2019	10/8/2019	1,027		
DPT-66	14–36	10/7/2019	10/7/2019	1,027		
DPT-67	14–36	10/6/2019	10/6/2019	1,027		
DPT-68	14–36	10/4/2019	10/5/2019	1,027		
DPT-69	14–36	10/3/2019	10/4/2019	1,027		
DPT-70	14–36	10/5/2019	10/6/2019	1,027		
DPT-71	14–36	10/6/2019	10/7/2019	1,027		
DPT-72	14–36	10/7/2019	10/8/2019	1,027		
DPT-73	14–36	10/8/2019	10/10/2019	1,027		
DPT-74	14–36	10/10/2019	10/10/2019	1,027		
DPT-75	14–36	10/10/2019	10/11/2019	1,027		
DPT-76	14–36	10/4/2019	10/4/2019	1,027		
DPT-77	14–36	10/5/2019	10/6/2019	1,027		
DPT-78	14–36	10/6/2019	10/7/2019	1,027		
DPT-79	14–36	10/7/2019	10/8/2019	1,027		
Total Injected				**41,627**		
Mid Plume Intermediate Zone Biobarrier						
16EW05	47–52	11/16/2019	11/22/2019	2,395		
16EW06	50–55	11/16/2019	11/22/2019	2,394		
16EW07	41–46	11/16/2019	11/22/2019	2,394		
16EW08	34-39	11/16/2019	11/22/2019	2,394		
16IW25	40-55	9/27/2019	9/29/2019	2,394		
16IW26	40-55	9/27/2019	9/29/2019	2,394		
16IW27/16TIP27	40-55	9/27/2019	10/9/2019	2,394		
16IW28/16TIP28	35-50	9/27/2019	10/14/2019	2,394		
16IW29	35-50	9/27/2019	9/29/2019	2,395		
16IW30	35-50	9/27/2019	10/1/2019	2,038		
Total				**23,585**		
16EW05	47–52	10/17/2019	11/14/2019		112,320	
16EW06	50–55	10/17/2019	11/14/2019			
16EW07	41–46	10/17/2019	11/14/2019			
16EW08	34–39	10/17/2019	11/14/2019			
Total Extracted					**112,320**	
16IW25	40–55	10/18/2019	11/14/2019			112,320
16IW26	40–55	10/18/2019	11/14/2019			
16IW29	35–50	10/18/2019	11/14/2019			
16IW30	35–50	10/18/2019	11/14/2019			
Total Recirculated						**112,320**
Landfill BioBarrier #1						
DPT 01	15–21	10/16/2019	10/16/2019	291		

Table 4-2
Injection Volumes

Location	Target Interval (feet bgs)	Start Date	Completion Date	Volume Injected (gallons)	Volume Extracted (gallons)	Volume Recirculated (gallons)
DPT 02	15–21	10/15/2019	10/16/2019	291		
DPT 03	15–21	10/16/2019	10/16/2019	291		
DPT 04	15–21	10/15/2019	10/16/2019	291		
DPT 05	15–21	10/16/2019	10/16/2019	291		
DPT 06	15–21	10/16/2019	10/16/2019	291		
DPT 07	15–21	10/15/2019	10/16/2019	291		
DPT 08	13–18	10/16/2019	10/16/2019	234		
DPT 09	13–18	10/16/2019	10/16/2019	234		
DPT 10	13–18	10/16/2019	10/16/2019	234		
DPT 11	13–18	10/10/2019	10/10/2019	234		
DPT 12	13–18	10/16/2019	10/16/2019	234		
DPT 13	5–18	10/16/2019	10/16/2019	632		
DPT 14	5–18	10/17/2019	10/18/2019	632		
DPT 15	5–18	10/16/2019	10/18/2019	632		
DPT 16	5–18	10/17/2010	10/17/2010	632		
DPT 17	5–18	10/16/2010	10/17/2010	632		
DPT 18	5–18	10/17/2010	10/17/2010	632		
16IW09	13–18	10/17/2010	10/17/2010	242		
Total Injected				**7,241**		
Landfill BioBarrier #2						
16EW11	15.2–24.8	12/20/2019	12/21/2019	540		
16EW12B	13–18	12/20/2019	12/20/2019	540		
16EW13	15–24.6	12/20/2019	12/20/2019	540		
16EW14B	14–29	12/20/2019	12/20/2019	540		
16EW15	13.9–23.5	12/20/2019	12/21/2019	540		
16IW01	15–25	12/3/2019	12/4/2019	650		
16IW03	15–25	12/3/2019	12/4/2019	651		
16IW05	15–25	12/3/2019	12/4/2019	651		
16IW07	14–24	12/3/2019	12/4/2019	651		
Total Injected				**5,302**		
16EW11	15.2–24.8	12/3/2019	12/18/2019			
16EW12B	13–28	12/3/2019	12/18/2019			
16EW13	15–24.6	12/3/2019	12/18/2019		21,438	
16EW14B	14–29	12/3/2019	12/18/2019			
16EW15	13.9–23.5	12/3/2019	12/18/2019			
Total Extracted					**21,438**	
16IW01	15–25	12/11/2019	12/19/2019			4,618
16IW03	15–25	12/11/2019	12/19/2019			4,712
16IW05	15–25	12/11/2019	12/19/2019			4,983
16IW07	14–24	12/11/2019	12/19/2019			4,718
Total Recirculated						19,030

Table 4-2
Injection Volumes

Location	Target Interval (feet bgs)	Start Date	Completion Date	Volume Injected (gallons)	Volume Extracted (gallons)	Volume Recirculated (gallons)
Landfill BioBarrier #3						
DPT 19	17–27	10/19/2019	10/19/2019	421		
DPT 20	17–27	10/19/2019	10/19/2019	421		
DPT 21	17–27	10/19/2019	10/19/2019	424		
DPT 22	17–27	10/19/2019	10/19/2019	424		
DPT 23	15–25	10/19/2019	10/19/2019	423		
DPT 24	15–25	10/19/2019	10/19/2019	422		
DPT 25	15–25	10/19/2019	10/19/2019	421		
16IW10	15–25	10/19/2019	10/19/2019	422		
Total Injected				**3,377**		

Notes:

[1] 16IW20 is sometimes labeled as DPT-36. However, it is a permanent injection well, not a direct push point.

bgs below ground surface

Table 4-3
Harrison Bayou Observations

Date	Time	Dissolved Oxygen (mg/L)	Comments	Reason for Observation
9/24/2019	8:50	2.85	First Injections started at 10:45	Reading prior to start of injections.
9/24/2019	12:45	3.19	No visible product in creek	Observations while injections were in progress at Bayou Biobarrier
9/24/2019	13:45	3.41	No visible product in creek	
9/24/2019	14:47	3.47	No visible product in creek	
9/24/2019	16:45	3.21	No visible product in creek	
9/25/2019	7:27	2.75	No visible product in creek	
9/25/2019	9:30	3.32	No visible product in creek	
9/25/2019	10:30	3.33	No visible product in creek	
9/25/2019	11:35	3.67	No visible product in creek	
9/25/2019	12:30	3.68	No visible product in creek	
9/25/2019	13:50	3.85	No visible product in creek	
9/25/2019	14:50	5.63	No visible product in creek	
9/25/2019	15:50	5.06	No visible product in creek	
9/26/2019	7:28	2.93	No visible product in creek	
9/26/2019	9:30	2.95	Finished Injection at 10:00	
9/26/2019	10:30	3.92	No visible product in creek	Daily observations for one week after injections.
9/27/2019	8:00	2.97	No visible product in creek	
9/28/2019	7:20	2.74	No visible product in creek	
9/29/2019	7:45	2.77	No visible product in creek	
9/30/2019	9:00	3.72	No visible product in creek	
10/1/2019	12:31	4.68	No visible product in creek	
10/2/2019	9:53	3.59	No visible product in creek	
10/3/2019	7:10	2.60	No visible product in creek	
10/22/2019	–	6	No visible product in creek	Extra observations.
11/4/2019	–	6.56	No visible product in creek	

Note:
mg/L - milligrams per liter

Table 4-4
TOC and Bromide During Implementation of Landfill Biobarrier #2

Bromide (SW9056) (mg/L)

Well ID	Sample Date						
	Pre-remedy 10/13/2018	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/18/2019
16EW11	4.68	4.12	4	3.91	3.77	3.92	4.58
16EW12B	3.82	3.32	3.43	2.6	2.93	2.94	2.93
16EW13	2.91	2.28	2.33	2.35	2.23	2.53	2.52
16EW14B	1.4	1.4	1.43	1.37	1.48	1.43	1.65
16EW15	1.86	1.54	1.59	1.52	1.53	1.48	1.59

Total Organic Carbon (SM5310) (mg/L)

Well ID	Sample Date						
	Pre-remedy 10/13/2018	12/4/2019	12/5/2019	12/6/2019	12/9/2019	12/12/2019	12/18/2019
16EW11	6.36	7.02	8.32	93.4	13.5	11.2	15.6
16EW12B	9.15	9.24	38.2	12.7	11.2	11.8	13.8
16EW13	9.85	8.5	9.09	9.21	9.54	10.2	23.9
16EW14B	21.6	21	21	20.7	22.6	21	22.1
16EW15	21	27.7	30.8	30.3	26.1	27.4	26.7

Notes:

Amendments were injected, extracted, and/or recirculated at Landfill Biobarrier #2 between December 3–21, 2019.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewater, 2017.*

SW9056 Test Method 9056A, SW-846, 2007.

ID identifier

mg/L milligrams per liter

TOC total organic carbon

Table 4-5
TOC and Bromide During Implementation of Mid-Plume Intermediate Biobarrier

Bromide (SW9056) (mg/L)

	Sample Date										
	Pre-remedy										
Well ID	10/9/2018	10/11/2018	10/13/2018	10/18/2019	10/22/2019	10/25/2019	10/31/2019	11/5/2019	11/6/2019	11/8/2019	11/11/2019
16EW05		3.1		3.92		1.93		2.82			2.78
16EW06	3.38				2.99		2.06			4.6 J	
16EW07			2.14	1.37		2.79		2.96			
16EW08			1.11		20.6				41.8		

Total Organic Carbon (SM5310) (mg/L)

	Sample Date					
	Pre-remedy					
Well ID	10/9/2018	10/31/2019	11/5/2019	11/6/2019	11/8/2019	11/11/2019
16EW05		30.6	21.1			31
16EW06	31	27			28.1	
16EW07		21	32.6			
16EW08				64		

Notes:

Amendments were injected, extracted, and or recirculated at the intermediate zone of the mid-plume area between 9/27/2019 and 11/22/2019.

SM5310 - Method 5310, *Standard Methods For the Examination of Water and Wastewater, 2017.*

SW9056 - Test Method 9056A, SW-846, 2007.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

ID - identification

mg/L - milligrams per liter

TOC - total organic carbon

Table 5-1
Design Effectiveness Results at Bayou Biobarrier

	Location Code	16IW20				16RW11		16RW12					
	Sample ID	16IW20-191022		16IW20-200309		16RW11-191022		16RW12-191022		16RW12-191022-FD		16RW12-200310	
	Sample Date	10/22/2019		3/9/2020		10/22/2019		10/22/2019		10/22/2019		3/10/2020	
	Location Description	Shallow; Bayou Biobarrier Area		Shallow; Bayou Biobarrier Area		Shallow; Within Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.04		2.6		0.07		0.88				1.34	
ORP (field reading)	mV	-182		-230		-39		159				7	
pH (field reading)	pH units	6.07		6.49		5.27		6.12				6.65	
Bromide (SW9056)	mg/L	4.09		13.4		213		3.85		3.9		4.3	
Total organic carbon (SM5310)	mg/L	38		10.7		3290		1.78		1.91		2.56	

	Location Code	16WW12						16WW22					
	Sample ID	16WW12-181012		16WW12-190918		16WW12-191022		16WW22-181010		16WW22-190917		16WW22-191022	
	Sample Date	10/12/2018		9/18/2019		10/22/2019		10/10/2018		9/17/2019		10/22/2019	
	Location Description	Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.36		0.34		0.05		0.89		0.23		0.52	
ORP (field reading)	mV	130.1		163.3		-37		68.3		-17.7		29	
pH (field reading)	pH units	5.74		5.79		6.02		5.86		6.05		6.30	
Bromide (SW9056)	mg/L	3.9				3.56		4.46				3.5	
Total organic carbon (SM5310)	mg/L					7.51		2.62				1.84	

	Location Code	16WW39						16WW40							
	Sample ID	16WW39-181010		16WW39-190917		16WW39-191022		16WW40-181012		16WW40-181012-FD		16WW40-190917		16WW40-191022	16WW40-200310
	Sample Date	10/10/2018		9/17/2019		10/22/2019		10/12/2018		10/12/2018		9/17/2019		10/22/2019	3/10/2020
	Location Description	Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier		Shallow; Upgradient of Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier		Shallow; Downgradient of Bayou Biobarrier	Shallow; Downgradient of Bayou Biobarrier
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.48		0.23		0.2		0.3				2.09		0.03		0.06	
ORP (field reading)	mV	115.9		24.1		57		-44.1				7.8		-56		78	
pH (field reading)	pH units	5.74		5.97		6.14		5.90				5.88		5.95		6.30	
Bromide (SW9056)	mg/L	4.2				4.96		5.57		5.72				4.49		4.2	
Total organic carbon (SM5310)	mg/L					3.53								7.72		9.79	

Notes:

Amendments were injected at the Bayou Biobarrier between 9/24/2019 and 9/26/2019.

Shading indicates samples that were collected prior to the injections.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewater* . 2017.

SW9056 Test Method 9056A, SW-846, 2007.

J - Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U - Undetected. The analyte was analyzed for, but not detected.

ID - identifier

ISB - in situ bioremediation

mg/L - milligrams per liter

mV - millivolts

ORP - oxidation-reduction potential

Val Qual - validation qualifier

Table 5-2
Design Effectiveness Results at Mid-Plume Shallow Zone Biogrid

Parameter	Location Code	16EW01				16EW02							
	Sample ID	16EW01-191111		16EW01-200309		16EW02-181009		16EW02-190918		16EW02-191111		16EW02-200309	
	Sample Date	11/11/2019		3/9/2020		10/9/2018		9/18/2019		11/11/2019		3/9/2020	
	Location Description	Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area	
	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.55		4.68		1.16		1.11		0.95		3.77	
ORP (field reading)	mV	-23.9		-79		80.2		171		70.9		55	
pH (field reading)	pH units	6.12		6.36		6.00		6.16		5.95		6.86	
Bromide (SW9056)	mg/L	3.33		3.39		2.66				1.74		2.06	
Total organic carbon (SM5310)	mg/L	9.06		13.4		10.3				10.3		6.48	

Parameter	Location Code	16EW03		16EW04					
	Sample ID	16EW03-191111		16EW04-191111		16EW04-191111-FD		16EW04-200309	
	Sample Date	11/11/2019		11/11/2019		11/11/2019		3/9/2020	
	Location Description	Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area		Shallow; Inside Mid-Plume ISB Area	
	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.39		0.57				2.78	
ORP (field reading)	mV	-110.1		128.3				65	
pH (field reading)	pH units	6.21		5.46				7.26	
Bromide (SW9056)	mg/L	5.3		2.48		2.54		0.637	
Total organic carbon (SM5310)	mg/L	22.6		13.6		15.3		3.4	

Notes:
Amendments were injected into the shallow groundwater zone in the mid-plume area between 9/30/2019 and 10/11/2019.
Shading indicates samples that were collected prior to the injections.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewate* r. 2017.
SW9056 Test Method 9056A, SW-846. 2007.
J Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.
U Undetected. The analyte was analyzed for, but not detected.
ID identifier
ISB in situ bioremediation
mg/L milligrams per liter
mV millivolts
ORP oxidation-reduction potential
Val Qual validation qualifier

Table 5-3
Design Effectiveness Results at Mid-Plume Intermediate Zone Biobarrier

	Location Code	16EW05													
	Sample ID	16EW05-181011		16EW05-191018		16EW05-191025		16EW05-EVENT2-191031		16EW05-191105		16EW05-191111		16EW05-E2-191223	
	Sample Date	10/11/2018		10/18/2019		10/25/2019		10/31/2019		11/5/2019		11/11/2019		12/23/2019	
	Location Description	Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.74												0.07	
ORP (field reading)	mV	189.9												-29	
pH (field reading)	pH units	6.17												5.33	
Bromide (SW9056)	mg/L	3.1		3.92		1.93				2.82		2.78		350	
Total organic carbon (SM5310)	mg/L							30.6		21.1		31		22,900	

	Location Code	16EW06													
	Sample ID	16EW06-181009		16EW06-190918		16EW06-191022		16EW06-EVENT2-191031		16EW06-191108		16EW06-E2-191223		16EW06-E2-191223-FD	
	Sample Date	10/9/2018		9/18/2019		10/22/2019		10/31/2019		11/8/2019		12/23/2019		12/23/2019	
	Location Description	Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.95		0.53								0.04			
ORP (field reading)	mV	59.3		58								-33			
pH (field reading)	pH units	5.84		6.18								5.25			
Bromide (SW9056)	mg/L	3.38				2.99		2.06		4.6	J	521		539	
Total organic carbon (SM5310)	mg/L	31						27		28.1		144,000		137,000	

	Location Code	16EW07											
	Sample ID	16EW07-181013		16EW07-191018		16EW07-191025		16EW07-EVENT2-191031		16EW07-191105		16EW07-E2-191223	
	Sample Date	10/13/2018		10/18/2019		10/25/2019		10/31/2019		11/5/2019		12/23/2019	
	Location Description	Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	1.62										0.02	
ORP (field reading)	mV	-130.9										-18	
pH (field reading)	pH units	7.12										5.19	
Bromide (SW9056)	mg/L	2.14		1.37		2.79				2.96		357	
Total organic carbon (SM5310)	mg/L							21		32.6		48,000	

	Location Code	16EW08							
	Sample ID	16EW08-181013		16EW08-191022		16EW08-191106		16EW08-E2-191223	
	Sample Date	10/13/2018		10/22/2019		11/6/2019		12/23/2019	
	Location Description	Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area		Intermediate; Inside Mid-plume ISB Area	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.48						0.09	
ORP (field reading)	mV	-16						-7	
pH (field reading)	pH units	6.23						5.20	
Bromide (SW9056)	mg/L	1.11		20.6		41.8		379	
Total organic carbon (SM5310)	mg/L					64		38,000	

Notes:

Amendments were injected into the intermediate zone of the mid-plume area between September 27 and November 22, 2019.

Shading indicates samples that were collected prior to the injections.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewater* . 2017.

SW9056 Test Method 9056A, SW-846. 2007.

J Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U Undetected. The analyte was analyzed for, but not detected.

ID identifier

ISB in situ bioremediation

mg/L milligrams per liter

mV millivolts

ORP oxidation-reduction potential

Val Qual validation qualifier

Table 5-4
Design Effectiveness Results at Landfill Biobarrier #1

	Location Code	16IW09		16RW01		16RW02		16RW03				16RW04					
	Sample ID	16IW09-191119		16RW01-191119		16RW02-191119		16RW03-191119		16RW03-200309		16RW04-191119		16RW04-191119-FD		16RW04-200309	
	Sample Date	11/19/2019		11/19/2019		11/19/2019		11/19/2019		3/9/2020		11/19/2019		11/19/2019		3/9/2020	
	Location Description	Shallow; Landfill Biobarrier #1 Area		Shallow; Upgradient of Landfill Biobarrier #1		Shallow; Upgradient of Landfill Biobarrier #1		Shallow; Within Landfill Biobarrier #1		Shallow; Within Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.04		0.19		0.03		0.49		0.32		0.12				0.2	
ORP (field reading)	mV	-88		303		-15		85		199		228				250	
pH (field reading)	pH units	4.6		4.93		5.73		5.74		5.62		5.01				5.07	
Bromide (SW9056)	mg/L	70.7		0.52		0.13		0.713		0.792		0.66		0.656		0.43	
Total organic carbon (SM5310)	mg/L	7820		3.66		4.37	J	2.51	J	1.04		2.81		2.8		3.17	

	Location Code	16RW05		16WW26							
	Sample ID	16RW05-191119		16WW26-181009		16WW26-190917		16WW26-191119		16WW26-200309	
	Sample Date	11/19/2019		10/9/2018		9/17/2019		11/19/2019		3/9/2020	
	Location Description	Shallow; Downgradient of Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1		Shallow; Downgradient of Landfill Biobarrier #1	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.05		0.66		0.44		0.18		0.07	
ORP (field reading)	mV	-178		50.4		-1.6		95		266	
pH (field reading)	pH units	6.16		5.08		5.21		5.29		4.72	
Bromide (SW9056)	mg/L	75.4		0.1	U			0.262		0.258	
Total organic carbon (SM5310)	mg/L	791		5.03				2.38		2.27	

	Location Code	16WW42									
	Sample ID	16WW42-181012		16WW42-190916		16WW42-191119		16WW42-200310		16WW42-200310-FD	
	Sample Date	10/12/2018		9/16/2019		11/19/2019		3/10/2020		3/10/2020	
	Location Description	Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	1.21		1.89		1.37		1.52			
ORP (field reading)	mV	113.6		-31.4		48		241			
pH (field reading)	pH units	5.27		6.10		5.58		5.15			
Bromide (SW9056)	mg/L	0.182				0.662		1.36		1.35	
Total organic carbon (SM5310)	mg/L					3.94		1.73		1.68	

Notes:

Amendments were injected at Landfill Biobarrier #1 between October 15–18, 2019.

Shading indicates samples that were collected prior to the injections.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewater* . 2017.

SW9056 Test Method 9056A, SW-846. 2007.

J Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U Undetected. The analyte was analyzed for, but not detected.

ID identification

ISB in situ bioremediation

mg/L milligrams per liter

mV millivolts

ORP oxidation-reduction potential

Val Qual validation qualifier

Table 5-5
Design Effectiveness Results at Landfill Biobarrier #2

	Location Code	16IW03		16IW04				16PM02		16PM03	
	Sample ID	16IW03-200123		16IW04-200123		16IW04-200310		16PM02-200123		16PM03-200123	
	Sample Date	1/23/2020		1/23/2020		3/10/2020		1/23/2020		1/23/2020	
	Location Description	Shallow, Injection Well, Within Landfill		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.04		0.06		0.06		0.08		0.02	
ORP (field reading)	mV	-78		-37		-79		53		18	
pH (field reading)	pH units	7.25		7.0		6.56		7.15		7.06	
Bromide (SW9056)	mg/L	0.66		4.68		4.82		0.774		4.55	
Total organic carbon (SM5310)	mg/L	222		6.7		7.68		6.58		4.88	

	Location Code	16PM06						16PM09			
	Sample ID	16PM06-200123		16PM06-200123-FD		16PM06-200310		16PM09-200123		16PM09-200310	
	Sample Date	1/23/2020		1/23/2020		3/10/2020		1/23/2020		3/10/2020	
	Location Description	Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.08				0.09		0.03		0.64	
ORP (field reading)	mV	-21				-53		175		75	
pH (field reading)	pH units	6.85				6.21		6.73		6.36	
Bromide (SW9056)	mg/L	2.74		2.74		2.26		0.744		0.266	
Total organic carbon (SM5310)	mg/L	9.03		9.01		8		7.58		3.33	

	Location Code	16PM14				16WW36							
	Sample ID	16PM14-200123		16PM14-200310		16WW36-181009		16WW36-190916		16WW36-200123		16WW36-200311	
	Sample Date	1/23/2020		3/10/2020		10/9/2018		9/16/2019		1/23/2020		3/11/2020	
	Location Description	Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,		Shallow, Performance Well,	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.04		0.08		0.39		0.21		0.07			
ORP (field reading)	mV	6		88		116.1		87.4		152			
pH (field reading)	pH units	6.81		6.36		6.07		5.98		7.14			
Bromide (SW9056)	mg/L	2.99		2.65		2.7				1.4		0.91	
Total organic carbon (SM5310)	mg/L	10.4		10.5		33				21	J	19.7	

Notes:

Amendments were injected, extracted, and/or recirculated at Landfill Biobarrier #2 between December 3–21, 2019.

Shading indicates samples that were collected prior to the injections.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewater*. 2017.

SW9056 Test Method 9056A, SW-846. 2007.

J Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U Undetected. The analyte was analyzed for, but not detected.

ID identification

ISB in situ bioremediation

mg/L milligrams per liter

mV millivolts

ORP oxidation-reduction potential

Val Qual validation qualifier

Table 5-6
Design Effectiveness Results at Landfill Biobarrier #3

	Location Code	16IW10		16RW06				16RW07		16RW08			
	Sample ID	16IW10-191120		16RW06-191120		16RW06-191120-FD		16RW07-191120		16RW08-191120		16RW08-200311	
	Sample Date	11/20/2019		11/20/2019		11/20/2019		11/20/2019		11/20/2019		3/11/2020	
	Location Description	Shallow; Landfill Biobarrier #3 Area		Shallow; Upgradient of Landfill Biobarrier #3		Shallow; Upgradient of Landfill Biobarrier #3		Shallow; Upgradient of Landfill Biobarrier #3		Shallow; Within Landfill Biobarrier #3		Shallow; Within Landfill Biobarrier #3	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.05		0.06				0.03		0.04		0.67	
ORP (field reading)	mV	-47		140				43		90		28	
pH (field reading)	pH units	6.2		6.02				6.14		6.35		6.76	
Bromide (SW9056)	mg/L	201		5.03		5.05		4.25		6.06		5.1	
Total organic carbon (SM5310)	mg/L	1850		1.54		1.55		1.59		2.02		2.6	

	Location Code	16RW09				16RW10			
	Sample ID	16RW09-191120		16RW09-200311		16RW10-191120		16RW10-200311	
	Sample Date	11/20/2019		3/11/2020		11/20/2019		3/11/2020	
	Location Description	Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3		Shallow; Downgradient of Landfill Biobarrier #3	
Parameter	Units	Result	Val Qual	Result	Val Qual	Result	Val Qual	Result	Val Qual
Dissolved oxygen (field reading)	mg/L	0.21		0.04		0.03		0.86	
ORP (field reading)	mV	124		53		85		50	
pH (field reading)	pH units	6.17		6.69		6.26		6.64	
Bromide (SW9056)	mg/L	4.53		4.86		3.99		3.33	
Total organic carbon (SM5310)	mg/L	1.99		2.56		4.08		4.08	

Notes:

Amendments were injected at Landfill Biobarrier #3 on October 19, 2019.

SM5310 Method 5310, *Standard Methods For the Examination of Water and Wastewater. 2017.*

SW9056 Test Method 9056A, SW-846. 2007.

J Estimated. The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

U Undetected. The analyte was analyzed for, but not detected.

ID identification

ISB in situ bioremediation

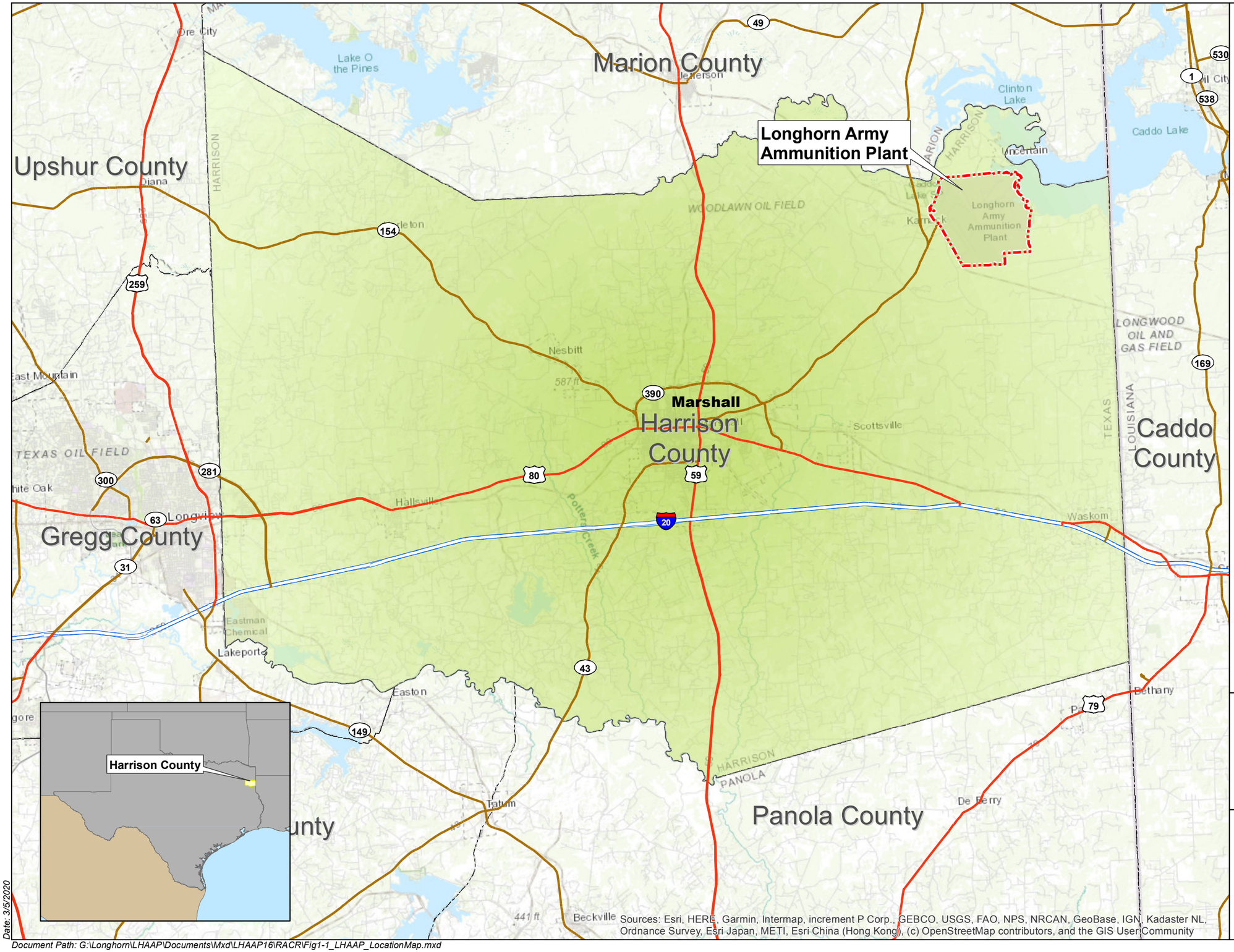
mg/L milligrams per liter

mV millivolts

ORP oxidation-reduction potential

Val Qual validation qualifier

Figures



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Figure 1-1

LHAAP Location Map
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/5/2020

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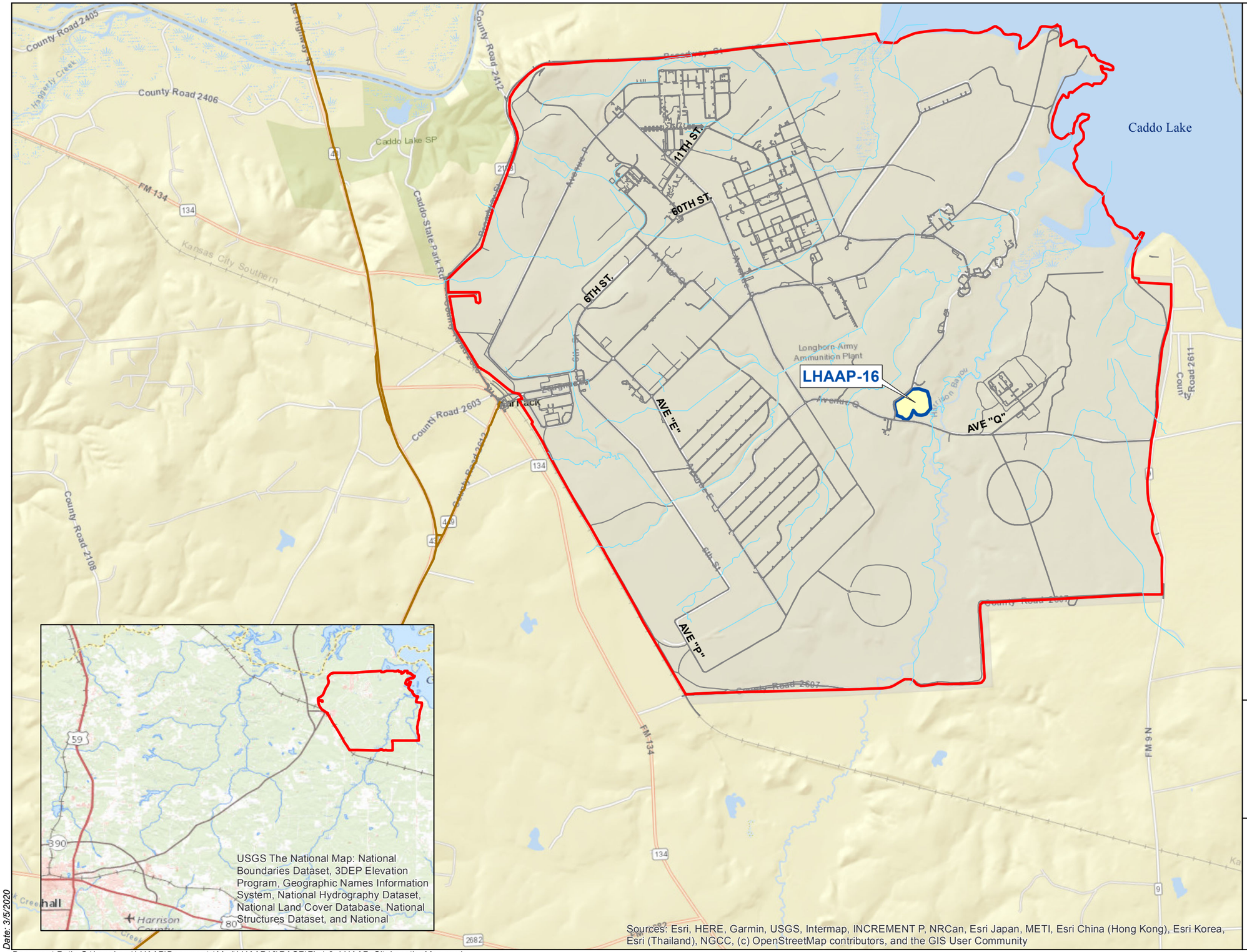

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TULSA, OKLAHOMA

bhate APTIM

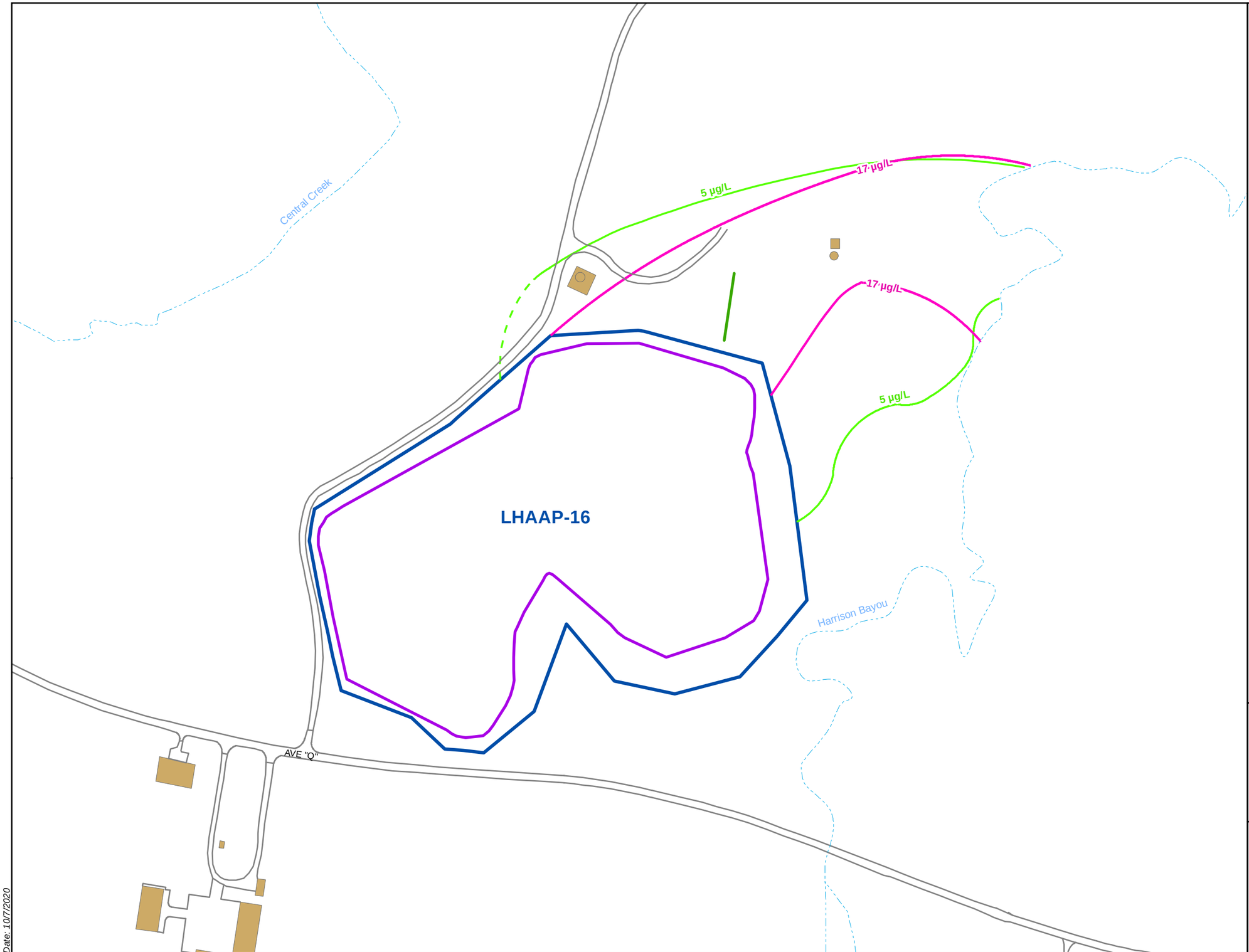
Figure 1-2

LHAAP Site Location Map
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/5/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig1-2_LHAAP_SiteLocationMap.mxd



Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)

Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)

Location of Semi-Passive Biobarrier Demonstration (February 2004 through June 2006 [Geosyntec 2009])

Stream

Road

Approximate Limits of Od Landfill

LHAAP-16 Landfill Fence

Building or Tank

Notes:
1. µg/L - micrograms per liter
2. TCE - trichloroethene

N

0 110 220 Feet

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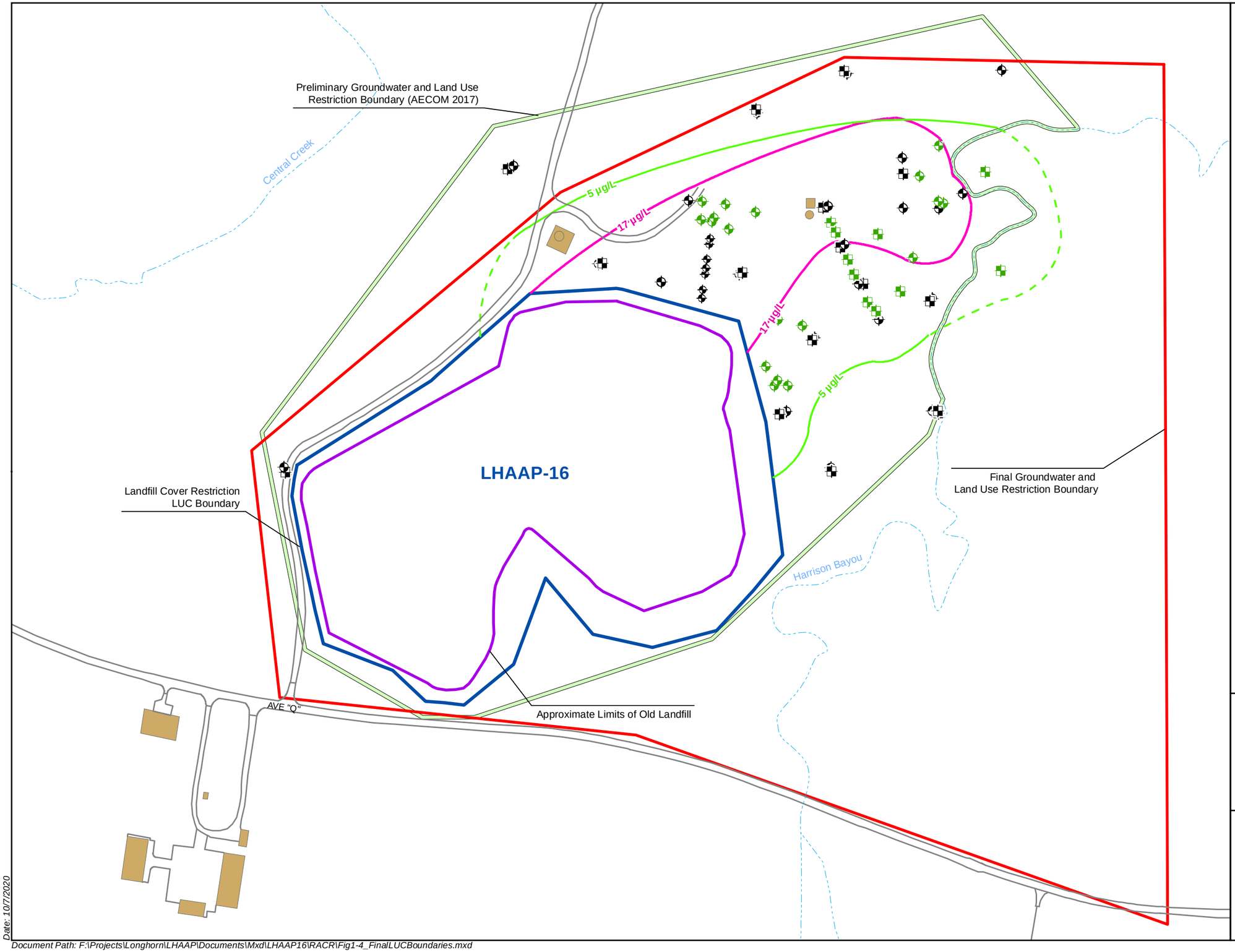
Figure 1-3

LHAAP-16 Site Plan
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig1-3_SitePlan.mxd



Shallow Well Installed 2018 or 2019

Intermediate Well Installed 2018 or 2019

Existing Shallow Monitoring Well

Existing Intermediate Monitoring Well

Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (September 2019)

Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (September 2019)

Stream

Road

Final Groundwater and Land Use Restriction Boundary

Landfill Cover Restriction LUC Boundary

Approximate Limits of Old Landfill

Preliminary Groundwater and Land Use Restriction Boundary (AECOM 2017)

Building or Tank

Notes:
1. µg/L - micrograms per liter
2. LUC - land use control
3. TCE - trichloroethene
4. The eastern side of the Final Groundwater and Land Use Restriction Boundary is shared with the western edge of a similar land use restriction that will cover LHAAP-17 and LHAAP-18/24 located to the east of LHAAP-16.

N

0 110 220 Feet

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Figure 1-4

Final LUC Boundaries
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig1-4_FinalLUCBoundaries.mxd

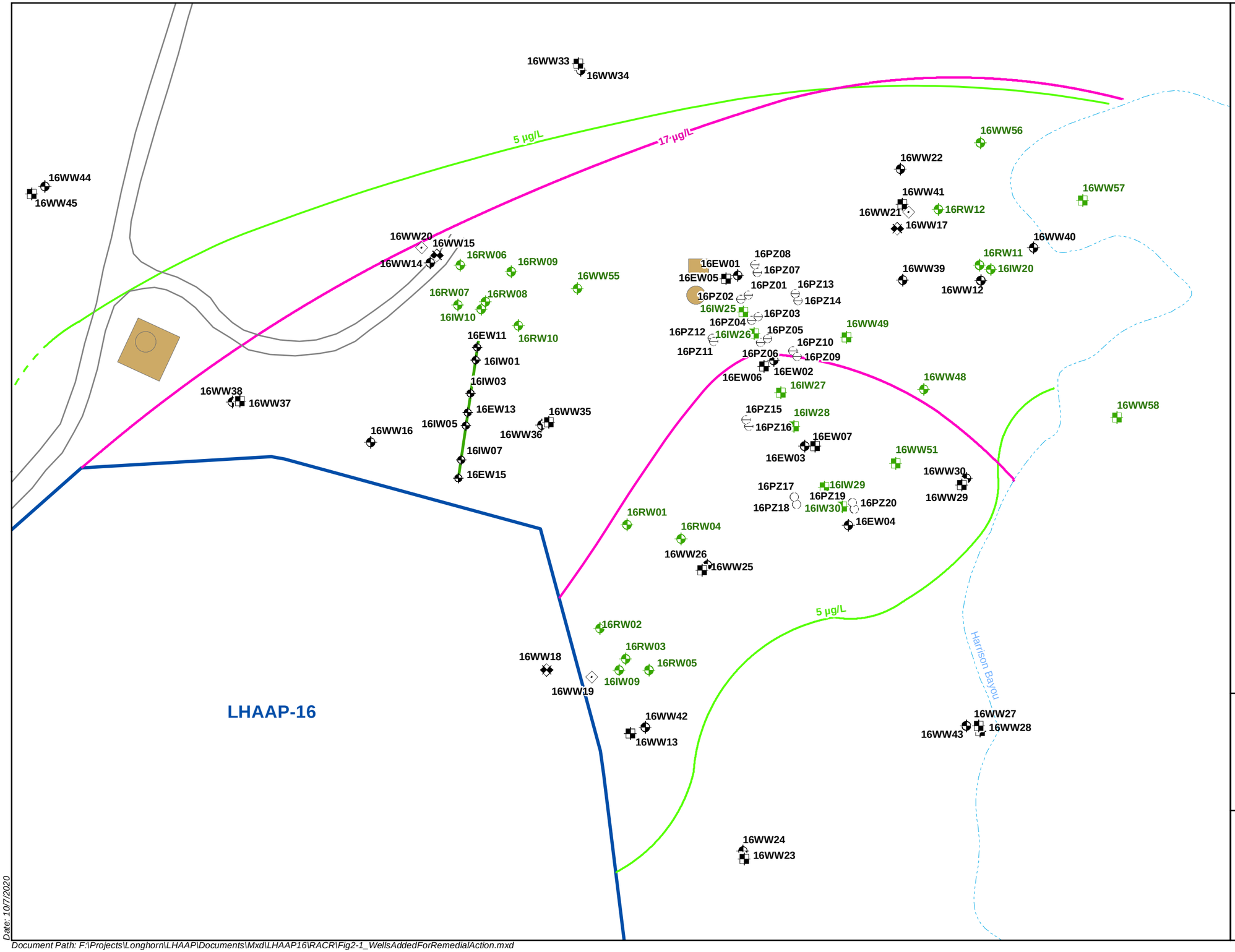

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Figure 2-1

Wells Added for Remedial Action
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig2-1_WellsAddedForRemedialAction.mxd

16WW44
0.5 U
NS

16WW32
0.5 U
NS

16WW46
3
NS

16WW34
0.5 U
NS

16WW56
NS
27

16WW22
150
34

5 µg/L

16WW14
42
25

16WW55
5900
3200

16WW39
3900
1200

16WW12
4100
2100

16WW40
660
740

16EW02
24000
42000

16WW48
8800
3700

16WW38
4400
NS

16WW36
22000
15000

16WW16
21000
13000

16WW30
1.8
360

16WW26
2400
380

LHAAP-16

5 µg/L

Harrison Bayou

16WW42
6
29

16WW43
0.5 U
0.5 U

16WW24
0.5 U
0.5 U

- Shallow Monitoring Well
- Groundwater Flow Direction (October 2018)
- Extent of Trichloroethene Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)
- Stream
- Road
- LHAAP-16 Landfill Fence
- Building or Tank

Notes:
1. All results are in µg/L.
2. For each location, the black result is from October 2018 and the red result is from September 2019. Results that exceed the MCL are highlighted.
3. The MCL for Trichloroethene is 5 µg/L.
4. Abbreviations/acronyms:
   µg/L - micrograms per liter
   ID - identification
   MCL - maximum contaminant limit.
   NS - not sampled
   U - Undetected. The analyte was analyzed for, but not detected above the associated detection limit.

N

0 50 100 Feet

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

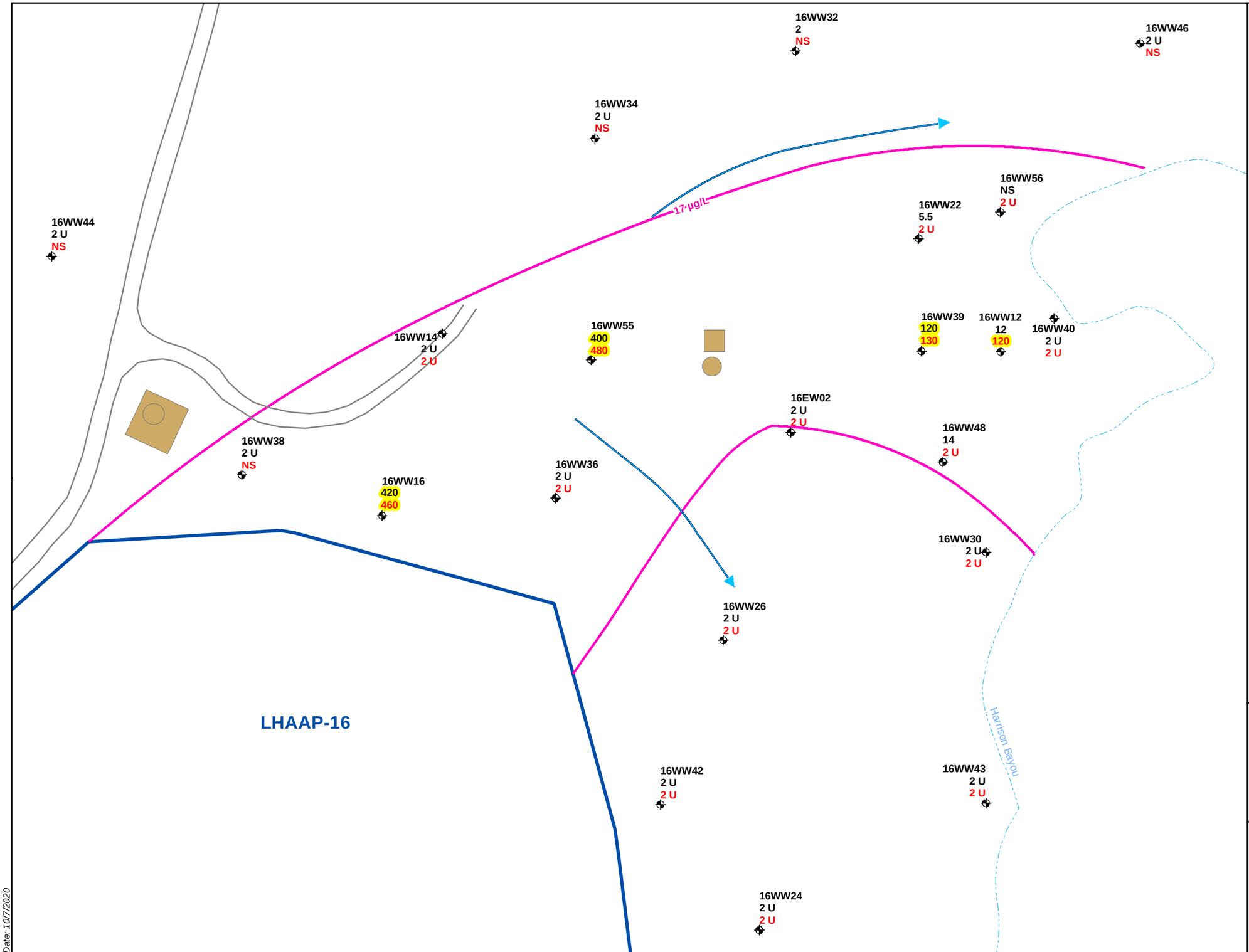
bhate APTIM

Figure 3-1
Trichloroethene Baseline Concentrations
Shallow Groundwater
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig3-1_TCEBaselineShallow.mxd



Shallow Monitoring Well

Groundwater Flow Direction (October 2018)

Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)

Stream

Road

LHAAP-16 Landfill Fence

Building or Tank

Notes:
1. All results are in µg/L.
2. For each location, the black result is from October 2018 and the red result is from September 2019. Results that exceed the PCL are highlighted.
3. The PCL for Perchlorate is 17 µg/L.
4. Abbreviations/acronyms:
   µg/L - micrograms per liter
   ID - identification
   NS - not sampled
   PCL - protected concentration level.
   U - Undetected. The analyte was analyzed for, but not detected above the associated detection limit.

N

0 50 100 Feet

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

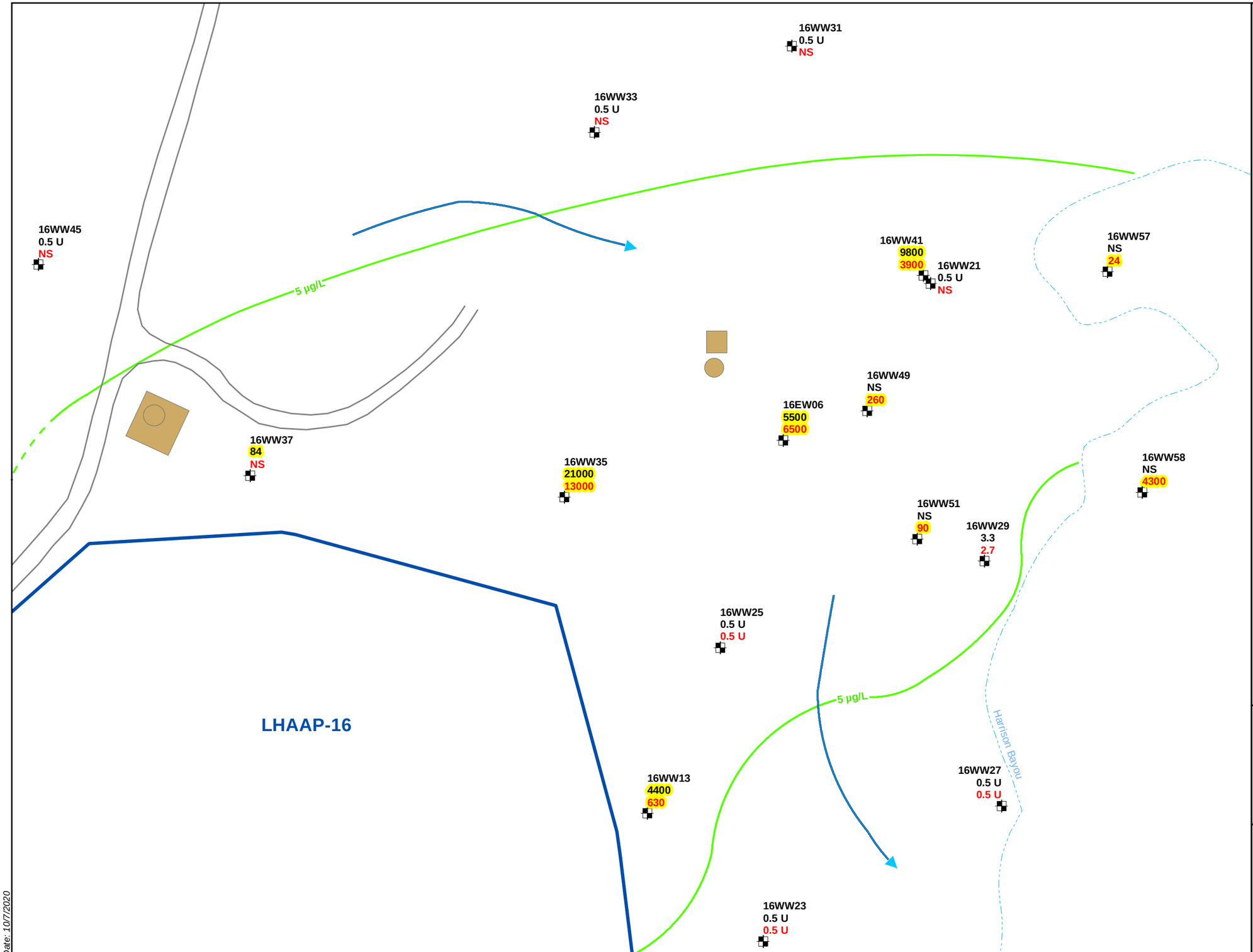
Figure 3-2

Perchlorate Baseline Concentrations
Shallow Groundwater
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig3-2_PerchBaselineShallow.mxd



Shallow Monitoring Well

Groundwater Flow Direction (October 2018)

Extent of Trichloroethene Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)

Stream

Road

LHAAP-16 Landfill Fence

Building or Tank

Notes:
1. All results are in µg/L.
2. For each location, the black result is from October 2018 and the red result is from September 2019. Results that exceed the MCL are highlighted.
3. The MCL for Trichloroethene is 5 µg/L.
4. Abbreviations/acronyms:
   µg/L - micrograms per liter
   ID - identification
   MCL - maximum contaminant limit.
   NS - not sampled
   U - Undetected. The analyte was analyzed for, but not detected above the associated detection limit.

N

0 50 100 Feet

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

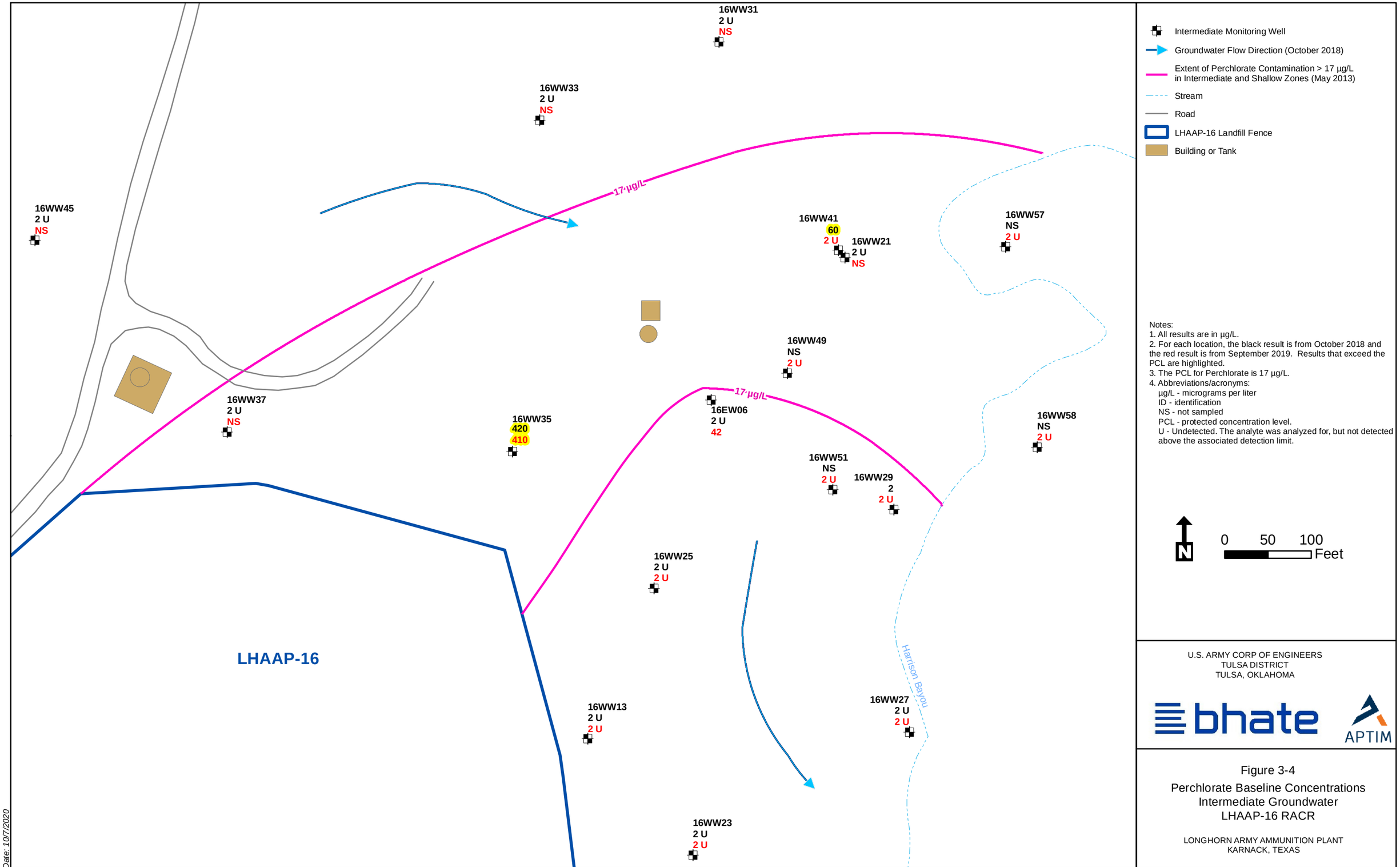
bhate APTIM

Figure 3-3
Trichloroethene Baseline Concentrations
Intermediate Groundwater
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig3-3_TCEBaselineIntermediate.mxd



Notes:
1. All results are in µg/L.
2. For each location, the black result is from October 2018 and the red result is from September 2019. Results that exceed the PCL are highlighted.
3. The PCL for Perchlorate is 17 µg/L.
4. Abbreviations/acronyms:
   µg/L - micrograms per liter
   ID - identification
   NS - not sampled
   PCL - protected concentration level.
   U - Undetected. The analyte was analyzed for, but not detected above the associated detection limit.

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

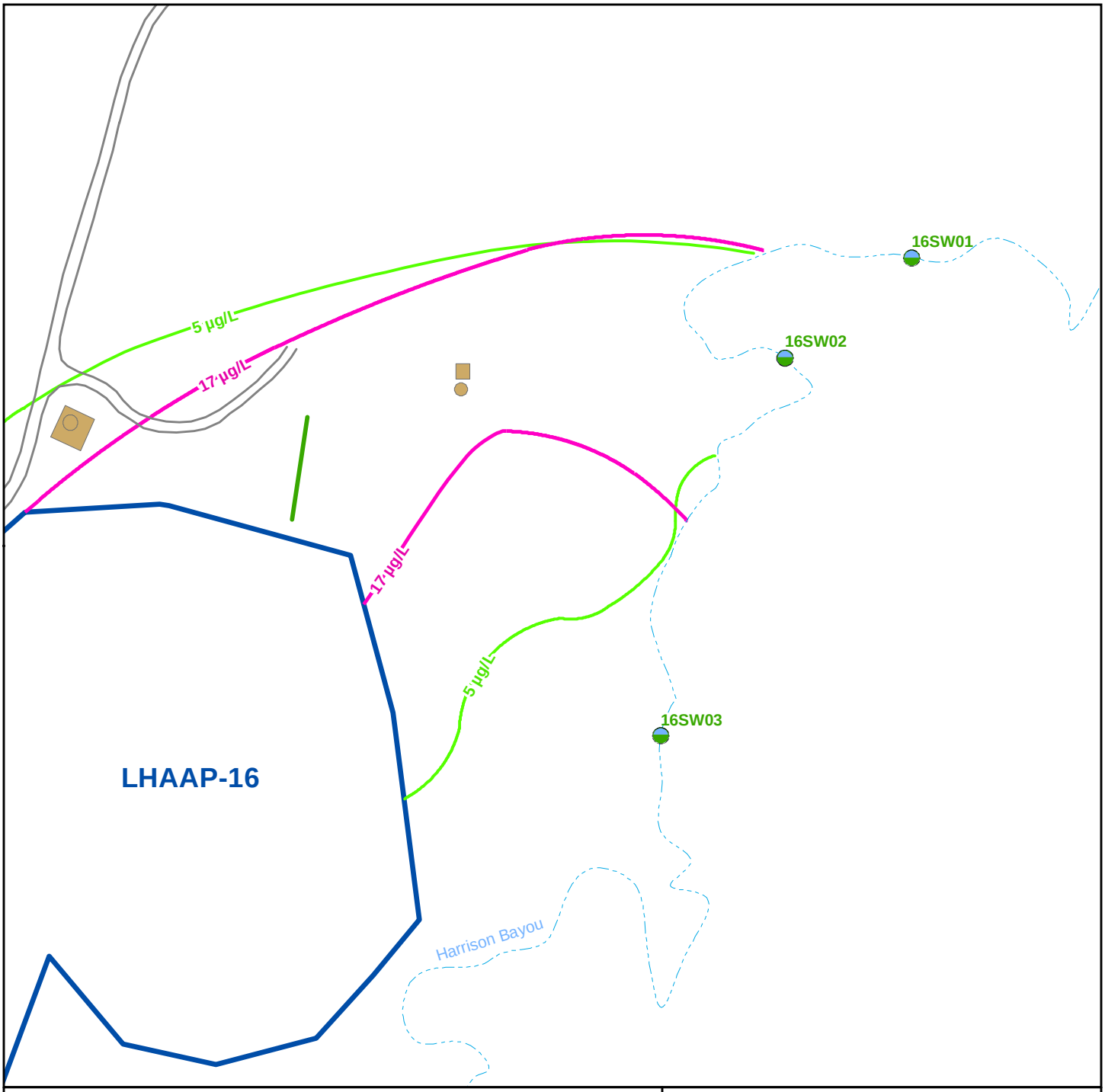
bhate APTIM

Figure 3-4
Perchlorate Baseline Concentrations
Intermediate Groundwater
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig3-4_PerchBaselineIntermediate.mxd



Surface Water Sample Location

Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (May 2013)

Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (May 2013)

Location of Semi-Passive Biobarrier Demonstration (February 2004 through June 2006 [Geosyntec 2009])

Stream

Road

LHAAP-16 Landfill Fence

Building or Tank

Notes:
1. µg/L - micrograms per liter
2. TCE - trichloroethene

N

0 110 220 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

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Figure 3-5

Surface Water Sampling Locations
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig3-5_SurfaceWaterSamplingLocations.mxd

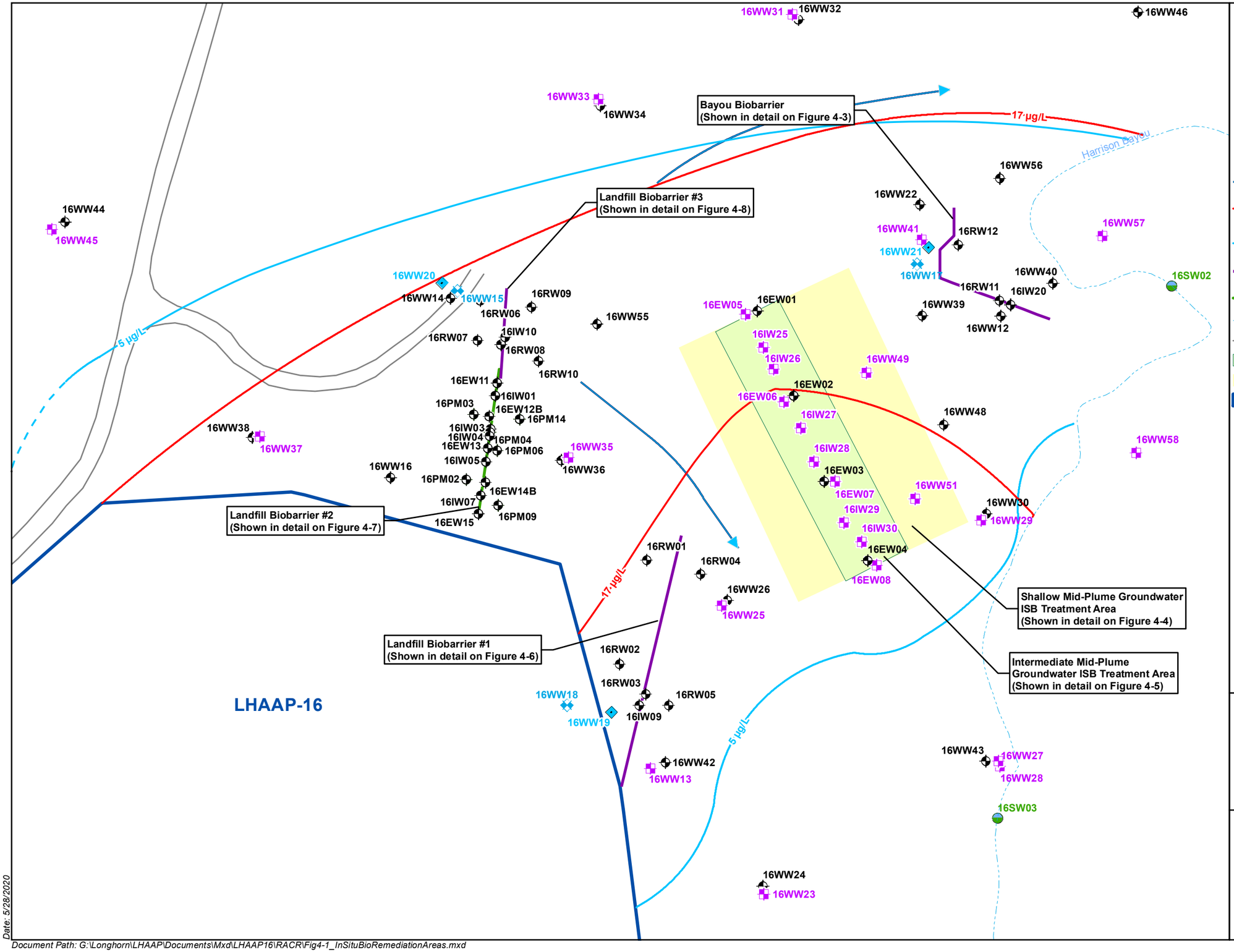

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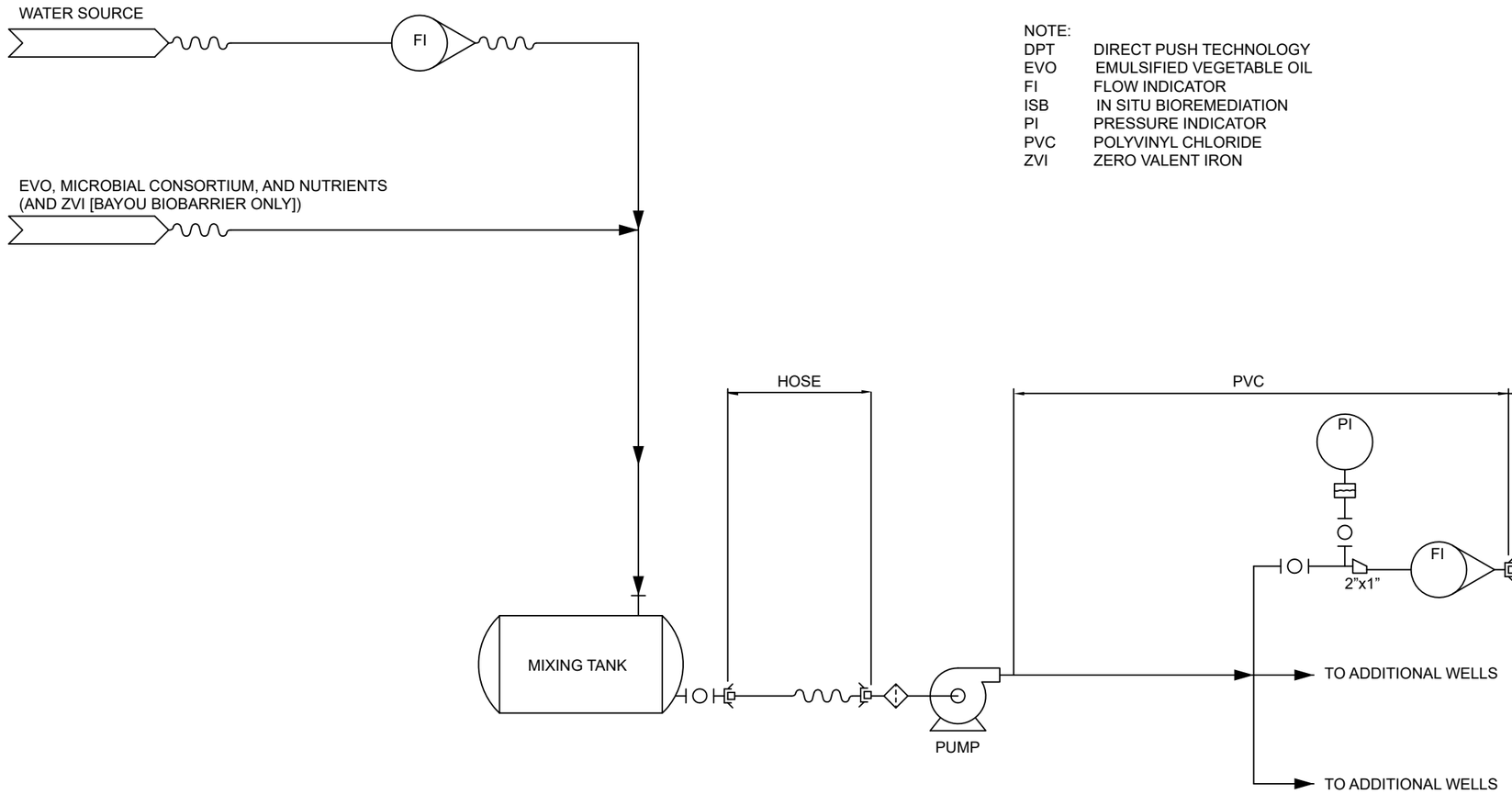
Figure 4-1

In-Situ Bioremediation
Areas at LHAAP-16
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-1_InSituBioRemediationAreas.mxd

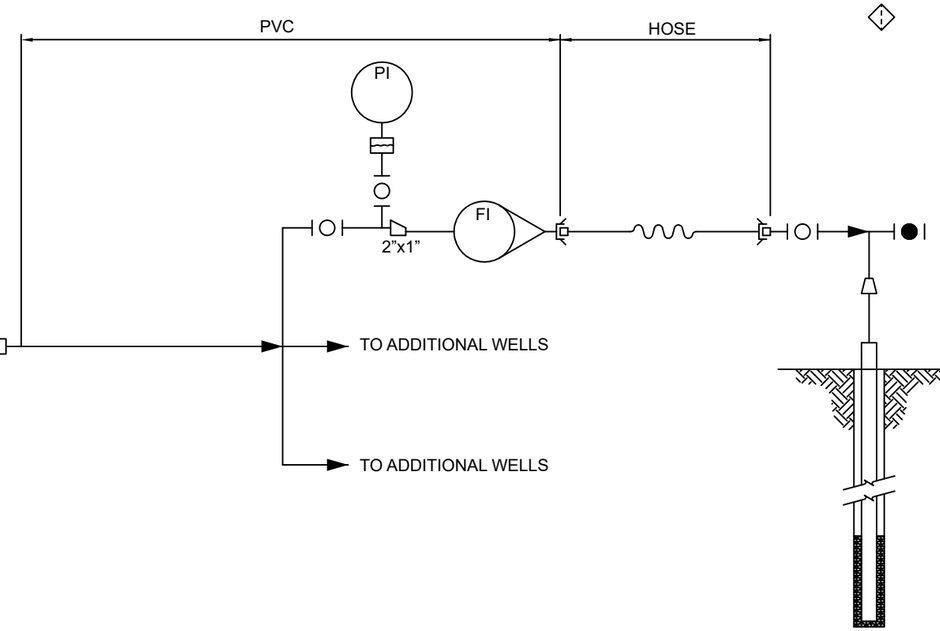


NOTE:

DPT	DIRECT PUSH TECHNOLOGY
EVO	EMULSIFIED VEGETABLE OIL
FI	FLOW INDICATOR
ISB	IN SITU BIOREMEDIATION
PI	PRESSURE INDICATOR
PVC	POLYVINYL CHLORIDE
ZVI	ZERO VALENT IRON

LEGEND:

- BALL VALVE (OPEN)
- BALL VALVE (CLOSED)
- ECCENTRIC REDUCER
- CONCENTRIC REDUCER
- CAMLOCK QUICK DISCONNECT
- BALL LOCK QUICK DISCONNECT
- SEAL
- FLEXHOSE
- INLINE FILTER



INJECTION WELL OR DPT POINT

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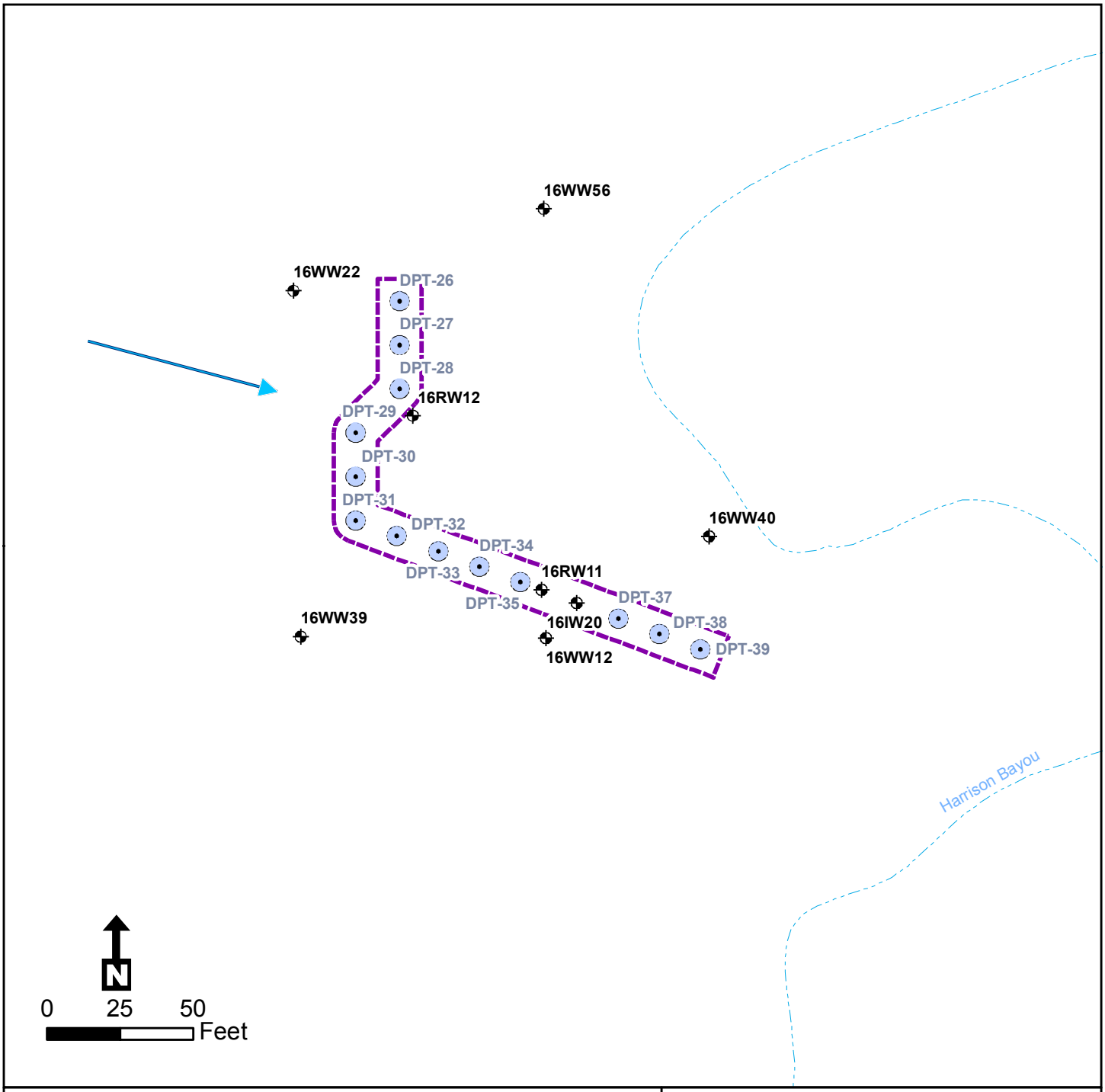
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

FIGURE 4-2

ISB Injection System
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS



Shallow Well

Direct Push Injection Point

Groundwater Flow Direction (October 2018)

Target In Situ Reaction Zone Based on Design Radius of Influence

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TULSA DISTRICT
TULSA, OKLAHOMA

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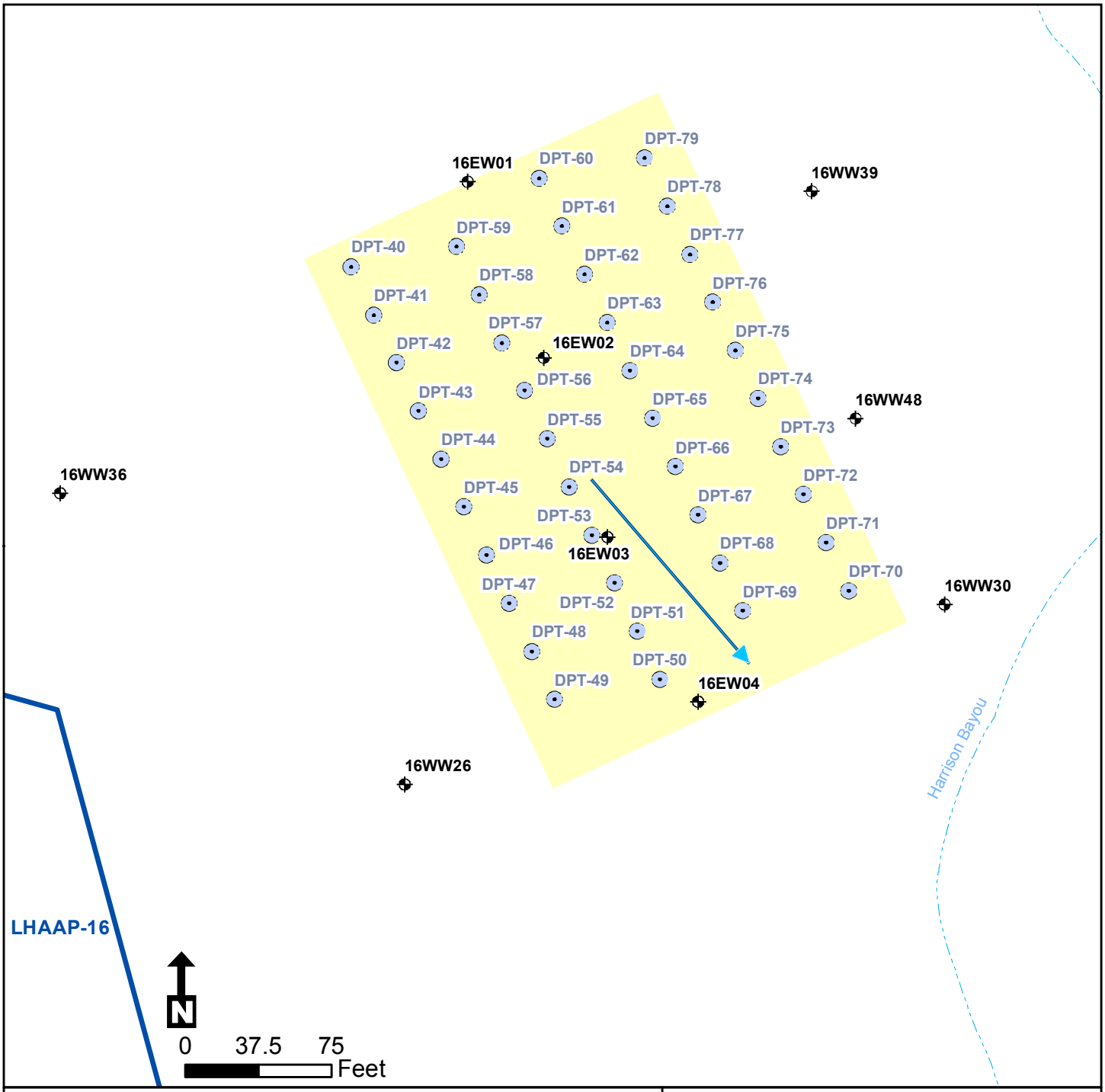
Figure 4-3

Bayou Biobarrier
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-3_Landfill_Biobarrier_Bayou.mxd



Shallow Zone Extraction or Monitoring Well

Direct Push Injection Point

Groundwater Flow Direction (October 2018)

Stream

Shallow In Situ Bioremediation Area

LHAAP-16 Landfill Fence

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

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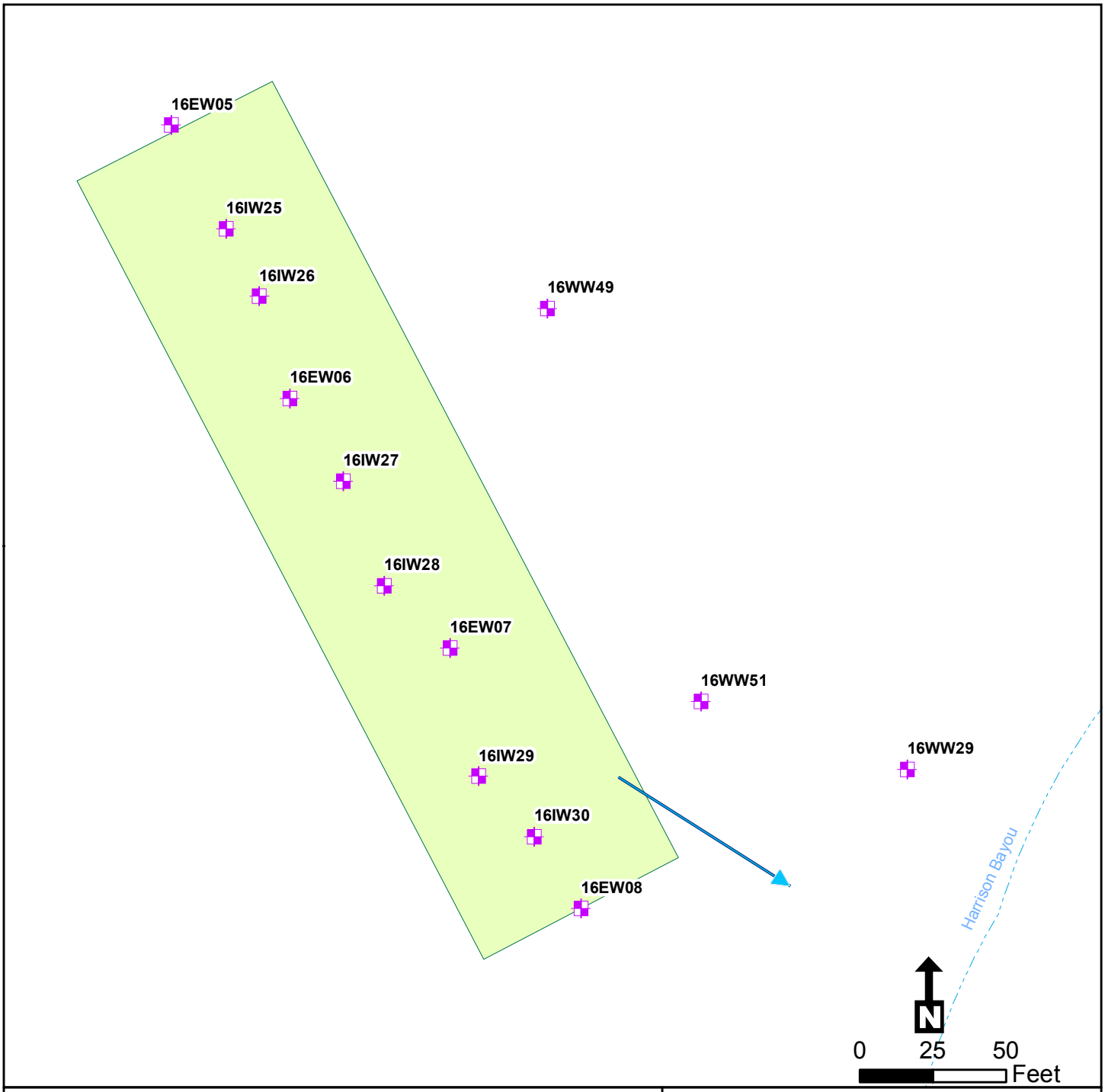
Figure 4-4

Mid-Plume Shallow Groundwater Zone
Biogrid
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-4_Biobarrier_MidPlume_Shallow.mxd



Intermediate Zone Injection, Extraction, or Monitoring Well

Groundwater Flow Direction (October 2018)

Stream

Intermediate Groundwater Zone In Situ Bioremediation Area

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

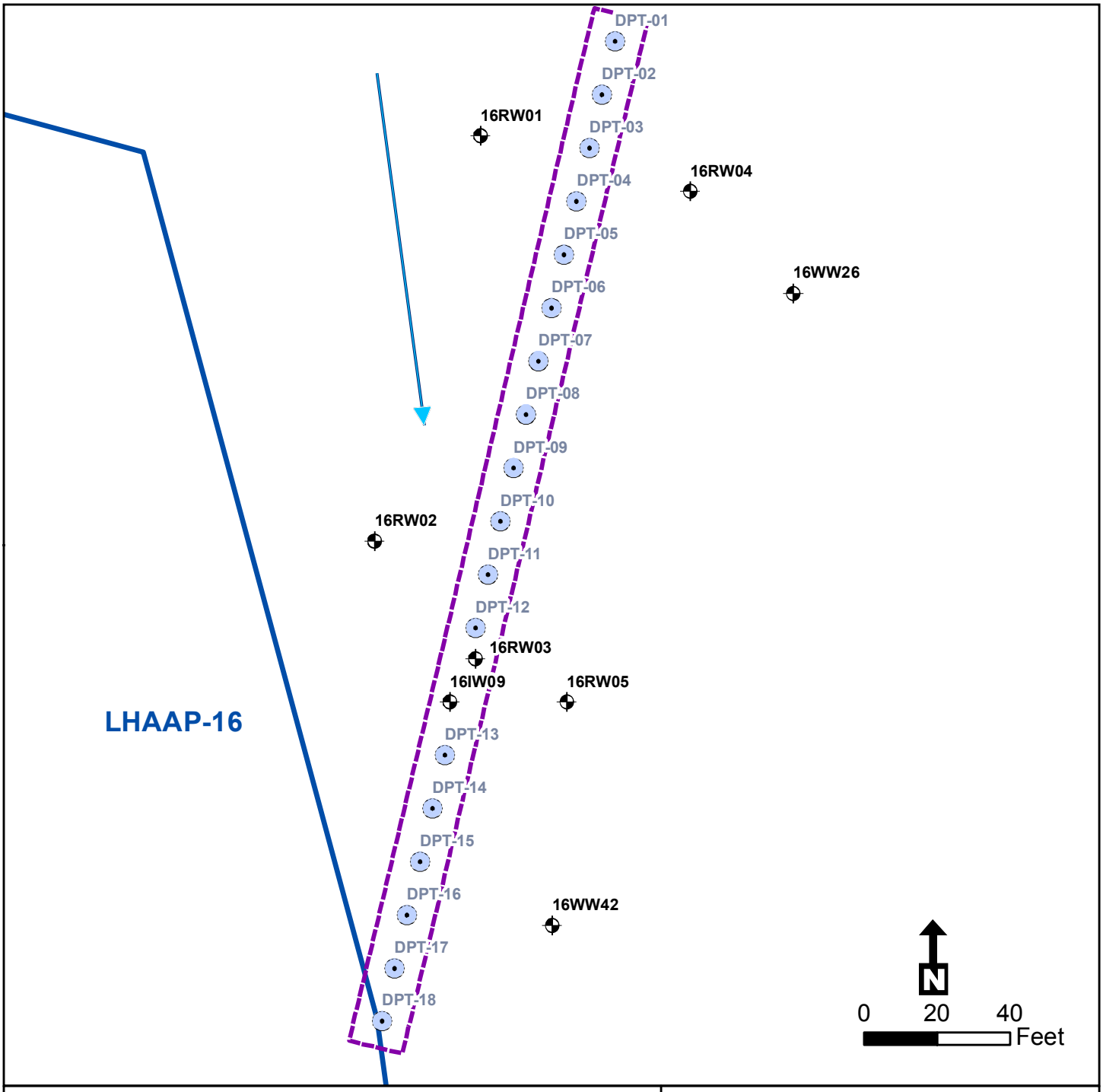
Figure 4-5

Mid-Plume Intermediate Groundwater Zone
Biobarrier
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-5_Biobarrier_Intermediate.mxd



Shallow Well Location

Direct Push Injection Point

Groundwater Flow Direction (October 2018)

Target In Situ Reaction Zone

LHAAP-16 Landfill Fence

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

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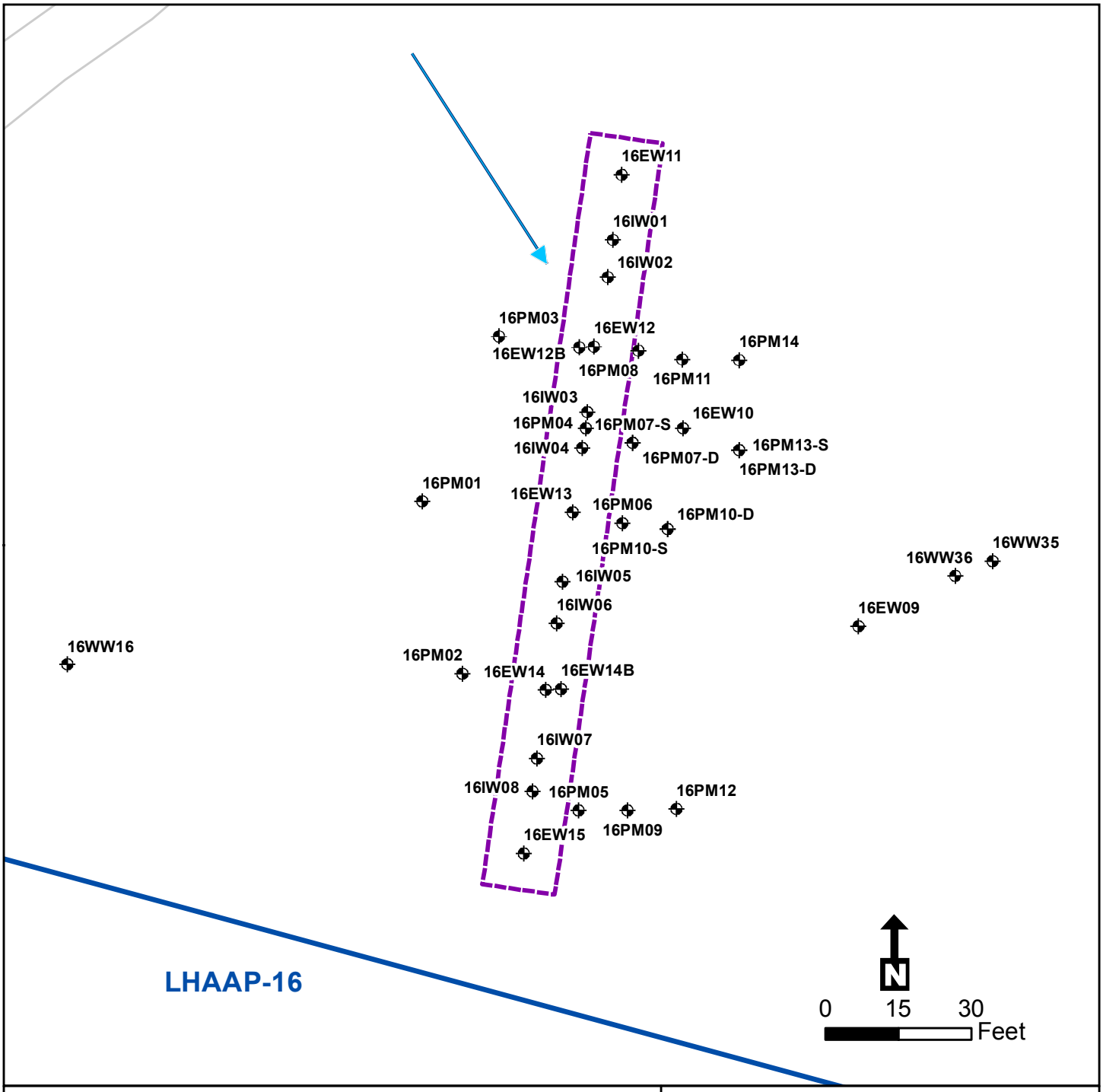
Figure 4-6

Landfill Biobarrier #1
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-6_Landfill_Biobarrier_1.mxd



Shallow Extraction, Injection, or Monitoring Well

Groundwater Flow Direction (October 2018)

Target In Situ Reaction Zone

LHAAP-16 Landfill Fence

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

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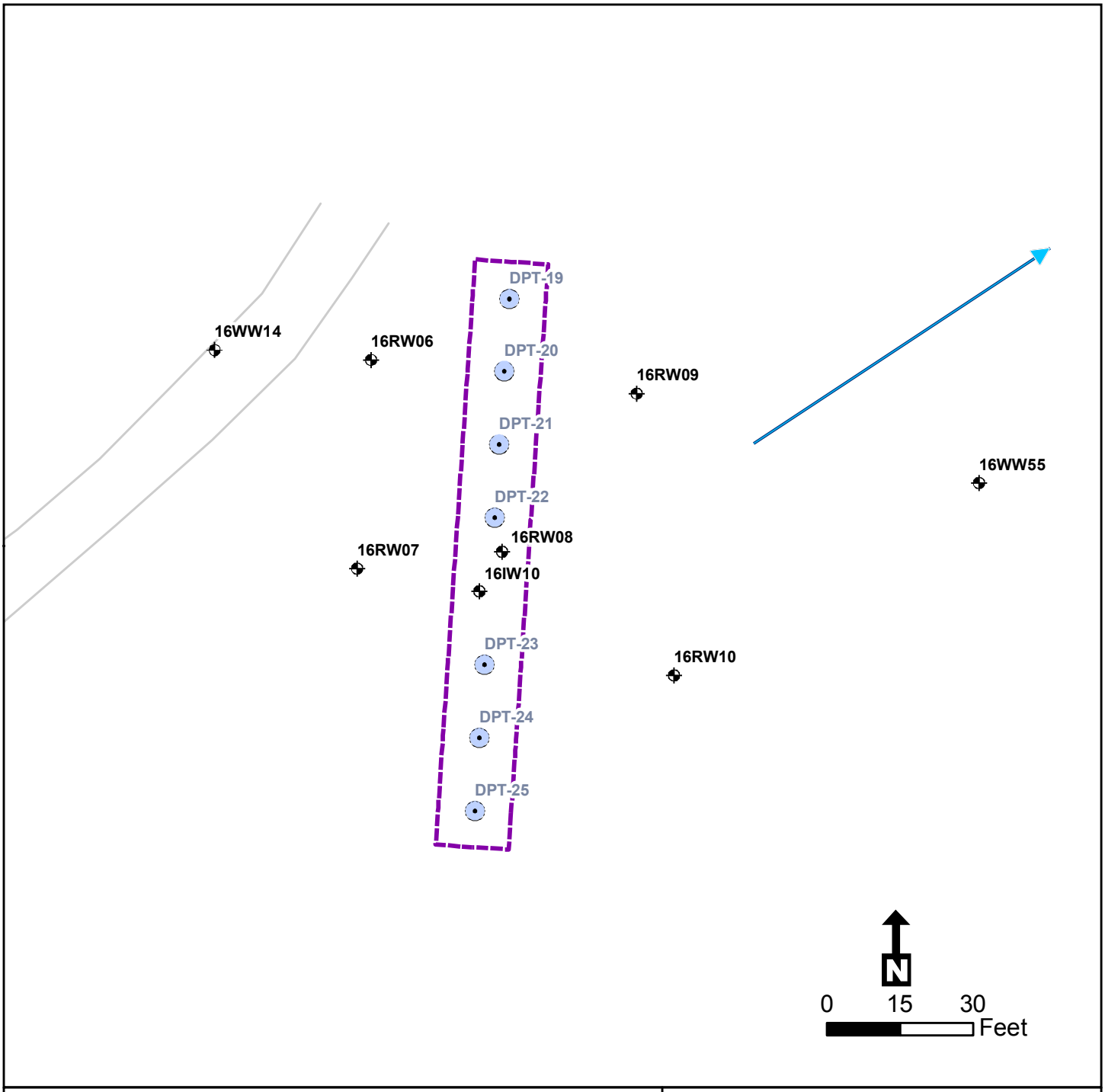
Figure 4-7

Landfill Biobarrier #2
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-7_Landfill_Biobarrier_2.mxd



Shallow Zone Injection, Monitoring, or Recovery Well

Direct Push Injection Point

Groundwater Flow Direction (October 2018)

Target In Situ Reaction Zone

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

Figure 4-8

Landfill Biobarrier #3
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig4-8_Landfill_Biobarrier_3.mxd

Appendix A

Notice of LUCs and Final LUC Boundary

2021-000003204

*** DO NOT REMOVE THIS PAGE – IT IS A PART OF THIS INSTRUMENT***

NOTICE

9 Pages

FILED AND RECORDED-OPR	CLERKS NOTES
On: 03/22/2021 03:29 PM Document Number: 2021-000003204 Receipt No: 2103298 Amount: $ 54.00 By: Emily Najera, Deputy Elizabeth James, County Clerk Harrison County, Texas	

STATE OF TEXAS

COUNTY OF HARRISON

I hereby certify that this instrument was filed on the date and time stamped hereon by me and was duly recorded in the Official Public Records of Harrison County, Texas.

Elizabeth James

Elizabeth James, Harrison County Clerk

Record and Return To:

WILLIAM FOSS
2500 CITY WEST BLVD., SUITE 1700

HOUSTON, TX 77042

STATE OF TEXAS

HARRISON COUNTY

INDUSTRIAL SOLID WASTE
NOTICE OF LAND USE CONTROLS AT LHAAP-16

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 a capped landfill, located in the south-central portion of the Former Longhorn Army Ammunition Plant (LHAAP) and is designated as LHAAP-16. LHAAP was placed on the National Priorities List (NPL) in August 1990. After its listing on the NPL, the U.S. Army, United States Environmental Protection Agency (USEPA) and the 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-16 were performed in accordance with the FFA requirements.

The LHAAP-16 landfill was established in the 1940s and was used for disposal of solid and industrial wastes until the 1980s when disposal activities were terminated. A multilayer cap was completed in 1998 as an early interim remedial action to mitigate potential risks posed by buried source material at the site. The U.S. Department of the Army issued the Final ROD for LHAAP-16, for the final remedy which includes in situ enhanced bioremediation and monitored natural attenuation for groundwater, maintenance and repair of the landfill cap, and land use controls. The ROD was cosigned by USEPA on September 13, 2016. The TCEQ issued a letter concurring with the ROD on September 6, 2016. The LUCs at LHAAP-16 will ensure protection of human health by preserving the integrity of the cap end restricting intrusive activities; restricting groundwater use to environmental monitoring and testing only, restricting use to non-residential, and maintaining groundwater monitoring and remediation systems until levels of contaminants of concern (COCs) allow for unlimited use and unrestricted exposure.

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 (Room 103. first floor) 12100 Park 35 Circle, Austin, Texas 78753, (512) 239-2900, Monday through Friday 8:00 am to 5:00 pm, or the Administrative Record available at the Marshall Public Library, 300 South Alamo Boulevard, Marshall, Texas 75670, (930) 935-4465, Monday through Friday 9:30AM – 5:30PM.

The TCEQ requires certain persons to provide recordation in the real property records to notify the public on 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

LHAAP-16 covers an area of approximately 13.6 acres, 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**. The LUC boundaries for the landfill cover restriction and the groundwater and land use restrictions encompass 17.811 acres and 70.339 acres, more or less, respectively, as described in **Exhibit A**. The LUC boundaries are 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 the purposes of this certification, residential land use includes, but is not limited to, single family to multi-family residences; child care facilities; nursing home or assisted living facilities; and any type of education purpose for children/young adults in grades kindergarten through 12. The U.S. Department of the Army has undertaken careful environmental study of the LHAAP-16 site and concluded that the LUCs set forth below are required to ensure protection of human health and the environment:

- Landfill Cover Restriction. The landfill restriction boundary consists of the 17.811-acre tract. Intrusive activities (e.g., digging) are restricted as long as landfill waste remains or until the levels of COCs allow for unlimited use and unrestricted exposure.
- Groundwater Use Restriction. The groundwater use restriction boundary consists of the 70.339-acre tract, more or less, and extends beyond the landfill and LHAAP-16 site boundary. The groundwater underlying this land is contaminated with volatile organic compounds (VOCs) (trichloroethene [TCE], cis-1,2-dichloroethene [DCE], and vinyl chloride [VC]), perchlorate, and five metals (arsenic, chromium, manganese, nickel, and thallium). A prohibition of groundwater use (except for environmental monitoring and testing) as a potable source is in place until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.
- Non-Residential Use Restriction. The non-residential use restriction boundary is coincident with the boundary for Groundwater Use Restriction and consists of the 70.339-acre tract, more or less. The site is restricted to nonresidential use until it is demonstrated that surface and subsurface soil and groundwater COCs are at levels that allow for unlimited use and unrestricted exposure.

- Maintain Integrity of Monitoring Systems. The integrity of any current or future remedial or monitoring systems will remain in place until the cleanup levels of COCs in groundwater are met.

III

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

ATTN: DAIN-ISE-LO (H. Procter)
Program Manager/Analyst
Office of the Deputy Chief of Staff, (DAIN-ISE)
Environmental Division, BRAC Field Branch
600 Army Pentagon
Washington, D.C. 22310-0600

Or

Mr. Thomas A. Lineer
Chief
Office of the Deputy Chief of Staff, (DAIN-ISE)
Environmental Division, BRAC Field Branch
600 Army Pentagon
Washington, D.C. 22310-0600

Rose M. Zeiler
Longhorn AP Site Manager

EXECUTED this the 25th day of Feb, 2021.

BEFORE ME, on this 25th day of Feb 2021, personally appeared Rose M. Zeiler, of the 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.

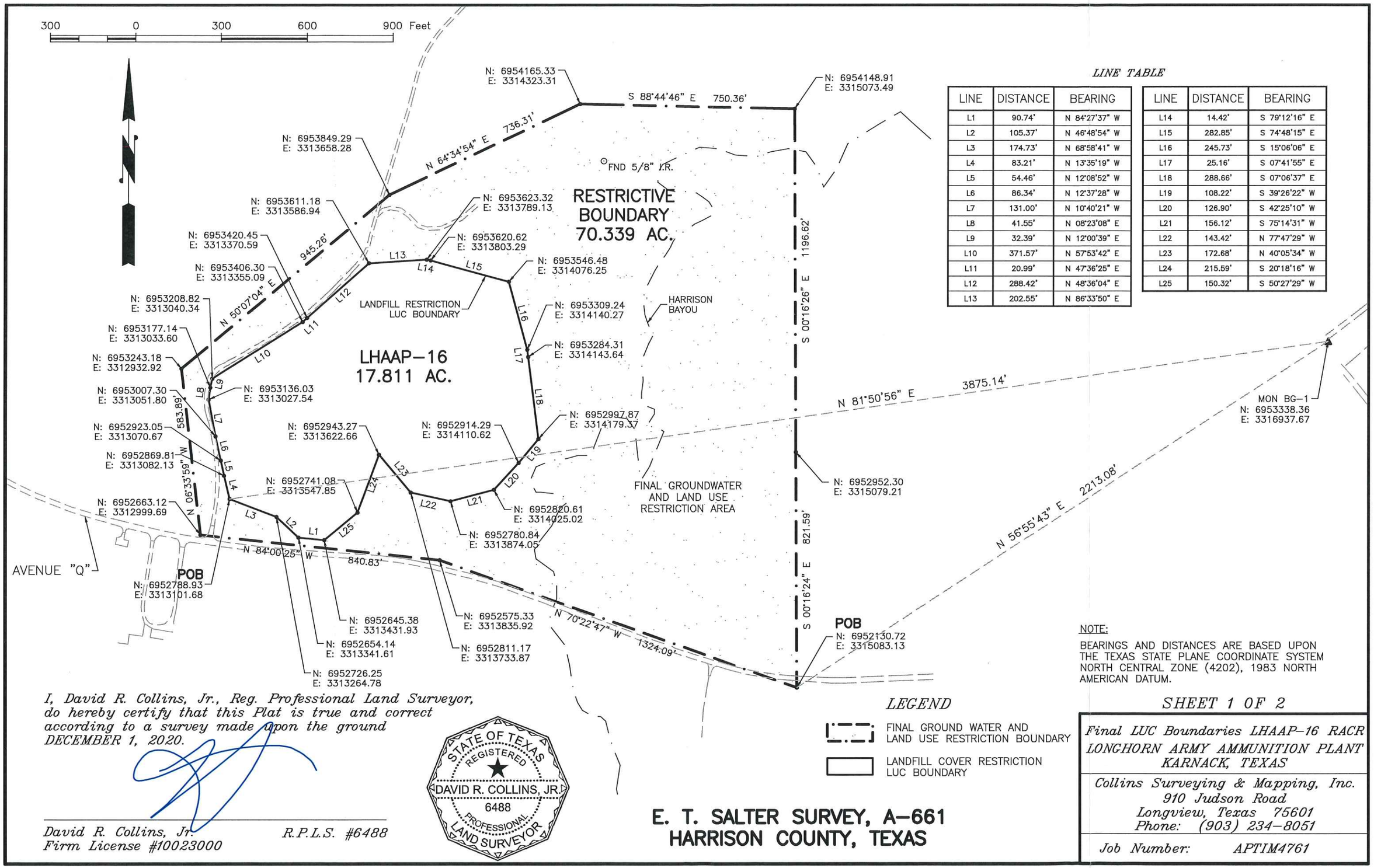
GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the 25th day of February, 2021.

KAREN DAVIS
MY COMMISSION # 12382216
EXPIRES: May 20, 2021
Logan County

Notary Public in and for the State of Arkansas
County of Logan

Exhibit A

Survey and Legal Plat



LINE TABLE

LINE	DISTANCE	BEARING
L1	90.74'	N 84°27'37" W
L2	105.37'	N 46°48'54" W
L3	174.73'	N 68°58'41" W
L4	83.21'	N 13°35'19" W
L5	54.46'	N 12°08'52" W
L6	86.34'	N 12°37'28" W
L7	131.00'	N 10°40'21" W
L8	41.55'	N 08°23'08" E
L9	32.39'	N 12°00'39" E
L10	371.57'	N 57°53'42" E
L11	20.99'	N 47°36'25" E
L12	288.42'	N 48°36'04" E
L13	202.55'	N 86°33'50" E

LINE	DISTANCE	BEARING
L14	14.42'	S 79°12'16" E
L15	282.85'	S 74°48'15" E
L16	245.73'	S 15°06'06" E
L17	25.16'	S 07°41'55" E
L18	288.66'	S 07°06'37" E
L19	108.22'	S 39°26'22" W
L20	126.90'	S 42°25'10" W
L21	156.12'	S 75°14'31" W
L22	143.42'	N 77°47'29" W
L23	172.68'	N 40°05'34" W
L24	215.59'	S 20°18'16" W
L25	150.32'	S 50°27'29" W

NOTE:

BEARINGS AND DISTANCES ARE BASED UPON THE TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE (4202), 1983 NORTH AMERICAN DATUM.

LEGEND

FINAL GROUND WATER AND LAND USE RESTRICTION BOUNDARY

LANDFILL COVER RESTRICTION LUC BOUNDARY

I, David R. Collins, Jr., Reg. Professional Land Surveyor, do hereby certify that this Plat is true and correct according to a survey made upon the ground DECEMBER 1, 2020.

David R. Collins, Jr. *R.P.L.S. #6488*
Firm License #10023000

STATE OF TEXAS
REGISTERED
DAVID R. COLLINS, JR.
6488
PROFESSIONAL
LAND SURVEYOR

E. T. SALTER SURVEY, A-661
HARRISON COUNTY, TEXAS

SHEET 1 OF 2

Final LUC Boundaries LHAAP-16 RACR
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Collins Surveying & Mapping, Inc.
910 Judson Road
Longview, Texas 75601
Phone: (903) 234-8051

Job Number: APTIM4761

LEGAL DESCRIPTION
LANDFILL COVER RESTRICTION LUC BOUNDARY:

All that certain 17.811 acre tract of land contained within Longhorn Army Ammunition Plant, Harrison County, Texas, said 17.811 acre tract more particularly described as follows:

BEGINNING at a point north of Avenue "Q" and east of a gravel lease road said point with the coordinates of N: 6952788.93, E: 3313101.68, from which a corps of engineers monument BG–1 found at the east corner of the roadway intersection at the entrance of Longhorn Army Ammunition Plant Burning Grounds said monument with the coordinates of N: 6953338.36, E: 3316937.67, and bears N 81°50'56" E 3875.14 feet;

THENCE: N 12°08'52" W 83.21 feet; THENCE: N 12°08'52" W 54.46 feet; N 12°37'28" W 86.34 feet; THENCE: N 10°40'21" W 131.00 feet; THENCE: N 08°23'08" E 41.55 feet; THENCE: N 12°00'39" E 32.39 feet; THENCE: N 57°53'42" E 371.57 feet; THENCE: N 47°36'25" E 20.99 feet; THENCE: N 48°36'04" E 288.42 feet; THENCE: N 86°33'50" E 202.55 feet; THENCE: S 79°12'16" E 14.42 feet; THENCE: S 74°48'15" E 282.85 feet; THENCE: S 15°06'06" E 245.73 feet; THENCE: S 07°41'55" E 25.16 feet; THENCE: S 07°06'37" E 288.66 feet; THENCE: S 39°26'22" W 108.22 feet; THENCE: S 42°25'10" W 126.90 feet; THENCE: S 75°14'31" W 156.12 feet; THENCE: N 77°47'29" W 143.42 feet; THENCE: N 40°05'34" W 172.68 feet; THENCE: S 20°18'16" W 215.59 feet; THENCE: S 50°27'29" W 150.32 feet; THENCE: N 84°27'37" W 90.74 feet; THENCE: N 46°48'54" W 105.37 feet;

THENCE: N 68°58'41" W 174.73 feet to the POINT OF BEGINNING, containing 17.811 acres of land, more or less.

LEGAL DESCRIPTION
FINAL GROUND WATER AND LAND USE RESTRICTION BOUNDARY:

All that certain 70.339 acre tract of land contained within Longhorn Army Ammunition Plant, Harrison County, Texas, said 17.811 acre tract more particularly described as follows:
BEGINNING at a point south of Avenue "Q" with the coordinates of N: 6952130.72, E: 3315083.13, from which a corps of engineers monument BG–1 found at the east corner of the roadway intersection at the entrance of Longhorn Army Ammunition Plant Burning Grounds said monument with the coordinates of N: 6953338.36, E: 3316937.67, and bears N 56°55'43" E 2213.08 feet; THENCE: N 70°22'47" W generally along said Avenue "Q" 1324.09 feet to a point north of said Avenue "Q" for an angle point; THENCE: N 84°00'25" W generally along the north edge of said Avenue "Q" 840.83 feet to a point for the southwest corner of this tract; THENCE: N 06°33'59" W 583.89 feet; THENCE: N 50°07'04" E 945.26 feet; THENCE: N 64°34'54" E 736.31 feet; THENCE: S 88°44'46" E 750.36 feet to a point for the northeast corner of this tract; THENCE: S 00°16'26" E 1196.62 feet;
THENCE: S 00°16'24" E 821.59 feet to the POINT OF BEGINNING, containing 70.339 acres of land, more or less.

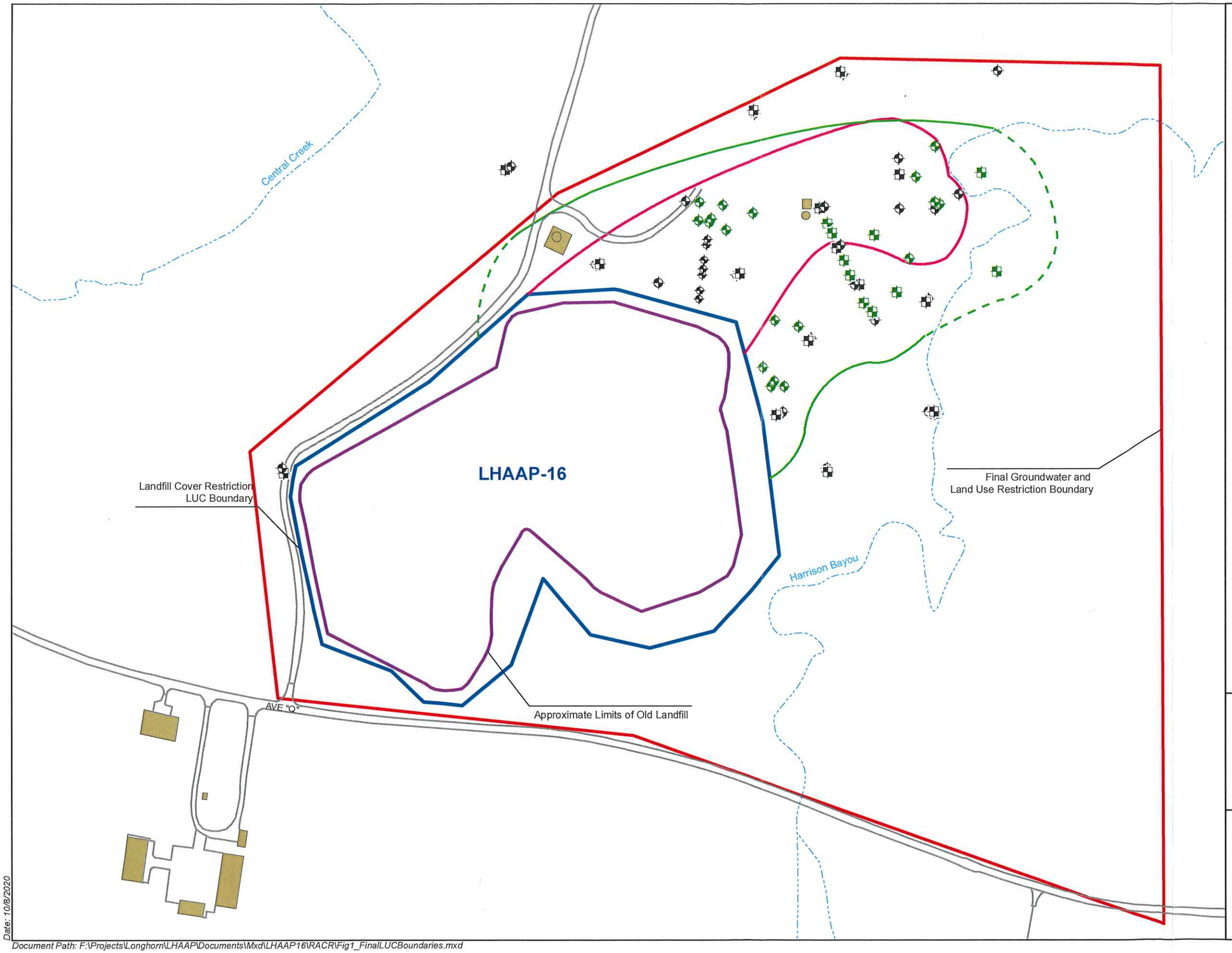
Final LUC Boundaries LHAAP–16 RACR
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Collins Surveying & Mapping, Inc.
910 Judson Road
Longview, Texas 75601
Phone: (903) 234–8051

Job Number: APTIM4761

Figure 1

Final LUC Boundaries



- Shallow Well Installed 2018 or 2019
- Intermediate Well Installed 2018 or 2019
- Existing Shallow Monitoring Well
- Existing Intermediate Monitoring Well
- Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (September 2019)
- Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (September 2019)
- Stream
- Road
- Final Groundwater and Land Use Restriction Boundary
- Landfill Cover Restriction LUC Boundary
- Approximate Limits of Old Landfill
- Building or Tank

Notes:
1. µg/L - micrograms per liter
2. LUC - land use control
3. TCE - trichloroethene
4. The eastern side of the Final Groundwater and Land Use Restriction Boundary is shared with the western edge of a similar land use restriction that will cover LHAAP-17 and LHAAP-18/24 located to the east of LHAAP-16.

N

0 110 220 Feet

U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

Figure 1

Final LUC Boundaries
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/8/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig1_FinalLUCBoundaries.mxd

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Hon. Chad L. Sims
Harrison County Judge
#1 Peter Whetstone Square, Room 314
Marshall, Texas 75670

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Judge Sims,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

The point of contact for this action is the undersigned. I may be contacted at 479-635-0110, or by email at rose.m.zeiler.civ@mail.mil

Sincerely,

Rose M. Zeiler, Ph.D.
Longhorn AAP Site Manager

Attachments:
LHAAP-04 Land Use Controls for Soil and Groundwater Contamination
LHAAP-04 Site Location Map
LHAAP-04 Final Land Use Control Boundary Map
LHAAP-16 Land Use Controls for Soil and Groundwater Contamination
LHAAP-16 Site Location Map
LHAAP-16 Final Land Use Control Boundary Map

Copies furnished:
A. Palmie, TCEQ, Austin, TX
L. Poulos, USEPA, Dallas, TX
K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Mr. Thomas Speir
Chairman, Harrison County Historical Commission
200 West Houston Street
Marshall, Texas 75670

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Mr. Speir,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Mr. William D. Hatfield
Harrison County Commissioner, Precinct 1
Waskom Sub-Courthouse
165 West Texas Avenue
Waskom, Texas 75692

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Commissioner Hatfield,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Hon. Judye Patterson
Mayor, City of Uncertain, Texas
P.O. Box 277
Uncertain, Texas 75661

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Mayor Patterson,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Mr. Eric Duerkop
Manager, Caddo Lake National Wildlife Refuge
15600 Highway 134
Karnack, Texas 75661

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Mr. Duerkop,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Mr. Terry Britt
President, Caddo Lake Water Supply Corporation
P.O. Box 136
Uncertain, Texas 75661

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Mr. Britt,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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L. Poulos, USEPA, Dallas, TX
K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Mr. Carl Shelton
President, Leigh Water Supply Corporation
342 Byrd Circle
Karnack, Texas 75661

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Mr. Shelton,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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L. Poulos, USEPA, Dallas, TX
K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Rep. Chris Paddie
Texas House of Representatives, District 9
102 West Houston Street
Marshall, Texas 75670

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Representative Paddie,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Sen. Bryan Hughes
Texas State Senate, District 1
201 West Houston Street, Suite 106
Marshall, Texas 75670

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Senator Hughes,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Texas Department of Licensing and Regulation
Water Well Drillers and Pump Installers Program
P.O. Box 12157
Austin, Texas 78711

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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Longhorn AAP Site Manager

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Rep. Louis Gohmert
United States House of Representatives
Texas 1st Congressional District
102 West Houston Street
Marshall, Texas 75670

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Representative Gohmert,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Sen. John Cornyn
United States Senate
Regions Bank Building
100 East Ferguson Street, Suite 1004
Tyler, Texas 75702

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Senator Cornyn,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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DEPARTMENT OF THE ARMY
LONGHORN ARMY AMMUNITION PLANT
POST OFFICE BOX 220
RATCLIFF, AR 72951

February 23, 2021

DAIN-ODB-LO

Sen. Ted Cruz
United States Senate
305 South Broadway, Suite 501
Tyler, Texas 75702

Re: Land Use Controls and Final Land Use Control Boundary for Soil and Groundwater Contamination at Two Environmental Sites at Former Longhorn Army Ammunition Plant, Karnack, Texas, February 2021

Dear Senator Cruz,

The final remedial actions for two sites, LHAAP 04, Former Pilot Wastewater Treatment Plant; and LHAAP-16 Landfill 16, were completed in November 2019 and December 2019, respectively. The attached information is provided to fulfill a requirement of the Remedial Action Completion Report for each site by giving notice of the land use restrictions referenced in the Record of Decision and to provide a Final Land Use Control boundary map. These notices are being sent to federal, state and local governments involved at this site and the owners and occupants of the property subject to the use restrictions and land use controls.

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L. Poulos, USEPA, Dallas, TX
K. Nemmers, Bhate, Lakewood, CO (Administrative Record)

Land Use Controls for Soil and Groundwater Contamination

LHAAP-04 Former Pilot Wastewater Treatment Plant
Longhorn Army Ammunition Plant, Karnack, Texas

The Longhorn Army Ammunition Plant (LHAAP) is an inactive government-owned, formerly contractor-operated and maintained Department of Defense facility located in central east Texas in the northeast corner of Harrison County. LHAAP is approximately 14 miles northeast of Marshall, Texas. The facility is approximately 40 miles west of Shreveport, Louisiana. The installation occupies approximately 1,100 of its former 8,416 acres between State Highway 43 at Karnack, Texas and the southwestern shore of Caddo Lake. The installation can be accessed by State Highways 43 and 134.

LHAAP was placed on the National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination began in 1990. After its listing on the NPL, the U.S. Army, the USEPA, and the Texas Water Commission (currently known as the Texas Commission of Environmental Quality [TCEQ]) entered into a CERCLA Section 120 Federal Facilities Agreement (FFA) for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

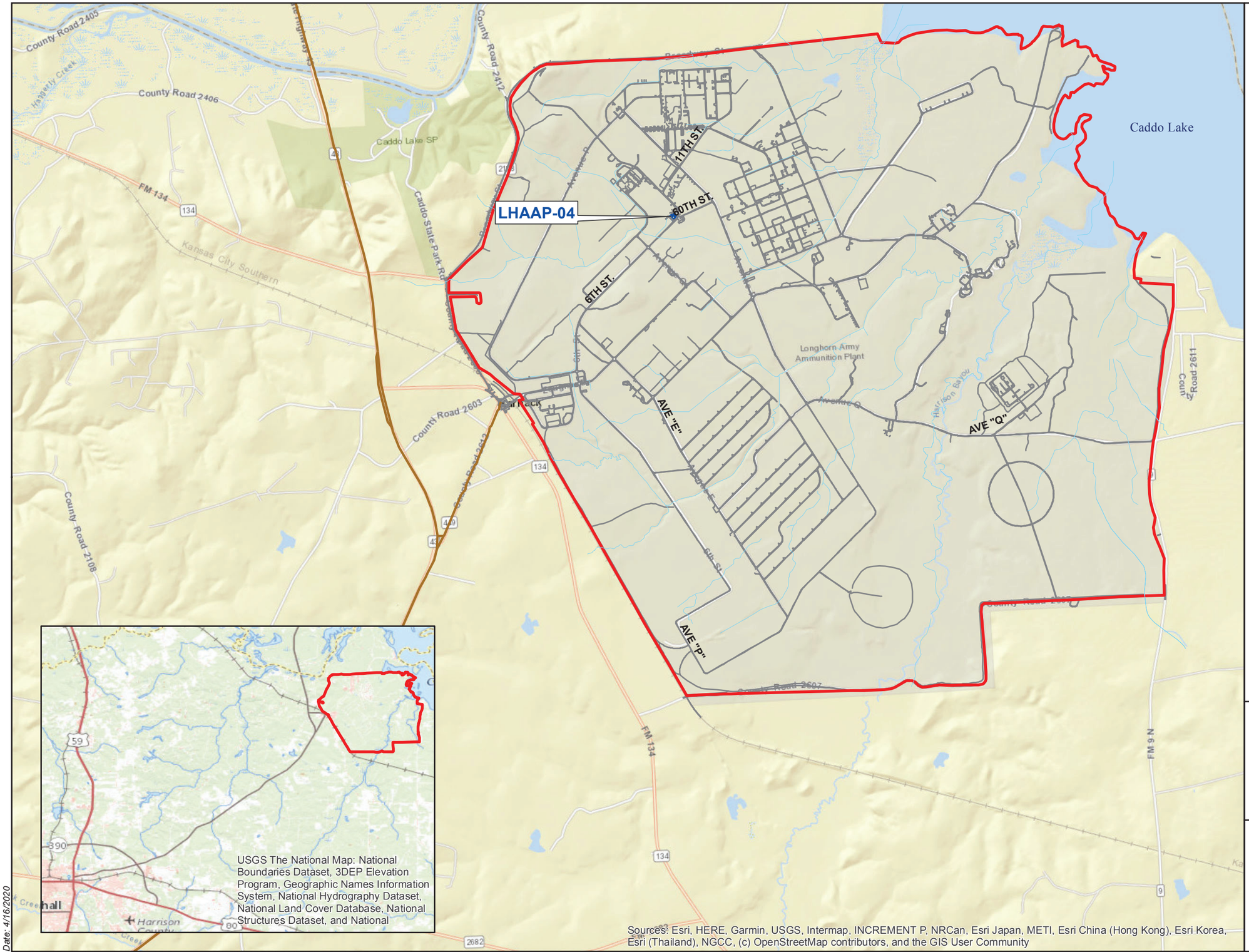
The site addressed in this Final Notice of Land Use Controls is LHAAP-04, which is shown on the attached figures (Figures 1-2 and 1-3 from the Response Action Completion Report) and discussed below. Land Use Controls (LUCs) are applied at LHAAP-04 as part of the remedy in accordance with the LHAAP-04 Record of Decision (ROD) finalized March 30, 2017. The LUCs are necessary because contaminants are present in groundwater at levels that do not support unlimited use and unrestricted exposure. The Final LUC boundary shown is the same as the preliminary boundary that was provided in the Initial Notice of LUCs provided on June 26, 2017.

Contaminants of Concern (COCs)
The only COC identified in the ROD for groundwater at LHAAP-04 was perchlorate, which was found at concentrations exceeding the TCEQ Protective Concentration Levels in the shallow zone.

Land Use Controls

- A LUC prohibiting groundwater use (except for environmental monitoring and testing) shall be implemented and shall remain in place at the site until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.
- A LUC restricting land use to nonresidential shall be implemented and shall remain in place at the site until the levels of COCs in surface and subsurface soil, and groundwater allow for unlimited use and unrestricted exposure.
- A LUC to maintain the integrity of any current or future remedial or monitoring systems shall remain in place until groundwater cleanup levels of COCs are met.

Further information may be found in the Administrative Record at the Marshall Public Library, at www.longhornaap.com or by contacting Rose M. Zeiler (479-635-0110 or rose.m.zeiler.civ@mail.mil).



U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

Figure 1-2

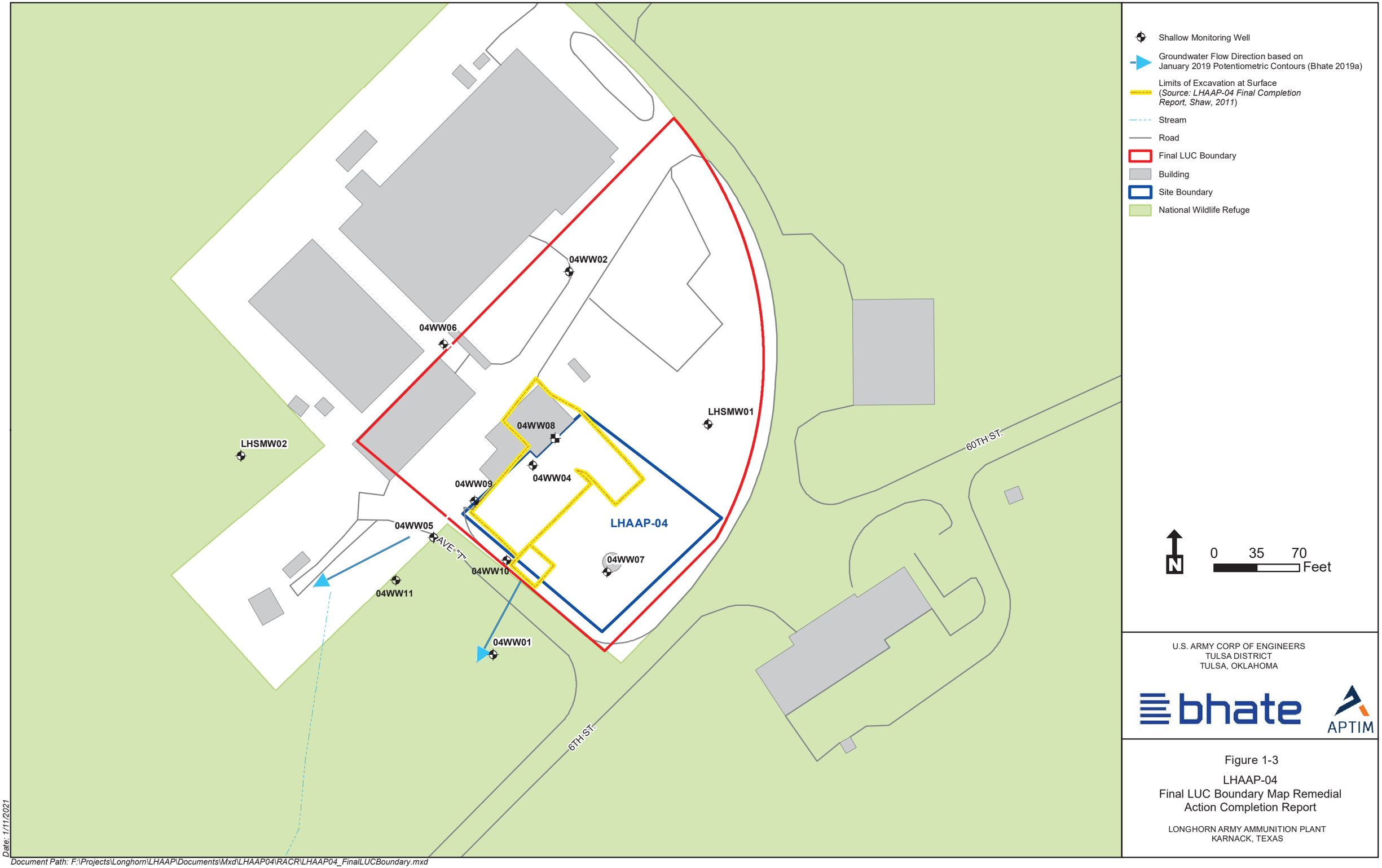
Site Location Map

LHAAP-04
Remedial Action Completion Report

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 4/16/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP04\RACR\Fig1-2_LHAAP_SiteLocationMap.mxd



U.S. ARMY CORP OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

bhate APTIM

Figure 1-3

LHAAP-04
Final LUC Boundary Map Remedial Action Completion Report

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 1/11/2021

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP04\RACR\LHAAP04_FinalLUCBoundary.mxd

Land Use Controls for Soil and Groundwater Contamination

Landfill 16 (LHAAP-16)

Longhorn Army Ammunition Plant, Karnack, Texas

The former Longhorn Army Ammunition Plant (LHAAP) is an inactive government-owned, formerly contractor-operated and maintained Department of Defense facility located in central east Texas in the northeast corner of Harrison County. LHAAP is approximately 14 miles northeast of Marshall, Texas. The facility is approximately 40 miles west of Shreveport, Louisiana. The former U.S. Army installation occupied nearly 8,416 acres between State Highway 43 at Karnack, Texas, and the southwestern shore of Caddo Lake and is accessed by State Highways 43 and 134.

LHAAP was placed on the National Priorities List (NPL) on August 9, 1990. Activities to remediate contamination began in 1990. After its listing on the NPL, the U.S. Army, the USEPA, and the Texas Water Commission (currently known as the Texas Commission on Environmental Quality [TCEQ]) entered into a CERCLA Section 120 Federal Facilities Agreement (FFA) for remedial activities at LHAAP. The FFA became effective December 30, 1991. LHAAP operated until 1997 when it was placed on inactive status and classified by the U.S. Army Armament, Munitions, and Chemical Command as excess property.

Land Use Controls (LUCs) are applied at LHAAP-16 as part of the remedy in accordance with the LHAAP-16 Record of Decision signed September 13, 2016. The LUCs are necessary because contaminants are present in groundwater at levels that do not support unlimited use and unrestricted exposure and landfill waste remains at the site under the existing landfill cap.

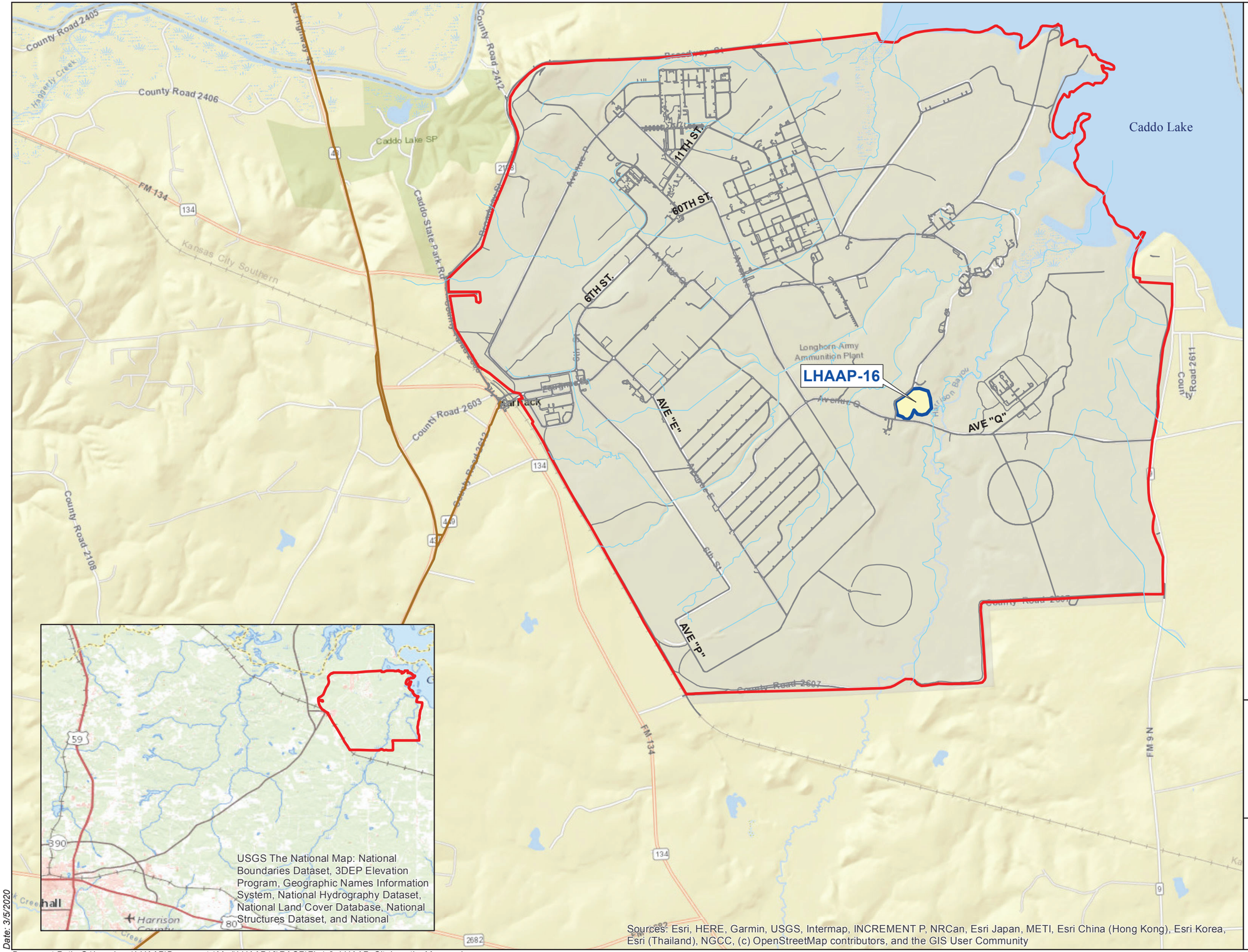
Contaminants of Concern (COCs)

In the shallow and intermediate groundwater zones, the COCs are volatile organic compounds (VOCs) (trichloroethene [TCE], cis-1,2-dichloroethene [DCE], 1,1-DCE, 1,2-dichloroethane, 1,1,2-trichloroethane, methylene chloride, and vinyl chloride [VC]), perchlorate, and five metals (arsenic, chromium, manganese, nickel, and thallium).

Land Use Controls

- The LUC to preserve the integrity of the landfill cap and restrict intrusive activities (e.g., digging) that would degrade or alter the cap shall remain in place as long as the landfill waste remains at the site or until the levels of COCs allow for unlimited use and unrestricted exposure.
- The LUC prohibiting groundwater use (except for environmental monitoring and testing) as a potable source shall be implemented and shall remain in place at the site until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.
- The LUC restricting land use to nonresidential shall be implemented and shall remain in place at the site until the levels of COCs in surface and subsurface soil and groundwater allow for unlimited use and unrestricted exposure.
- The LUC to maintain the integrity of any current or future remedial or monitoring systems shall remain in place until groundwater cleanup levels of COCs are met.

Further information may be found in the Administrative Record at the Marshall Public Library, at www.longhornaap.com or by contacting Rose M. Zeiler (479-635-0110 or rose.m.zeiler.civ@mail.mil).



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TULSA, OKLAHOMA

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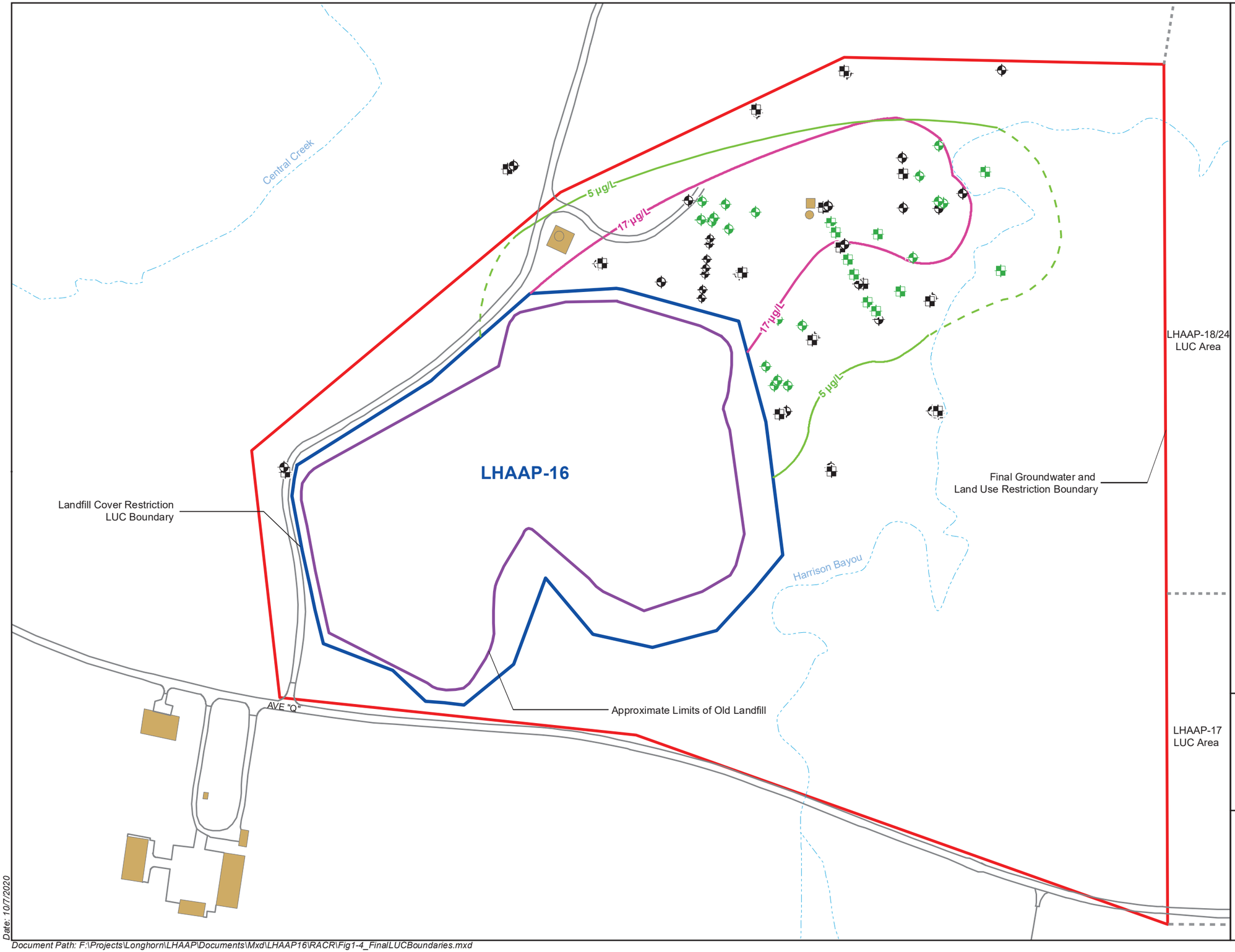
Figure 1-2

LHAAP Site Location Map
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 3/5/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig1-2_LHAAP_SiteLocationMap.mxd



Shallow Well Installed 2018 or 2019

Intermediate Well Installed 2018 or 2019

Existing Shallow Monitoring Well

Existing Intermediate Monitoring Well

Extent of Perchlorate Contamination > 17 µg/L in Intermediate and Shallow Zones (September 2019)

Extent of TCE Contamination > 5 µg/L in Intermediate and Shallow Zones (Dashed Where Inferred) (September 2019)

Stream

Road

Final Groundwater and Land Use Restriction Boundary

Landfill Cover Restriction LUC Boundary

Approximate Limits of Old Landfill

Building or Tank

LHAAP-17 and LHAAP-18/24 LUC Boundaries

Notes:
1. µg/L - micrograms per liter
2. LUC - land use control
3. TCE - trichloroethene
4. The eastern side of the Final Groundwater and Land Use Restriction Boundary is shared with the western edge of a similar land use restriction that will cover LHAAP-17 and LHAAP-18/24 located to the east of LHAAP-16.

N

0 110 220 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

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Figure 1-4

Final LUC Boundaries
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 10/7/2020

Document Path: F:\Projects\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\Fig1-4_FinalLUCBoundaries.mxd

Inspection and Maintenance Checklist

General Information	
Project Name	Inspection and Maintenance, LHAAP-16 Landfill, Longhorn Army Ammunition Plant, Karnack, TX
Contractor	
Inspector's Name	
Inspector's Title	
Inspector's Signature	
Inspector's Contact Number	
Inspection Date	
Type of Inspection	☐ Quarterly ☐ Semiannual ☐ Annual ☐ Prior to forecast rain ☐ After a rain event ☐ Other ----------

Description		**Yes**	**No**	**N/A**	**Comments** (Attach photos/location sketches)	**Corrective Action** (Attach photos)
A. CAP Cover Surface						
A.1	Are there any significant cracks present?					
A.2.	Are there any damaged areas?					
A.3	Is there any ponded water present?					
A.4	Any other relevant observations?					
B. CAP Vegetation and Animal Burrows						
B.1	Are there signs of stressed/ dead vegetation?					
B.2	Are there any significant bare spots?					
B.3	Are deep-rooted plants present?					
B.4	Are there signs of animal burrows?					
B. 5	Any other relevant observations?					

Description		Yes	No	N/A	**Comments** (Attach photos/location sketches)	**Corrective Action** (Attach photos)
C. CAP Erosion and Drainage System						
C.1	Is there any evidence of significant/ clearly visible erosion, settlement, or other deterioration?					
C.2	Are the drainage systems in poor condition?					
C.3	Is there excessive silting or debris clogging?					
C.4	Is there erosion of banks and slopes?					
C.5	Are there areas of choking by overgrown vegetation?					
C.7	Is there pooling of water in or along side a channel or berm?					
C.8	Any other relevant observations?					
D. Groundwater Monitoring Wells						
D.1	Are the installed groundwater monitoring wells in poor condition?					
D.2	Are there any signs of damage, unusual wear, rust and corrosion, vandalism, unauthorized entry/use, or settlement?					
D.3	Is well cap and/or locking mechanism not properly functioning?					
D.4	Are the well heads and protective casings damaged?					
D.5	Is the well cleared of vegetation and accessible?					
D.6	Any other relevant observations?					

Description		Yes	No	N/A	**Comments** (Attach photos/location sketches)	**Corrective Action** (Attach photos)
E. Site Access Features						
E.1	Are the perimeter fence and gates damaged?					
E.2	Gate(s) damaged?					
E.3	Litter encountered within the area?					
E.4	Are the gate locks missing?					
E.4	Are signs to prevent unauthorized entry missing?					
E.5	Are the access roads in unusable or poor condition?					
E.6	Any other relevant observations?					
F. Concrete Aprons and Bollards						
F.1	Are there any significant cracks present?					
F.2	Are there any damaged areas?					
F.3	Any other relevant observations?					

Annual Land Use Control Compliance Inspection Form

In accordance with the Remedial Design dated _____ for LHAAP-16 an inspection of the site was conducted by _____ [indicate transferee] on _____.

The land use control mechanisms are:

- Groundwater restrictions - prohibit access to the contaminated groundwater except for environmental monitoring and testing only until cleanup goals are met;
- Landfill integrity - preserve the integrity of the landfill cap and restrict intrusive activities (e.g., digging) that would degrade or alter the cap;
- Land use restrictions - restrict land use to nonresidential;
- Integrity of remedial and monitoring systems - maintain the integrity of any current or future remedial or monitoring systems until cleanup goals are met.

No unauthorized activities or uses have occurred. Compliance with land use controls and restrictions is as follows:

- No use of groundwater (other than environmental testing and monitoring), installation of new groundwater wells, or tampering with existing monitoring wells;
- No landfill intrusive activities (e.g., digging) that would degrade or alter the landfill cap; maintenance of vegetative cover and repair of soil subsidence or erosion areas on the cap;
- No land use other than nonresidential; and
- No activities that would compromise the integrity of the remedial or monitoring systems.

I, the undersigned, do document that the inspection was conducted 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, retained in the file and provided to Army, EPA and TCEQ upon request.

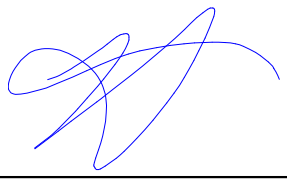
Appendix B

Well Information

LONGHORN ARMY AMMUNITION PLANT (LHAAP) - KARNACK, TEXAS

PREPARED FOR APTIM Federal Services, LLC.
2500 CityWest Blvd, Suite 1700
Houston, Texas 77042

	TEXAS STATE PLANE COORDINATE SYSTEM NORTH CENTRAL ZONE (4202), 1983 NORTH AMERICAN DATUM			
MONITORING WELL	NORTHING	EASTING	NAVD 88 ELEVATION	
	TOP OF CASING	TOP OF CASING	TOP OF CASING	GROUND
04WW06	6959225.38	3305871.99	215.63	212.52
04WW07	6959038.63	3306006.11	214.64	211.66
04WW08	6959148.15	3305963.41	214.82	212.07
04WW09	6959090.67	3305897.71	214.61	211.47
04WW10	6959041.73	3305928.94	213.67	210.40
04WW11	6959032.36	3305839.02	212.01	209.31
17WW19	6952718.36	3315313.67	180.08	176.63
17PZ01	6952783.40	3315662.50	177.22	174.14
17PZ02	6952764.55	3315647.64	177.75	174.57
17PZ03	6952773.35	3115739.59	177.76	174.69
17WW20	6952980.24	3315580.24	180.02	177.13
FLOWLINE CREEK 1	6958236.20	3307772.02	198.47 TOP BANK	191.49 FLOWLINE
FLOWLINE CREEK 2	6958026.38	3308220.92	196.62 TOP BANK	189.16 FLOWLINE
12 WW 10R	6954500.48	3311807.57	203.65	200.16
16 IW 09	6953396.09	3314160.35	181.41	178.08
16 IW 20	6953823.60	3314557.01	188.94	186.03
16 RW 01	6953551.08	3314168.77	189.77	186.56
16 RW 03	6953407.93	3314167.37	181.66	178.32
16 RW 04	6953535.89	3314226.20	190.94	188.04
16 RW 05	6953395.99	3314192.31	180.70	177.61
16 RW 11	6953828.09	3314545.02	189.95	187.46
16 RW 12	6953887.58	3314501.01	196.22	193.23
16 WW 48	6953695.43	3314485.33	184.41	181.46
16 WW 56	6953958.38	3314545.68	198.61	195.35
16 WW 57	6953896.70	3314654.99	177.06	173.12
16 WW 58	6953665.15	3314691.22	177.24	173.32
16IW10	6953780.74	3314013.26	195.90	192.69
16IW27	6953691.80	3314332.92	196.05	193.04
16IW28	6953655.99	3314347.06	189.50	186.62
16IW29	6953590.95	3314379.27	185.89	182.76
16IW30	6953570.27	3314398.21	184.74	181.72
16RW06	6953828.03	3313990.94	197.37	194.35
16RW07	6953785.38	3313988.18	195.48	192.20
16RW08	6953788.82	3314017.82	196.37	193.62
16RW09	6953821.11	3314045.50	197.81	195.14
16RW10	6953763.40	3314053.06	195.25	192.27
16IW25	6953777.99	3314293.02	199.24	196.29
16IW26	6953754.86	3314304.29	198.97	195.66
16WW49	6953750.74	3314402.85	190.69	187.66
16WW51	6953616.52	3314455.29	183.26	180.13
16WW55	6953802.81	3314115.62	194.03	191.11
67WW17	6957124.71	3311329.95	199.73	196.33
67WW18	6957000.55	3311152.49	198.90	195.29
50WW29	6957690.02	3309981.51	195.63	192.18
LHSMW23R	6962446.72	3306461.39	208.84	205.75
16RW02	6953440.13	3314139.68	182.97	179.94



DAVID R. COLLINS, JR. R.P.L.S.#6488
SURVEY DATE: MARCH 31, 2020

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW09
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/31/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	PEDRO GONZALES	**NORTHING:**	6953396.09
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314160.35

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

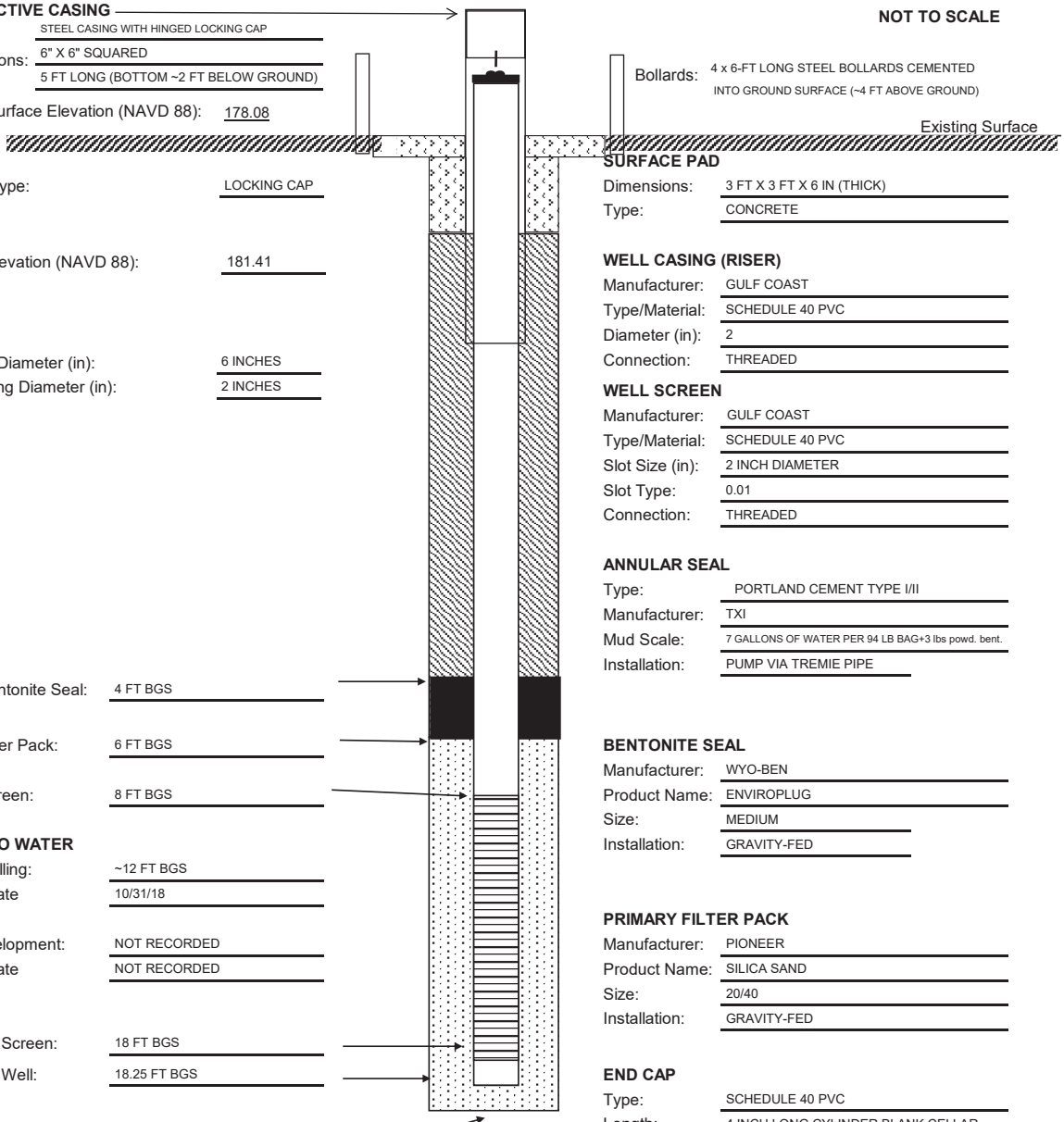
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 178.08

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 181.41

Borehole Diameter (in): 6 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 4 FT BGS

Top of Filter Pack: 6 FT BGS

Top of Screen: 8 FT BGS

DEPTH TO WATER

During Drilling: ~12 FT BGS

Date: 10/31/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 18 FT BGS

Bottom of Well: 18.25 FT BGS

Borehole Depth: 20

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW09
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 10/30/2018
Ended: 10/30/2018

Drilling Co.: ETTL
Drill Rig Model: Diedrich B-50
Driller: Pedro Gonzales
Drlling Method: Hollow-Stem Auger
Hole Diameter: 6 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
										▽ First Water: 12.8 ft bgs on 30-Oct-18 at hrs ▼ Static Water: ft bgs on at hrs	
										See Boring Log for RW-03. Due to method of drilling low recovery at this location.	set well at 18 ft btoc. See Well Diagram for details.
						5					
						10					
						▽					
						15					
						20				**Boring was terminated at approximately 20 feet bgs.**	
						25					
						30					

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW10
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/25/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953780.74
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314013.26

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

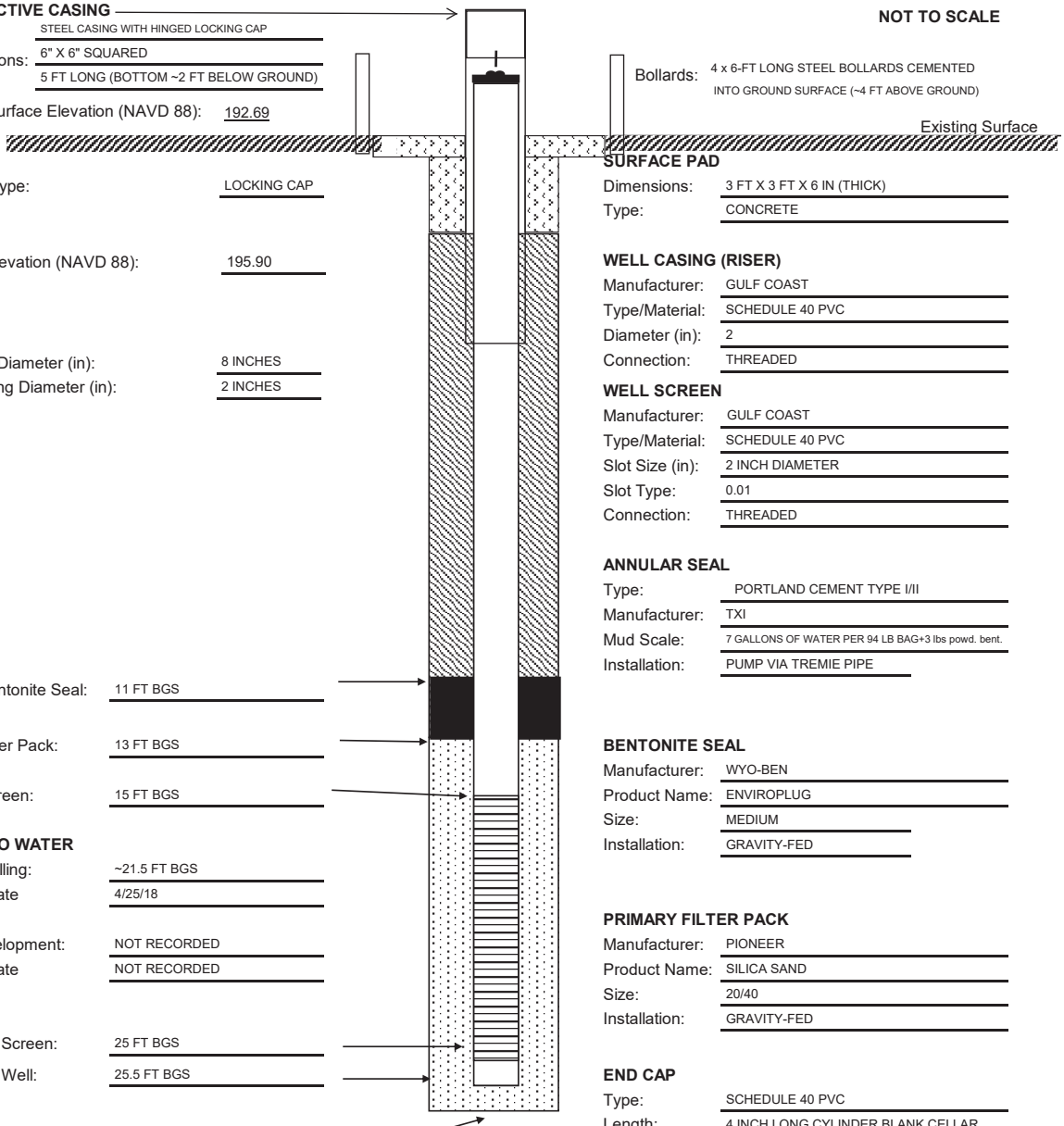
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 192.69

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 195.90

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 11 FT BGS

Top of Filter Pack: 13 FT BGS

Top of Screen: 15 FT BGS

DEPTH TO WATER

During Drilling: ~21.5 FT BGS

Date: 4/25/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 25 FT BGS

Bottom of Well: 25.5 FT BGS

Borehole Depth: 25.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW10
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/25/2018
Ended: 4/25/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 8 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 21.5 ft bgs on 25-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
1530		0.0							ML	**SANDY SILT**; light brown (7.5YR 6/4); dry; soft.		
									CH	**SILTY FAT CLAY**; light brown (7.5YR 6/3); dry; hard; mostly fines with medium plasticity; mottling is 7.5YR 7/8 Red.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
1537		0.1										
						5						
1542		0.2										
1546		0.1							ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry to moist; soft; alternates silty sand to sandy clay. With no to low plasticity.		
									CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
						10						
1552		0.1										
									ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		
1600		0.1							CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
						15						
1606		0.0							SM	**SILTY SAND**; light brown (7.5YR 6/4); dry; loose; some fines.		
									CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
1613		0.0										
						20						
1617		0.0										
									SM	**SILTY SAND**; light brown (7.5YR 6/4); moist to wet; loose; some fines.		Used Pioneer silica sand 20/40
1622		0.0										
									CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
						25						
										Boring was terminated at approximately 25.5 feet bgs.		Set well at 25.3; Screened from 15 to 25 ft bgs
						30						

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16IW10
Sheet: 1 **of** 1

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW20
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/3/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953823.60
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314557.01

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

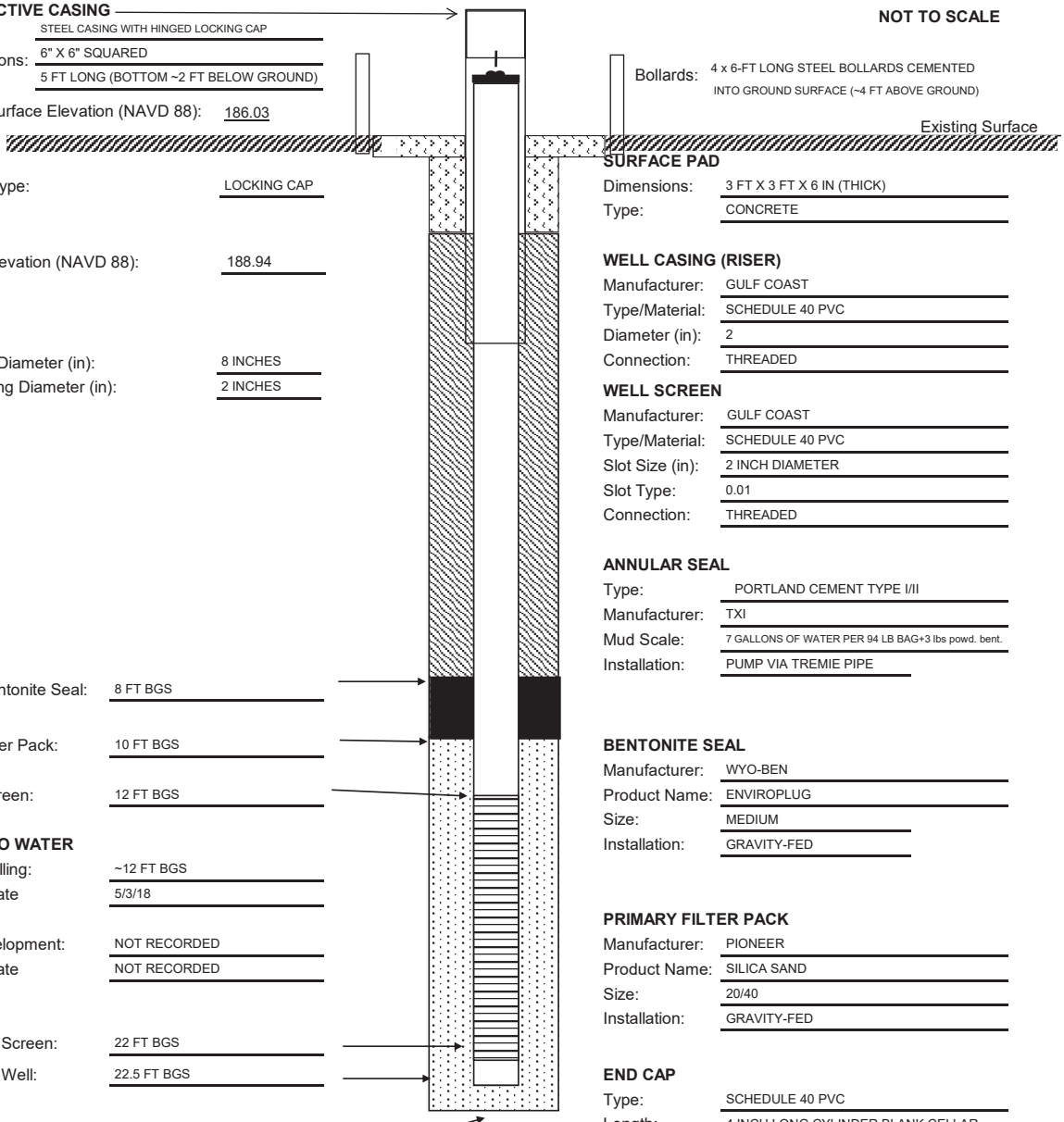
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 186.03

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 188.94

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 8 FT BGS

Top of Filter Pack: 10 FT BGS

Top of Screen: 12 FT BGS

DEPTH TO WATER

During Drilling: ~12 FT BGS

Date: 5/3/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 22 FT BGS

Bottom of Well: 22.5 FT BGS

Borehole Depth: 22.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

Boring/Well ID: 16IW20
Sheet: 1 **of** 1

Project No.: 501032
Client: USACE
Location: LONGHORN AAP, SITE 16
Started: 5/3/2018
Ended: 5/3/2018

Drilling Co.: Best Drilling Services, Inc
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drilling Method: Hollow-Stem Auger
Hole Diameter: 8 **(inches)**

Logged By: Allen Willmore
Edited By:
Checked By: G.N.Jones
Number:

▽ First Water: 12 ft bgs on 03-May-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
		0 1						CH	**SILTY FAT CLAY** ; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		
		0 4									
		0 4			5						Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
		0 6									
		0 2			10			ML-SM	**SILTY SAND WITH CLAY** ; reddish yellow (7.5YR 6/8); dry; medium dense; iron staining; browish red.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
		0 2			▽			SM	**SILTY SAND WITH CLAY** ; very pale brown (10YR 7/4); moist to wet; loose to medium dense; alternates silty sand to sandy clay; brownish red.		
		0 2			15						
		0 4						CL-ML	**CLAYEY SILT WITH SAND** ; very pale brown (10YR 7/4); moist; soft; more clay content than above.		Used Pioneer silica sand 20/40
		0			20			CL-ML	**SILTY FAT CLAY WITH SAND** ; light brown (7.5YR 6/4); dry; hard; mostly fines with high plasticity; organic content.		Little Recovery, clay seen in shoe.
									Boring was terminated at approximately 22.5 feet bgs.		Set well at 22.5 ft bgs; set screen 12' bgs to 22' bgs
					25						
					30						

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW25
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/1/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953777.99
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314293.02

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

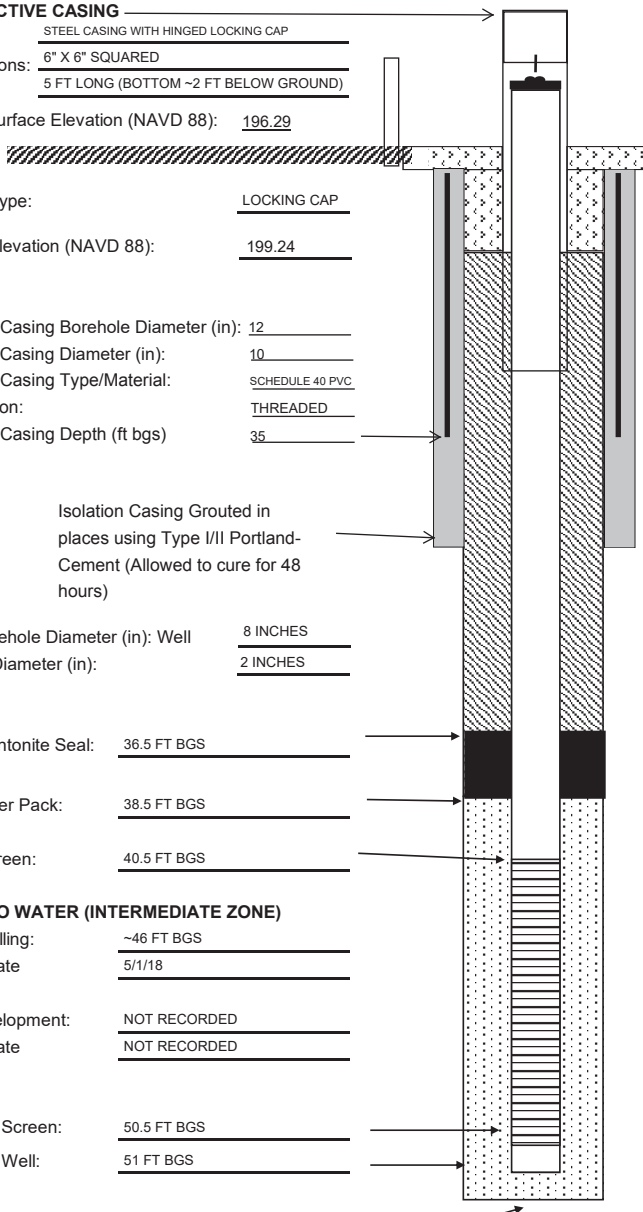
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 196.29

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 199.24

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 35

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 36.5 FT BGS

Top of Filter Pack: 38.5 FT BGS

Top of Screen: 40.5 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~46 FT BGS

Date 5/1/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 50.5 FT BGS

Bottom of Well: 51 FT BGS

Borehole Depth: 55

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW25
Sheet: 1 **of** 2

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/23/2018
Ended: 5/1/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 46 ft bgs on 23-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
1250		0							CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
1255		0									
1300		0				5			SM	**SILTY SAND WITH CLAY**; reddish yellow (7.5YR 6/8); dry; very dense; iron staining; browish red.	
1305		0									
1310		0				10			CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; hard; mostly fines with high plasticity; iron staining.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
									SM	**SILTY SAND WITH CLAY**; very pale brown (10YR 7/4); dry to moist; loose to medium dense; alternates silty sand to sandy clay; brownish red.	
1315		0									
1320		0.2				15			CL	**SILTY CLAY**; light brown (7.5YR 6/4); dry; firm; with high plasticity.	
1325		0							SM	**SILTY SAND WITH CLAY**; very pale brown (10YR 7/4); moist to wet; loose to medium dense; alternates silty sand to sandy clay; brownish red.	
1345		0.3				20					
1400		0								-coarsens downward, becomes more sandy.	
1404		0				25				Wet; -becomes saturated.	
1410		0.2									
						30					

BORING LOG

Boring/Well ID: 16IW25
Sheet: 2 **of** 2

APTIM

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
1420		0								
1440		0.1						CH	**SILTY CLAY** ; dry to moist; firm; mostly fines with high plasticity.	
		0.1			35					Set Isolation Casing at 35 ft bgs No recovery from 35 to 48 ft. Driller suspects sand at 46 ft
		0.1			40					
		0.0			45			SP-SM	**SILTY SAND** ; greenish gray (5BG 5/1); wet; dense; mostly subangular to subrounded, fine grained sand; -Becomes Wet.	
					50			CH	**FAT CLAY** ; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	set bottom of well at 49' bgs. Screen from 40.5 to 50.5
					55				**Boring was terminated at approximately 55 feet bgs.**	See well diagram for details
					60					

Project No.:
Location: ,

Boring/Well ID: 16IW25
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW26
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/2/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953754.86
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314304.29

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

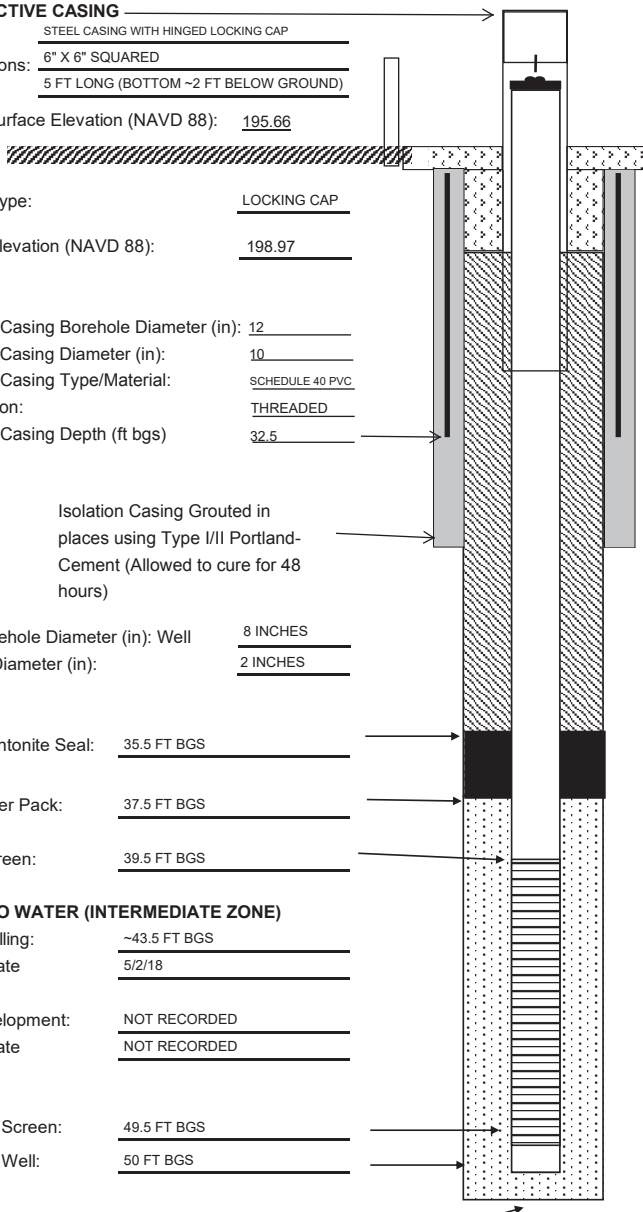
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 195.66

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 198.97

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 32.5

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 35.5 FT BGS

Top of Filter Pack: 37.5 FT BGS

Top of Screen: 39.5 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~43.5 FT BGS

Date 5/2/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 49.5 FT BGS

Bottom of Well: 50 FT BGS

Borehole Depth: 50

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW26
Sheet: 1 **of** 2

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/24/2018
Ended: 5/2/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 43.5 ft bgs on 24-Apr-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
0800		0							CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
0805		0									
0810		0				5			ML-SM	**SILTY SAND WITH CLAY**; reddish yellow (7.5YR 6/8); moist; medium dense; iron staining; browish red.	
0820		0									
0825		0.3				10					
0832		0									
0840		0				15			CL-ML	**SILTY FAT CLAY WITH SAND**; light brown (7.5YR 6/4); dry; hard; mostly fines with high plasticity; organic content. More sand content, becomes soft.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
0851		1.4							SM	**SILTY SAND WITH CLAY**; very pale brown (10YR 7/4); moist to wet; loose to medium dense; alternates silty sand to sandy clay; brownish red.	
0900		0				20			CL-ML	**CLAYEY SILT WITH SAND**; very pale brown (10YR 7/4); moist; soft; -coarsens downward, becomes more sandy.	
0905		0.5									
0912		0				25					
0920		0.9							CH	**SILTY CLAY**; light brown (7.5YR 6/4); dry to moist; firm; mostly fines with high plasticity.	
						30					

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

BORING LOG

Boring/Well ID: 16IW26
Sheet: 2 **of** 2

APTIM

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
0928		0						CH	**SILTY CLAY**; light brown (7.5YR 6/4); dry to moist; firm; mostly fines with high plasticity.	
		0.7			35					Set Isolation Casing at 32.5 ft bgs
		0.6			40					
		0.3			45			SP-SM	**SILTY SAND**; greenish gray (5BG 5/1); wet; dense; mostly subangular to subrounded, fine grained sand; saturated.	Very little recovery, contact difficult to determine
								CH	**FAT CLAY**; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	set bottom of well at 50' bgs. Screen from 39.5 to 49.5
					50				**Boring was terminated at approximately 50 feet bgs.**	See well diagram for details
					55					
					60					

Project No.:
Location: ,

Boring/Well ID: 16IW26
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW27
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/2/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953691.80
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314332.92

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

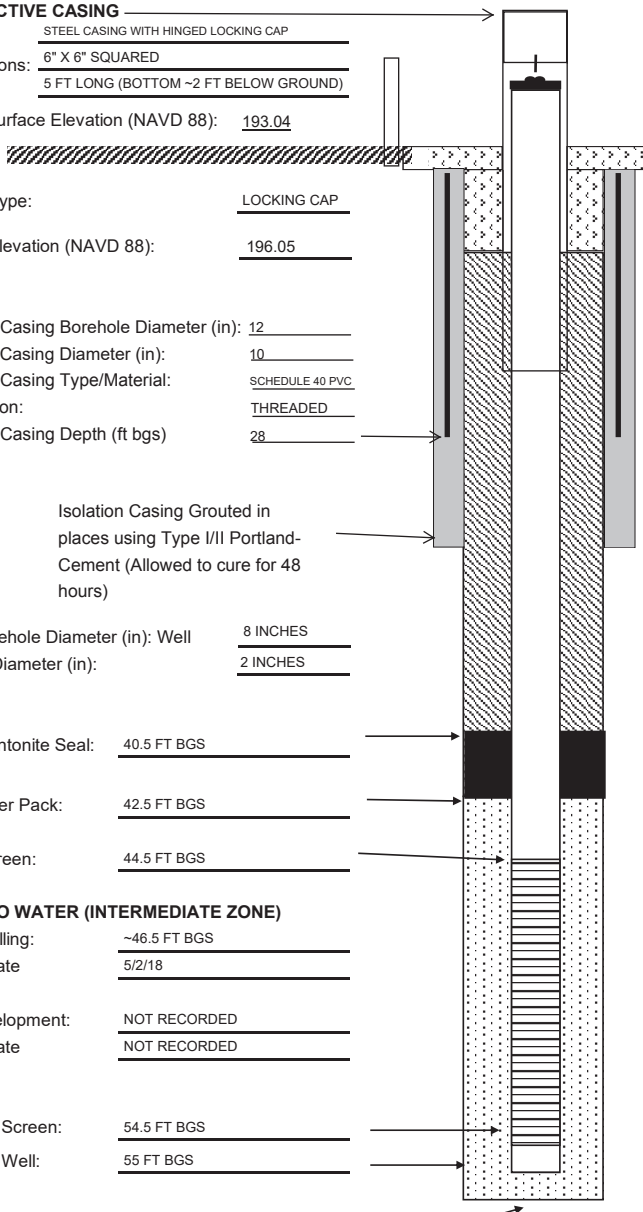
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 193.04

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 196.05

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 28

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 40.5 FT BGS

Top of Filter Pack: 42.5 FT BGS

Top of Screen: 44.5 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~46.5 FT BGS

Date 5/2/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 54.5 FT BGS

Bottom of Well: 55 FT BGS

Borehole Depth: 55

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II & BENTONITE MIX

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW27
Sheet: 1 **of** 2

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/25/2018
Ended: 5/2/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 46.5 ft bgs on 25-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
1605		0							CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
1610		0									
1615		0				5			ML-SM	**SILTY SAND WITH CLAY**; reddish yellow (7.5YR 6/8); moist; medium dense; iron staining; browish red.	
1620		0							CL-ML	**SILTY FAT CLAY WITH SAND**; light brown (7.5YR 6/4); dry; hard; mostly fines with high plasticity; organic content.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
1625		0				10					
1630		0									
1635		0				15			SM	**SILTY SAND WITH CLAY**; very pale brown (10YR 7/4); moist to wet; loose to medium dense; alternates silty sand to sandy clay; brownish red.	
1640		1.2									
1645		1.7				20					
1650		2.4							CL-ML	**CLAYEY SILT WITH SAND**; very pale brown (10YR 7/4); moist; soft; -coarsens downward, becomes more sandy.	
1655		0.9				25					
1700		3.1							CH	**SILTY CLAY**; light brown (7.5YR 6/4); dry to moist; firm; mostly fines with high plasticity.	Set isolation Casing at 28 ft bgs
						30					

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16IW27
Sheet: 1 **of** 2

BORING LOG

Boring/Well ID: 16IW27
Sheet: 2 **of** 2

APTIM

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
		2.1								
		0.1			35					
		3.2			40					
		1.2			45					
								SP-SM	**SILTY SAND**; greenish gray (5BG 5/1); wet; dense; mostly subangular to subrounded, fine grained sand; -Becomes Wet.	No recovery from 35 to 48 ft. Driller suspects sand at 46 ft
		0.1			50					
					55			CH	**FAT CLAY**; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	set bottom of well at 55' bgs. Screen from 44.5 to 54.5
									Boring was terminated at approximately 55 feet bgs.	See well diagram for details
					60					

Project No.:
Location: ,

Boring/Well ID: 16IW27
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW28
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/1/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953655.99
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314347.06

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

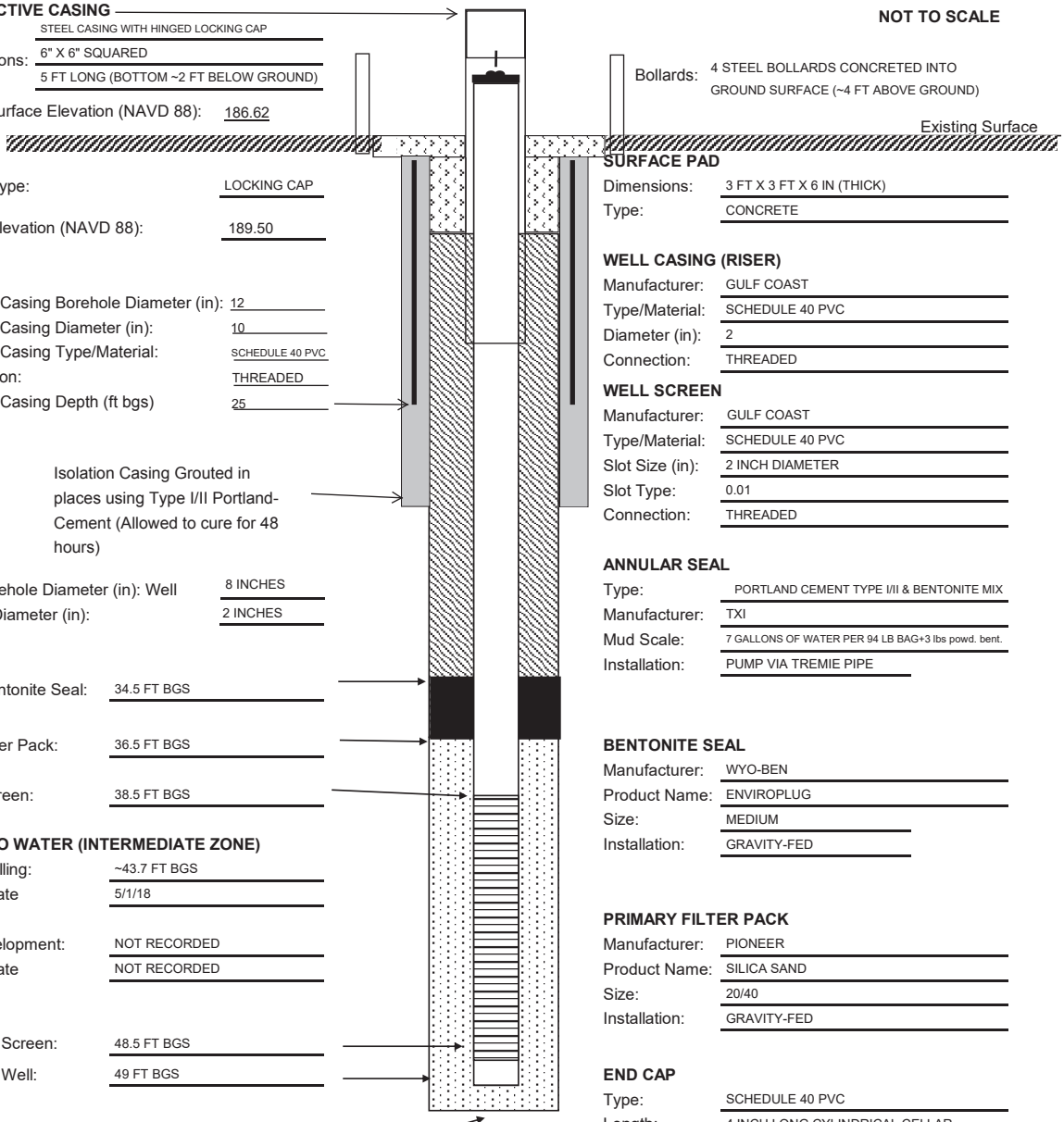
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 186.62

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 189.50

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 25

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 34.5 FT BGS

Top of Filter Pack: 36.5 FT BGS

Top of Screen: 38.5 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~43.7 FT BGS

Date 5/1/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 48.5 FT BGS

Bottom of Well: 49 FT BGS

Borehole Depth: 50

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II & BENTONITE MIX

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW28
Sheet: 1 **of** 2

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/18/2018
Ended: 5/1/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 43.7 ft bgs on 18-Apr-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
1127		0.2						CH	**SILTY FAT CLAY**; dry; soft to firm; mostly fines with high plasticity; iron staining, reddish-brown.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
1131		0.4						SM	**SILTY SAND WITH CLAY**; dry; very dense; iron staining; brownish red.	
					5			CH	**SILTY FAT CLAY**; dry; hard; mostly fines with medium plasticity; iron staining.	
1148		0.4								
1153		0.6						ML-SM	**SANDY ELASTIC SILT WITH CLAY**; dry to moist; soft to firm; alternates silty sand to sandy clay; brownish red.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
					10			CL	**SILTY CLAY**; dry; firm; with high plasticity.	
1157		1.4								
1204		2.1						SM	**SILTY SAND**; moist; dense; some fines.	
								CL	**SILTY CLAY**; dry; firm; with high plasticity.	
					15			SM	**SILTY SAND**; moist; dense; some fines. Moist to wet; ~15 ft. becomes moist to wet, difficult to determine exact depth.	
1211		2.1								
1215		2.8								
					20					
1225		0.9						CH	**SILTY CLAY**; dry; firm; mostly fines with high plasticity.	
1230		0.3								
					25					
		0.1								Set Isolation Casing set at 25' bgs
					30					

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16IW28
Sheet: 1 **of** 2

BORING LOG

APTIM

Boring/Well ID: 16IW28
Sheet: 2 **of** 2

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
		0.3								
		0.2			35					
		0.4			40					
		0.2			45			SP-SM	**SILTY SAND**; greenish gray (5BG 5/1); wet; dense; mostly subangular to subrounded, fine grained sand; -Becomes Wet.	
								CH	**FAT CLAY**; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	set bottom of well at 49' bgs. Screen from 38.5 to 48.5
					50				**Boring was terminated at approximately 50 feet bgs.**	See well diagram for details
					55					
					60					

Project No.:
Location: ,

Boring/Well ID: 16IW28
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW29
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/1/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953590.95
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314379.27

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

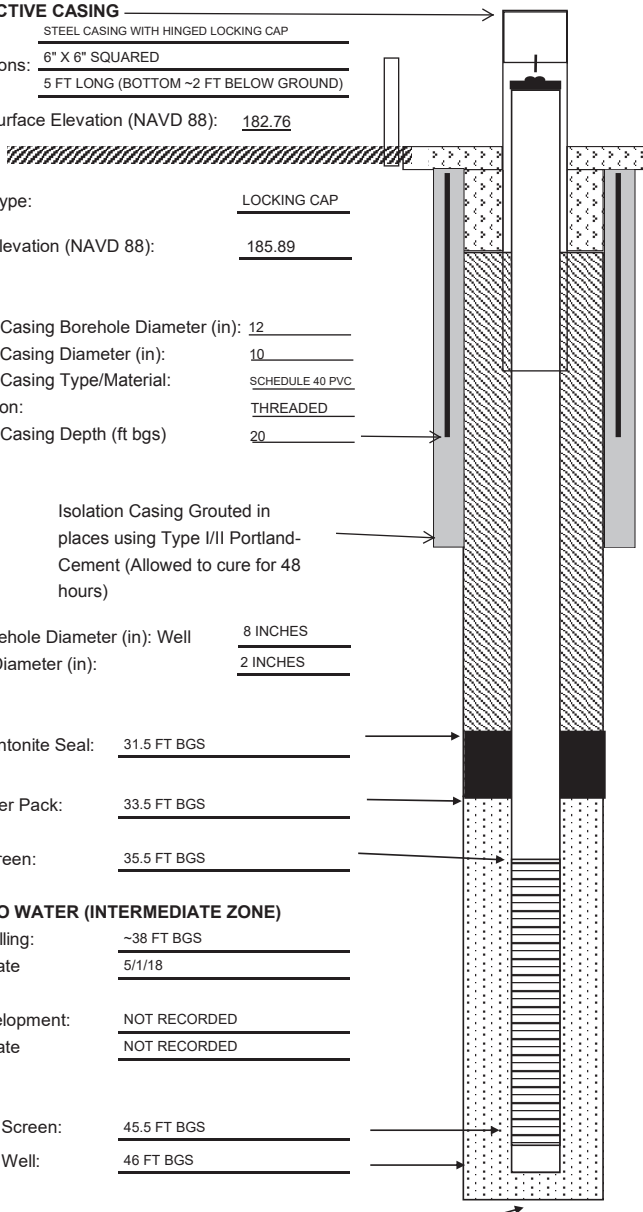
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 182.76

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 185.89

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 20

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 31.5 FT BGS

Top of Filter Pack: 33.5 FT BGS

Top of Screen: 35.5 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~38 FT BGS

Date 5/1/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 45.5 FT BGS

Bottom of Well: 46 FT BGS

Borehole Depth: 47.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16IW29
Sheet: 1 **of** 2

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/17/2018
Ended: 5/1/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 38 ft bgs on 17-Apr-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
1420		1.2						CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining, reddish-brown.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
1428		0.4								
1436		0.6			5			SM	**SILTY SAND WITH CLAY**; dry; very dense; iron staining; brownish red.	
								CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining.	
1444		1.2						SM	**SILTY SAND WITH CLAY**; dry to moist; soft to firm; alternates silty sand to sandy clay; brownish red.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
1452		3.1			10					
1455		2.9						SM	**SILTY SAND**; wet; loose; some fines.	
1457		0.5			15			CL	**SILTY CLAY**; dry; firm; with high plasticity.	
1504		0.1								
		0.6			20					Set Isolation Casing at 20 ft bgs
		1.2			25					
					30					

Project No.:
Location: ,

Boring/Well ID: 16IW29
Sheet: 1 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

BORING LOG

Boring/Well ID: 16IW29
Sheet: 2 **of** 2

APTIM

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
		0.9			35					
		0.3								
								SP-SM	**SILTY SAND**; greenish gray (5BG 5/1); wet; dense; mostly subangular to subrounded, fine grained sand; -Becomes Wet.	
		2.1			40					set bottom of well at 46' bgs. Screen from 35.5 to 45.5
		1.0			45			CH	**PEAT**; black (2.5Y 2.5/1); wet; organic. **FAT CLAY**; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	
									Boring was terminated at approximately 47.5 feet bgs.	See well diagram for details
					50					
					55					
					60					

Project No.:
Location: ,

Boring/Well ID: 16IW29
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16IW30
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/30/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953570.27
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314398.21

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

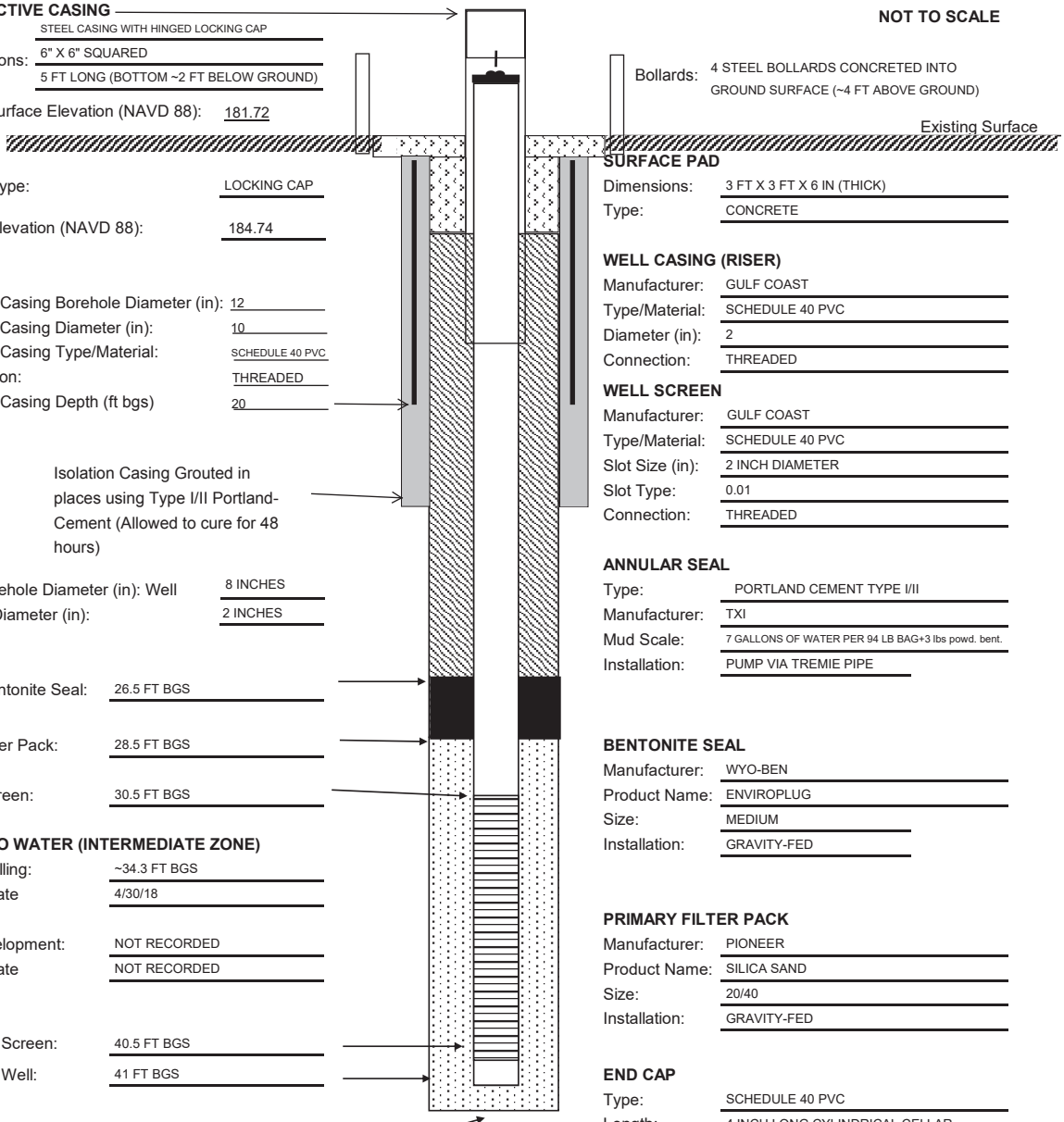
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 181.72

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 184.74

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 20

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 26.5 FT BGS

Top of Filter Pack: 28.5 FT BGS

Top of Screen: 30.5 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~34.3 FT BGS

Date 4/30/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 40.5 FT BGS

Bottom of Well: 41 FT BGS

Borehole Depth: 42

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

Boring/Well ID: 16IW30
Sheet: 1 **of** 2

APTIM

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/18/2018
Ended: 4/30/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 34.3 ft bgs on 18-Apr-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
0830		0.3							ML	**SANDY SILT**; moist; soft.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
0835		0.4							CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.	
0841		0.2				5			SM	**SILTY SAND WITH CLAY**; dry; very dense; iron staining; browish red.	
0848		0.0							CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
0856		0.5				10			SM	**SILTY SAND WITH CLAY**; dry to moist; soft to firm; alternates silty sand to sandy clay; brownish red.	
0905		0.6								Wet; -Becomes Wet.	
0915		0.2				15			CH	**SILTY CLAY**; greenish gray (5BG 5/1); dry; firm; with high plasticity; -Becomes dry.	Set Isolation Casing at 20 ft bgs
0918		0.2									
		0.2				20					
		0.5				25					
						30					

BORING LOG

Boring/Well ID: 16IW30
Sheet: 2 **of** 2

APTIM

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
		0.1							-Becomes softer, more plasticity.	
					35			SP-SM	**SILTY SAND** ; greenish gray (5BG 5/1); moist to wet; dense; mostly subangular to subrounded, fine grained sand; -Becomes Wet.	
		0.1							-Saturated.	heaving sands at ~36 ft bgs. Drill rods get stuck
					40			CH	**PEAT** ; black (2.5Y 2.5/1); wet; organic.	
		0.1							**FAT CLAY** ; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	set bottom of well at 41' bgs. Screen from 30.5 to 40.5 See well diagram for details
									Boring was terminated at approximately 42 feet bgs.	
		0.1			45					
					50					
					55					
					60					

Project No.:
Location: ,

Boring/Well ID: 16IW30
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW01
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/31/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	PEDRO GONZALES	**NORTHING:**	6953551.08
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314168.77

PROTECTIVE CASING

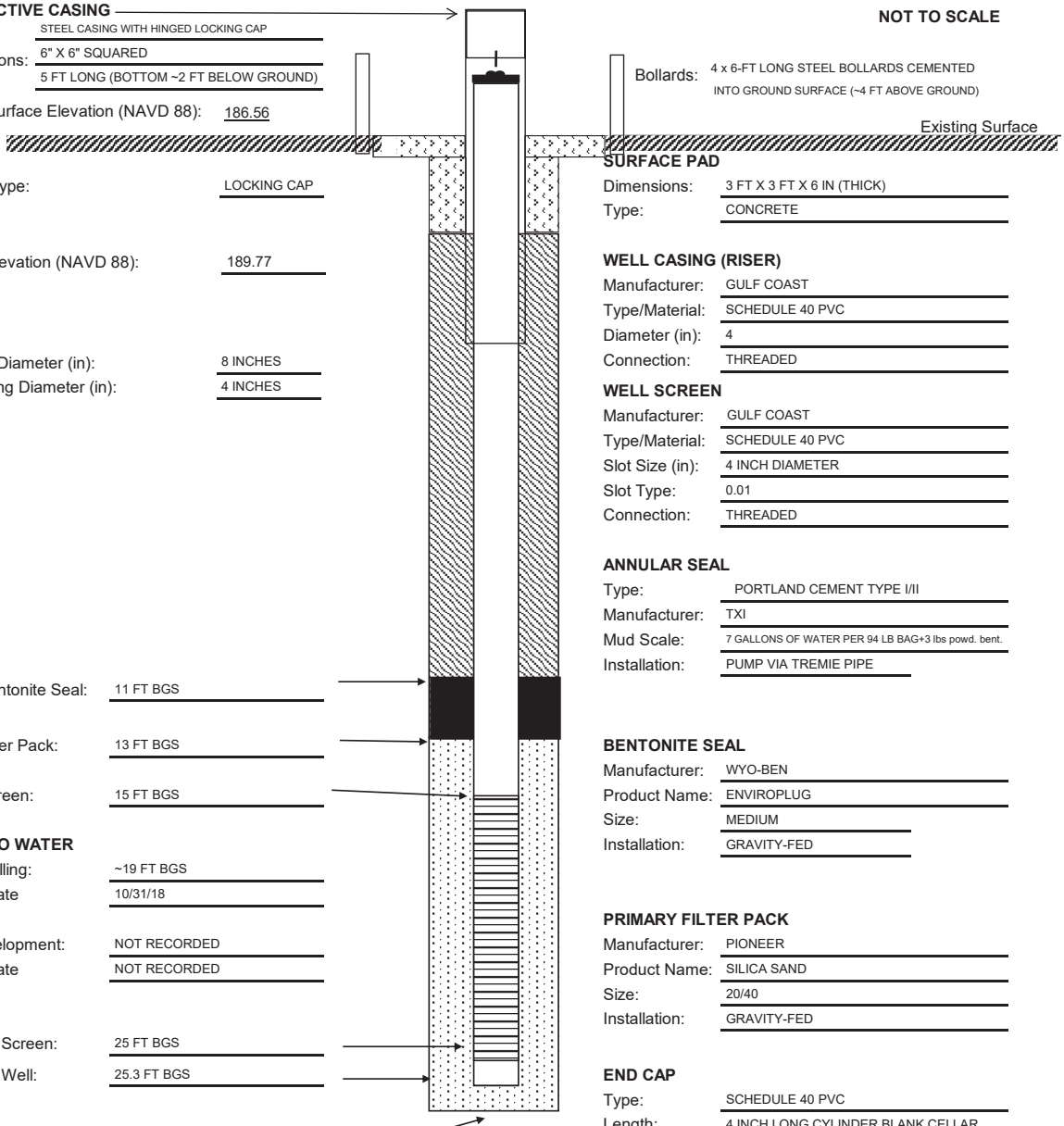
Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 186.56

NOT TO SCALE



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 189.77

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 11 FT BGS

Top of Filter Pack: 13 FT BGS

Top of Screen: 15 FT BGS

DEPTH TO WATER

During Drilling: ~19 FT BGS

Date: 10/31/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 25 FT BGS

Bottom of Well: 25.3 FT BGS

Borehole Depth: 26

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW01
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 10/31/2018
Ended: 10/31/2018

Drilling Co.: ETTL
Drill Rig Model: Diedrich B-50
Driller: Pedro Gonzales
Drlling Method: Hollow-Stem Auger
Hole Diameter: 8 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: ft bgs on 31-Oct-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
		0							CL	**SILTY CLAY WITH SAND**; red (10R 4/6); dry; soft to firm; trace fine grained sand; mostly fines with low plasticity.		
		0				5						
		0				10			SM	**SILTY SAND** ; light brown (7.5YR 6/4); dry to moist; loose to medium dense; mostly fine grained sand; some silty fines; heavy, mottling & iron staining.		Low Recovery
		0				15						
		0				20			SP	**POORLY GRADED SAND**; light brownish gray (2.5Y 6/2); moist to wet; dense; mostly fine grained sand; trace fines; iron staining.		
						25			CH	**FAT CLAY** ; light brown (7.5YR 6/3); dry; firm to hard; with high plasticity.		
						30				**Boring was terminated at approximately 25 feet bgs.**		

Project No.:
Location: ,

Boring/Well ID: 16RW01
Sheet: 1 **of** 1

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW02
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/12/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	RICH HERMAN	**NORTHING:**	6953440.13
SCIENTIST:	W. FOSS	**EASTING:**	3314139.68

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

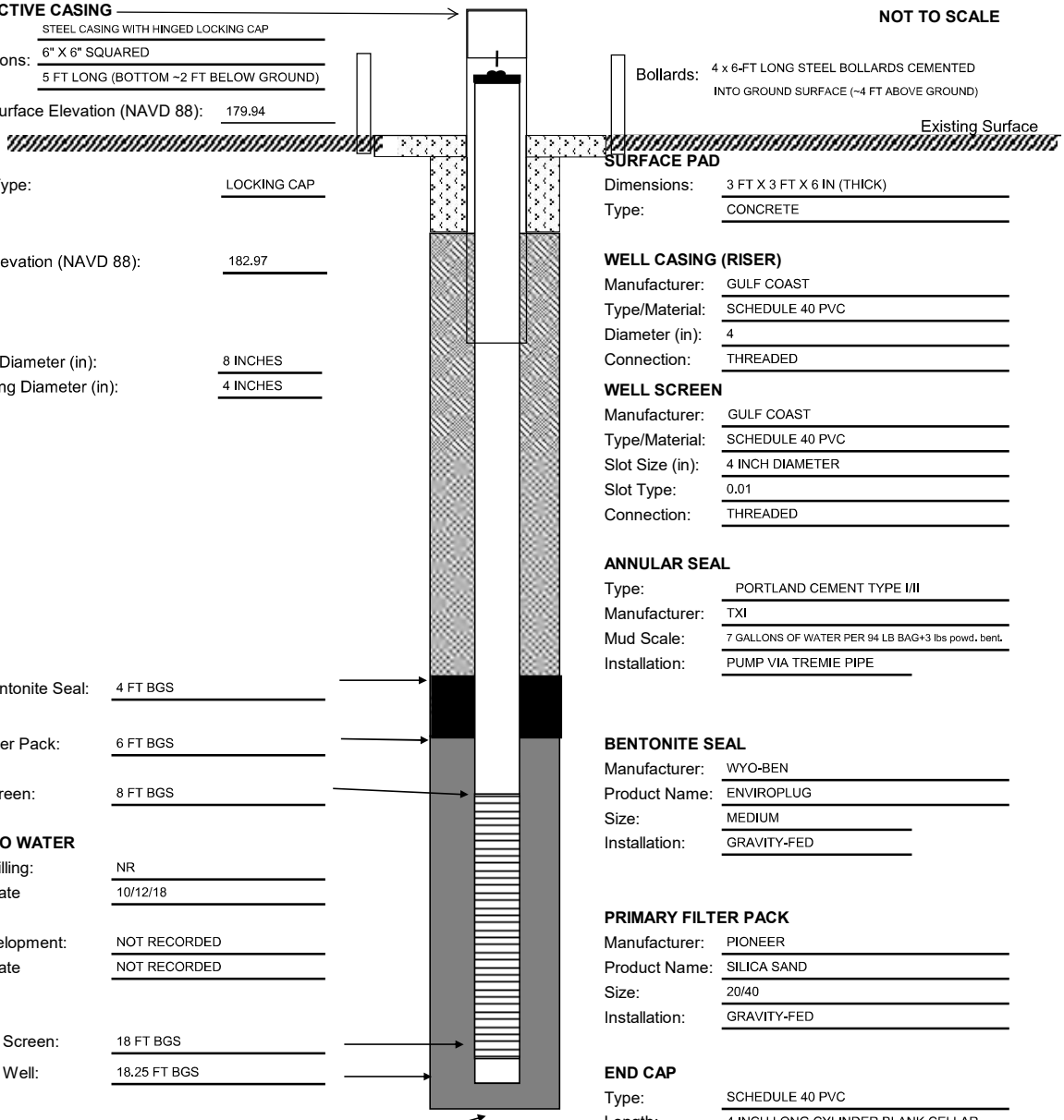
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 179.94

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 182.97

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 4 FT BGS

Top of Filter Pack: 6 FT BGS

Top of Screen: 8 FT BGS

DEPTH TO WATER

During Drilling: NR

Date: 10/12/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 18 FT BGS

Bottom of Well: 18.25 FT BGS

Borehole Depth: 18.25 FT BGS

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW03
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/11/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	RICH HERMAN	**NORTHING:**	6953407.93
SCIENTIST:	W. FOSS	**EASTING:**	3314167.37

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

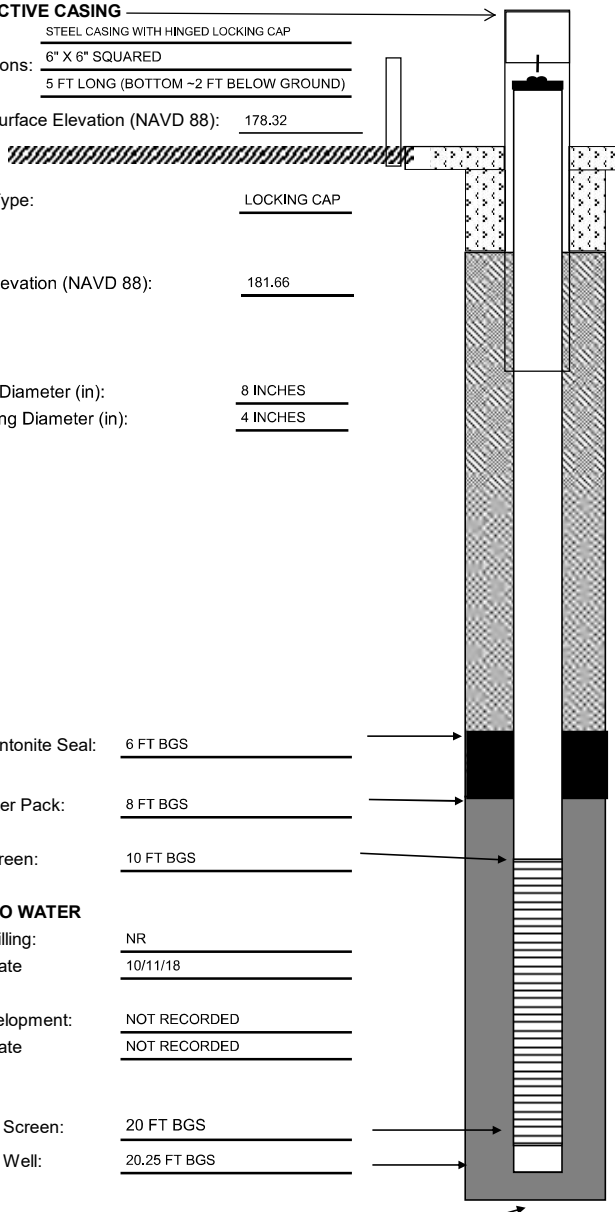
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 178.32

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 181.66

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 6 FT BGS

Top of Filter Pack: 8 FT BGS

Top of Screen: 10 FT BGS

DEPTH TO WATER

During Drilling: NR

Date: 10/11/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 20 FT BGS

Bottom of Well: 20.25 FT BGS

Borehole Depth: 20.25 FT BGS

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW04
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/31/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	PEDRO GONZALES	**NORTHING:**	6953535.89
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314226.20

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

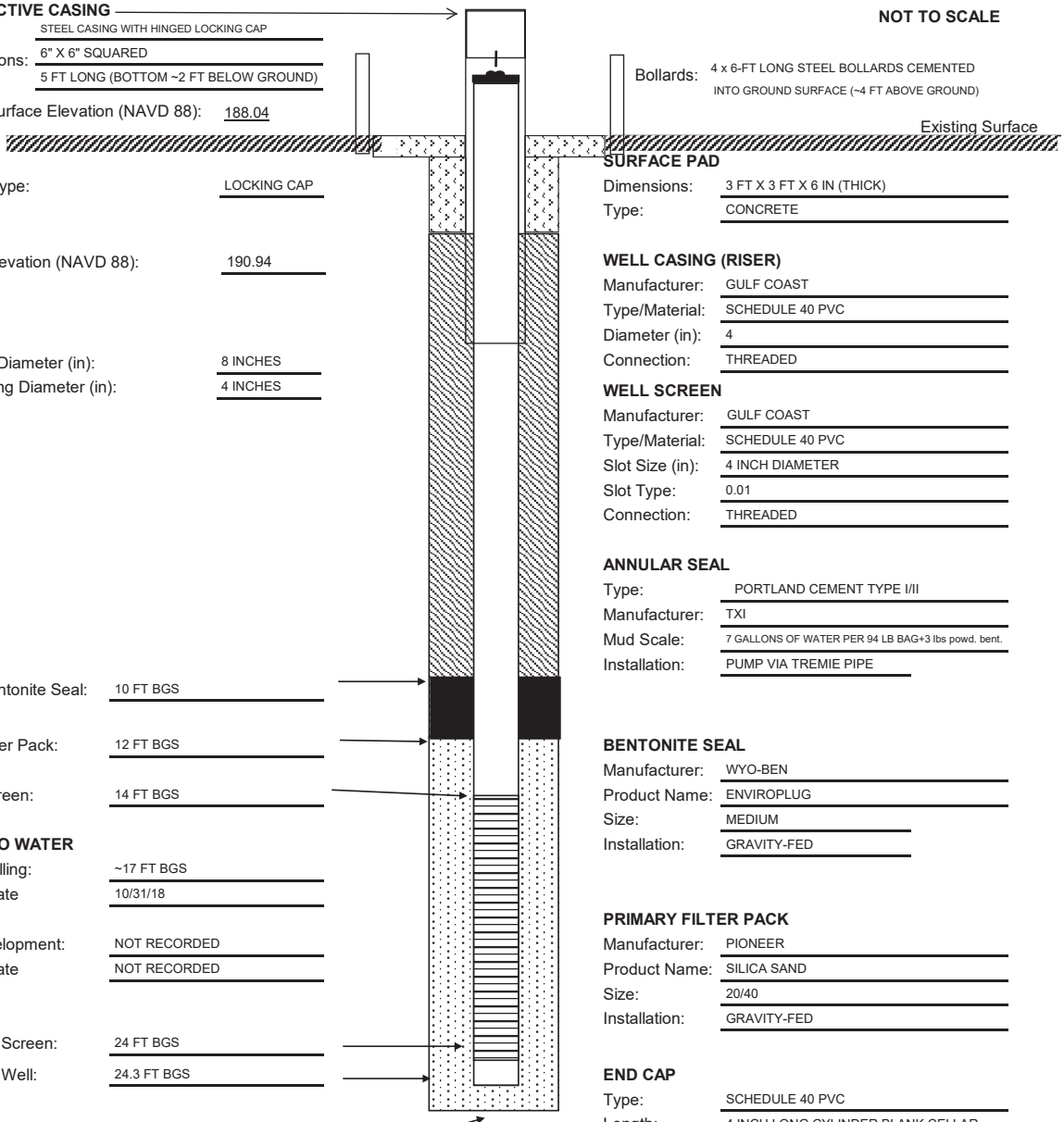
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 188.04

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 190.94

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 10 FT BGS

Top of Filter Pack: 12 FT BGS

Top of Screen: 14 FT BGS

DEPTH TO WATER

During Drilling: ~17 FT BGS

Date: 10/31/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 24 FT BGS

Bottom of Well: 24.3 FT BGS

Borehole Depth: 25

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW04
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 10/31/2018
Ended: 10/31/2018

Drilling Co.: ETTL
Drill Rig Model: Diedrich B-50
Driller: Pedro Gonzales
Drilling Method: Hollow-Stem Auger
Hole Diameter: 8 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: ft bgs on 31-Oct-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
		0						CL	**SILTY CLAY WITH SAND**; red (10R 4/6); dry; soft to firm; trace fine grained sand; mostly fines with low plasticity.		
		0			5						
		0			10			SM	**SILTY SAND**; light brown (7.5YR 6/4); dry to moist; loose to medium dense; mostly fine grained sand; some silty fines; heavy, mottling & iron staining.		Low Recovery
		0			15			CL	**SANDY LEAN CLAY**; light brown (7.5YR 6/3); dry; firm; trace fine grained sand; mostly fines; lighter mottling than above.		
		0			20			SP	**POORLY GRADED SAND**; light brownish gray (2.5Y 6/2); moist to wet; dense; mostly fine grained sand; trace fines; iron staining.		
					25			CH	**FAT CLAY**; light brown (7.5YR 6/3); dry; firm to hard; with high plasticity.		Set well at 24.5 ft bgs
					30				**Boring was terminated at approximately 25 feet bgs.**		

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

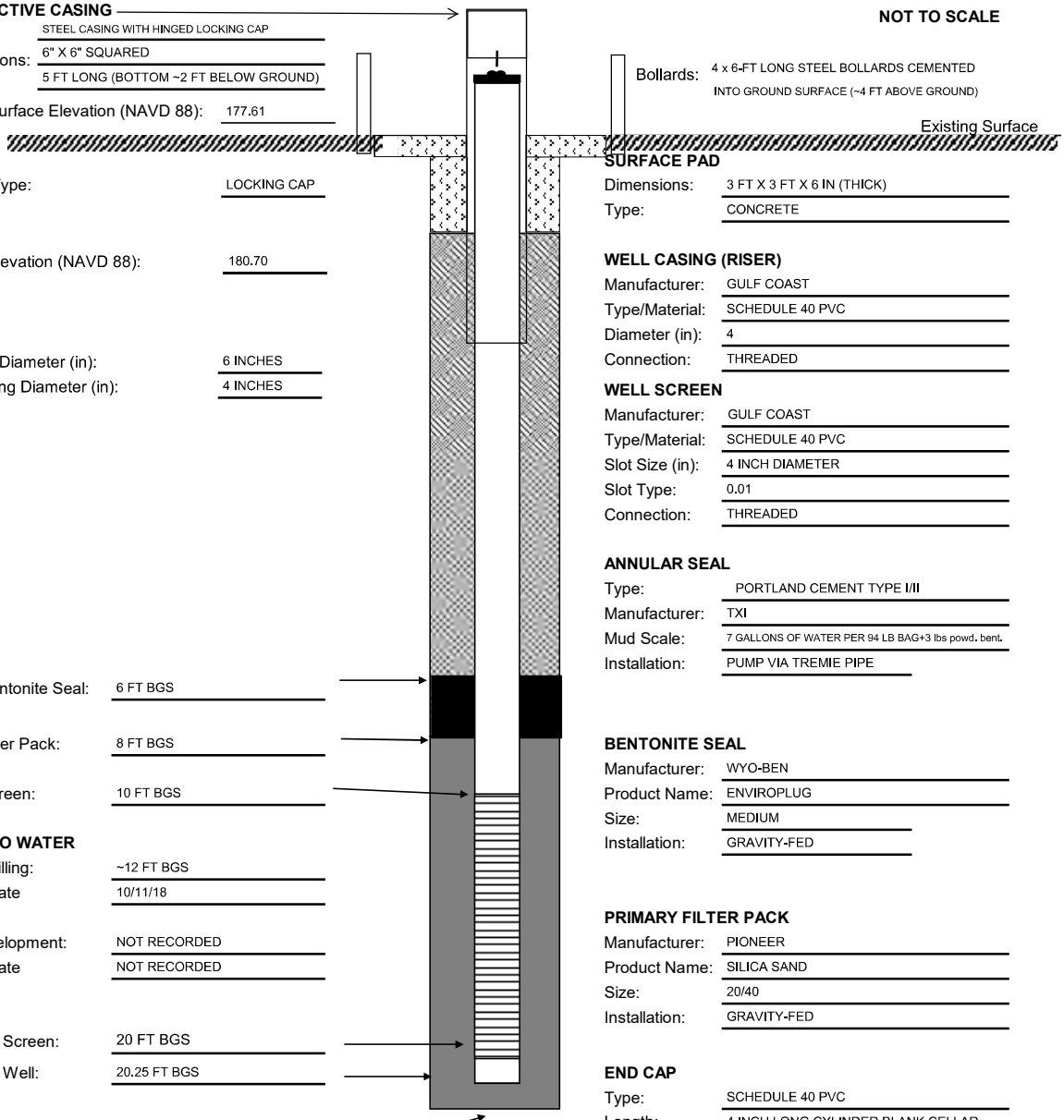
Boring/Well ID: 16RW04
Sheet: 1 **of** 1

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW05
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/11/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	RICH HERMAN	**NORTHING:**	6953395.99
SCIENTIST:	W. FOSS	**EASTING:**	3314192.31

PROTECTIVE CASING
Type: STEEL CASING WITH HINGED LOCKING CAP
Dimensions: 6" X 6" SQUARED
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)
Ground Surface Elevation (NAVD 88): 177.61

NOT TO SCALE



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 180.70

Borehole Diameter (in): 6 INCHES
Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 6 FT BGS

Top of Filter Pack: 8 FT BGS

Top of Screen: 10 FT BGS

DEPTH TO WATER
During Drilling: ~12 FT BGS
Date: 10/11/18

Post Development: NOT RECORDED
Date: NOT RECORDED

Bottom of Screen: 20 FT BGS

Bottom of Well: 20.25 FT BGS

Borehole Depth: 20.25 FT BGS

SURFACE PAD
Dimensions: 3 FT X 3 FT X 6 IN (THICK)
Type: CONCRETE

WELL CASING (RISER)
Manufacturer: GULF COAST
Type/Material: SCHEDULE 40 PVC
Diameter (in): 4
Connection: THREADED

WELL SCREEN
Manufacturer: GULF COAST
Type/Material: SCHEDULE 40 PVC
Slot Size (in): 4 INCH DIAMETER
Slot Type: 0.01
Connection: THREADED

ANNULAR SEAL
Type: PORTLAND CEMENT TYPE I/II
Manufacturer: TXI
Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.
Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL
Manufacturer: WYO-BEN
Product Name: ENVIROPLUG
Size: MEDIUM
Installation: GRAVITY-FED

PRIMARY FILTER PACK
Manufacturer: PIONEER
Product Name: SILICA SAND
Size: 20/40
Installation: GRAVITY-FED

END CAP
Type: SCHEDULE 40 PVC
Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL
Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW06
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/23/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953828.03
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3313990.94

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

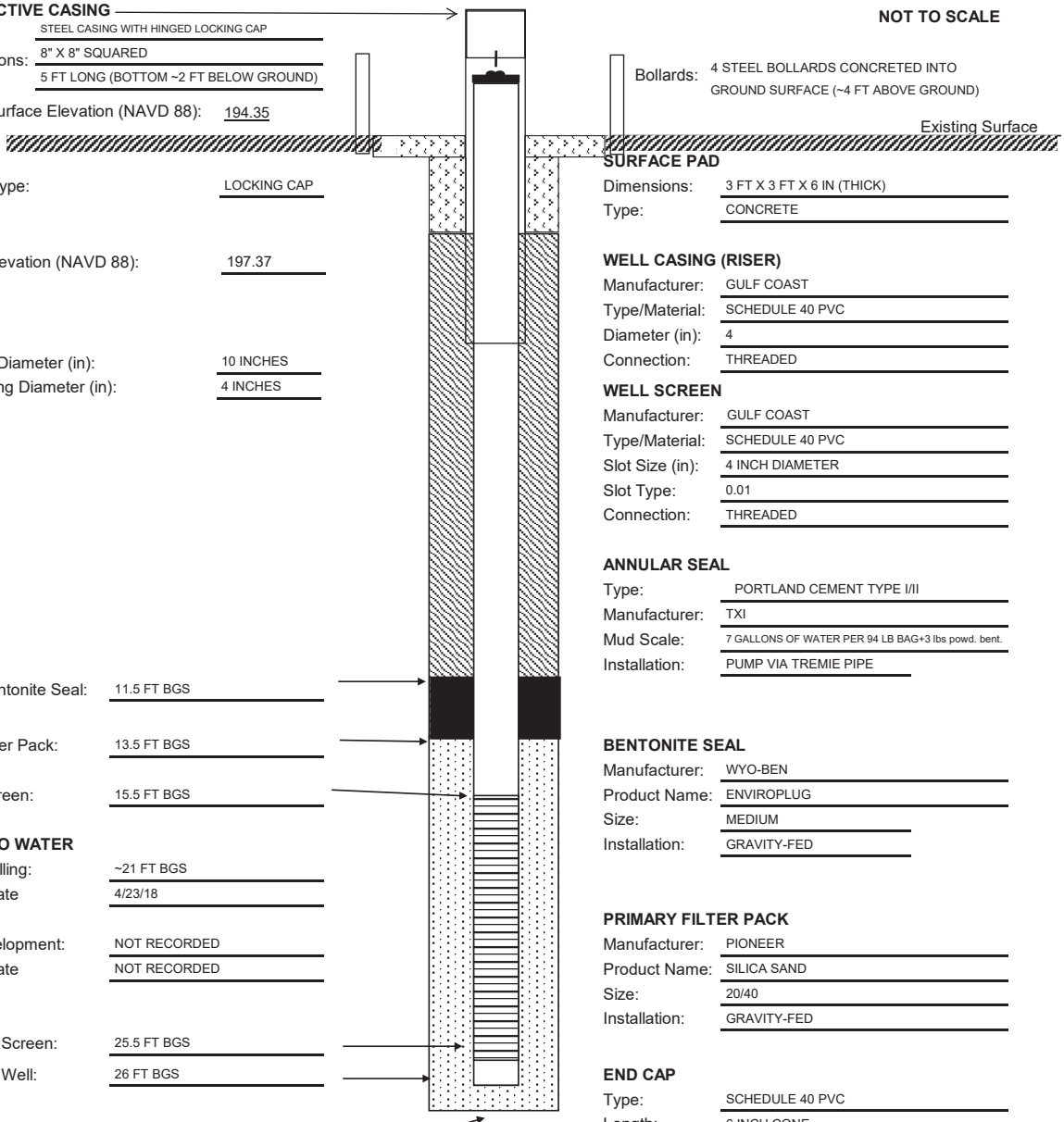
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 194.35

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 197.37

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 11.5 FT BGS

Top of Filter Pack: 13.5 FT BGS

Top of Screen: 15.5 FT BGS

DEPTH TO WATER

During Drilling: ~21 FT BGS

Date: 4/23/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 25.5 FT BGS

Bottom of Well: 26 FT BGS

Borehole Depth: 27.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW06
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/23/2018
Ended: 4/23/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 21 ft bgs on 23-Apr-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
0833		0							ML	**SANDY SILT**; light brown (7.5YR 6/4); dry; soft.		
									CH	**SILTY FAT CLAY**; light brown (7.5YR 6/3); dry; hard; mostly fines with medium plasticity; mottling is 7.5YR 7/8 Red.		
0841		0										
						5						
0844		0										
									ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		
0848		0							CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		
									ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
						10			CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		
0853		0										
0901		0.1							ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		
									CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
						15			ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		
0906		0.2							CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
0913		0.1										
						20						
0919		0.1								▽		
									SM	**SILTY SAND**; light brown (7.5YR 6/4); moist to wet; loose; some fines.		Used Pioneer silica sand 20/40
0928		0.1										
						25			CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard.		
0934		0										
										Boring was terminated at approximately 27.5 feet bgs.		Set well at 25.5; Screened from 15.5 to 25.5 ft bgs
						30						

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16RW06
Sheet: 1 **of** 1

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW07
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/20/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953785.38
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3313988.18

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

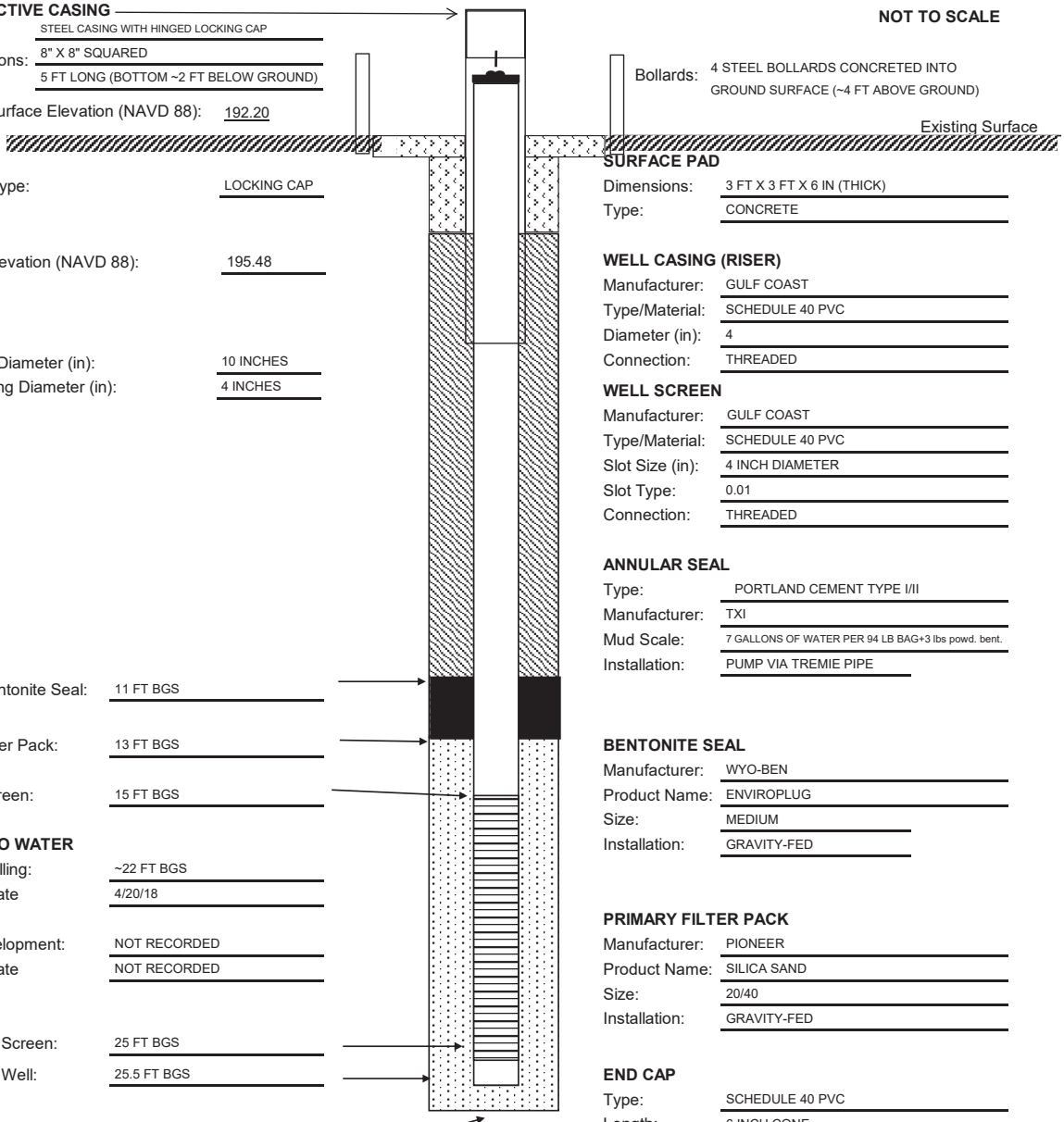
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 192.20

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 195.48

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 11 FT BGS

Top of Filter Pack: 13 FT BGS

Top of Screen: 15 FT BGS

DEPTH TO WATER

During Drilling: ~22 FT BGS

Date: 4/20/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 25 FT BGS

Bottom of Well: 25.5 FT BGS

Borehole Depth: 25.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW07
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/20/2018
Ended: 4/20/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 22 ft bgs on 20-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
0833		0						ML	**SANDY SILT**; light brown (7.5YR 6/4); dry; soft.		
								CH	**SILTY FAT CLAY**; light brown (7.5YR 6/3); dry; hard; mostly fines with medium plasticity; mottling is 7.5YR 7/8 Red.		
0839		0									
0842		0			5						
0848		0.3						ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
0851		0.4			10			CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
0900		0.2						ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		
0906		0.4			15			CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		
0911		0.2						ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry to moist; soft; alternates silty sand to sandy clay.		
0917		0.2			20						
0921		0						SM	**SILTY SAND**; light brown (7.5YR 6/4); moist to wet; loose; some fines.		Used Pioneer silica sand 20/40
								CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
0922		0			25				**Boring was terminated at approximately 25.5 feet bgs.**		Set well at 25.5; Screened from 15 to 25 ft bgs
					30						

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16RW07
Sheet: 1 **of** 1

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW08
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/19/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953788.82
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314017.82

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

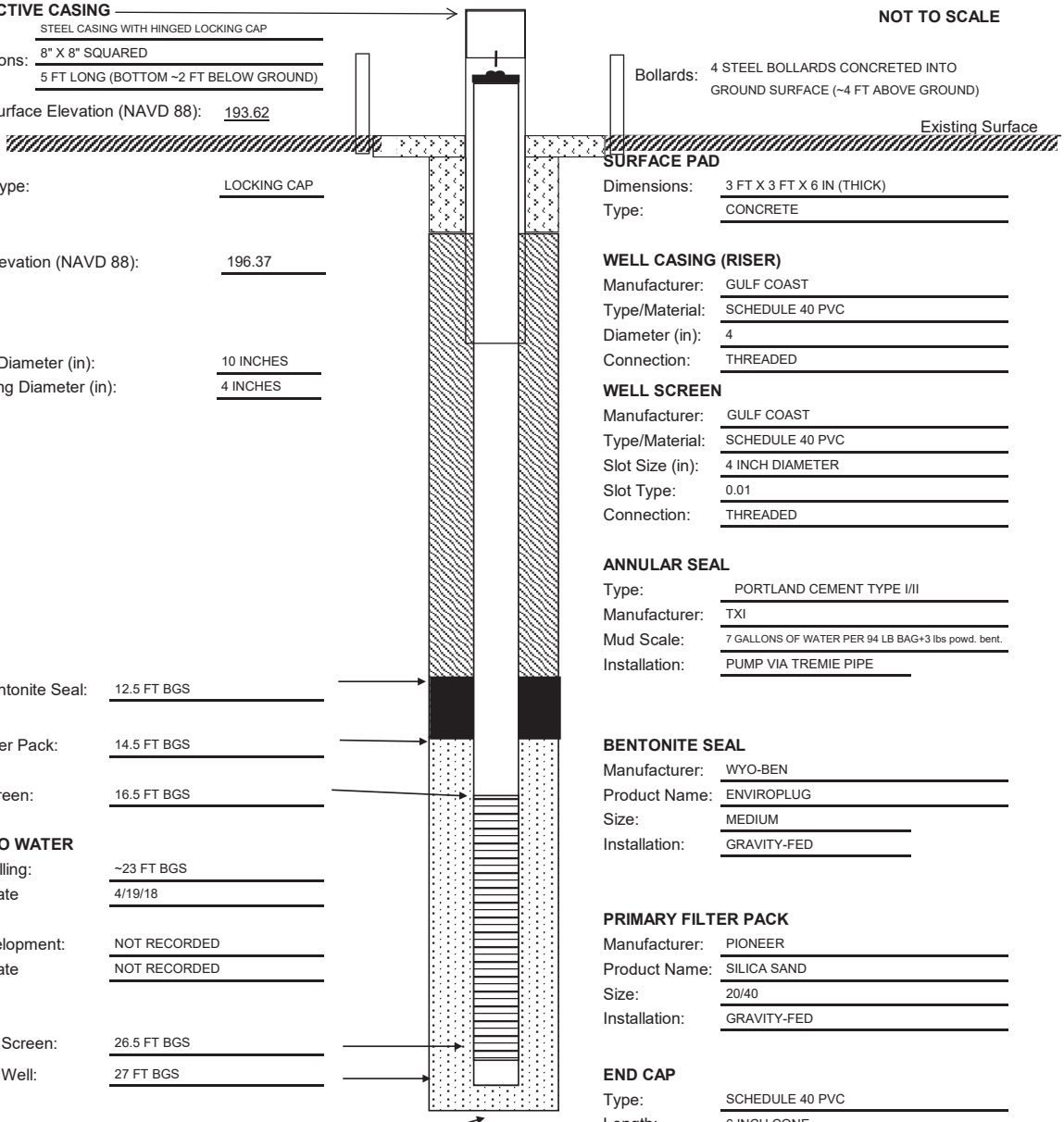
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 193.62

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 196.37

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 12.5 FT BGS

Top of Filter Pack: 14.5 FT BGS

Top of Screen: 16.5 FT BGS

DEPTH TO WATER

During Drilling: ~23 FT BGS

Date: 4/19/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 26.5 FT BGS

Bottom of Well: 27 FT BGS

Borehole Depth: 27.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW08
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/19/2018
Ended: 4/19/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 23 ft bgs on 19-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
1530		0.1						ML	**SANDY SILT**; light brown (7.5YR 6/4); dry; soft.		
								CH	**SILTY FAT CLAY**; light brown (7.5YR 6/3); dry; hard; mostly fines with medium plasticity; mottling is 7.5YR 7/8 Red.		
1537		0.3									
					5						
1542		0									
1546		0							With no to low plasticity.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
					10			ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry to moist; soft; alternates silty sand to sandy clay.		
1552		0						CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry; soft; mostly fines with no to low plasticity.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
1600		0.4						ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry; soft; alternates silty sand to sandy clay.		
					15			CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
1606		0.2									
								SM	**SILTY SAND**; light brown (7.5YR 6/4); dry; loose; some fines.		
1613		0.1						CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
					20						
1617		0.1									
1622		0						SM	**SILTY SAND**; light brown (7.5YR 6/4); moist to wet; loose; some fines.		Used Pioneer silica sand 20/40
					25						
16:60		0						CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		
									Boring was terminated at approximately 27.5 feet bgs.		Set well at 27; Screened from 16.5 to 26.5 ft bgs
					30						

Project No.:
Location: ,

Boring/Well ID: 16RW08
Sheet: 1 **of** 1

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW09
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/19/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953821.11
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314045.50

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

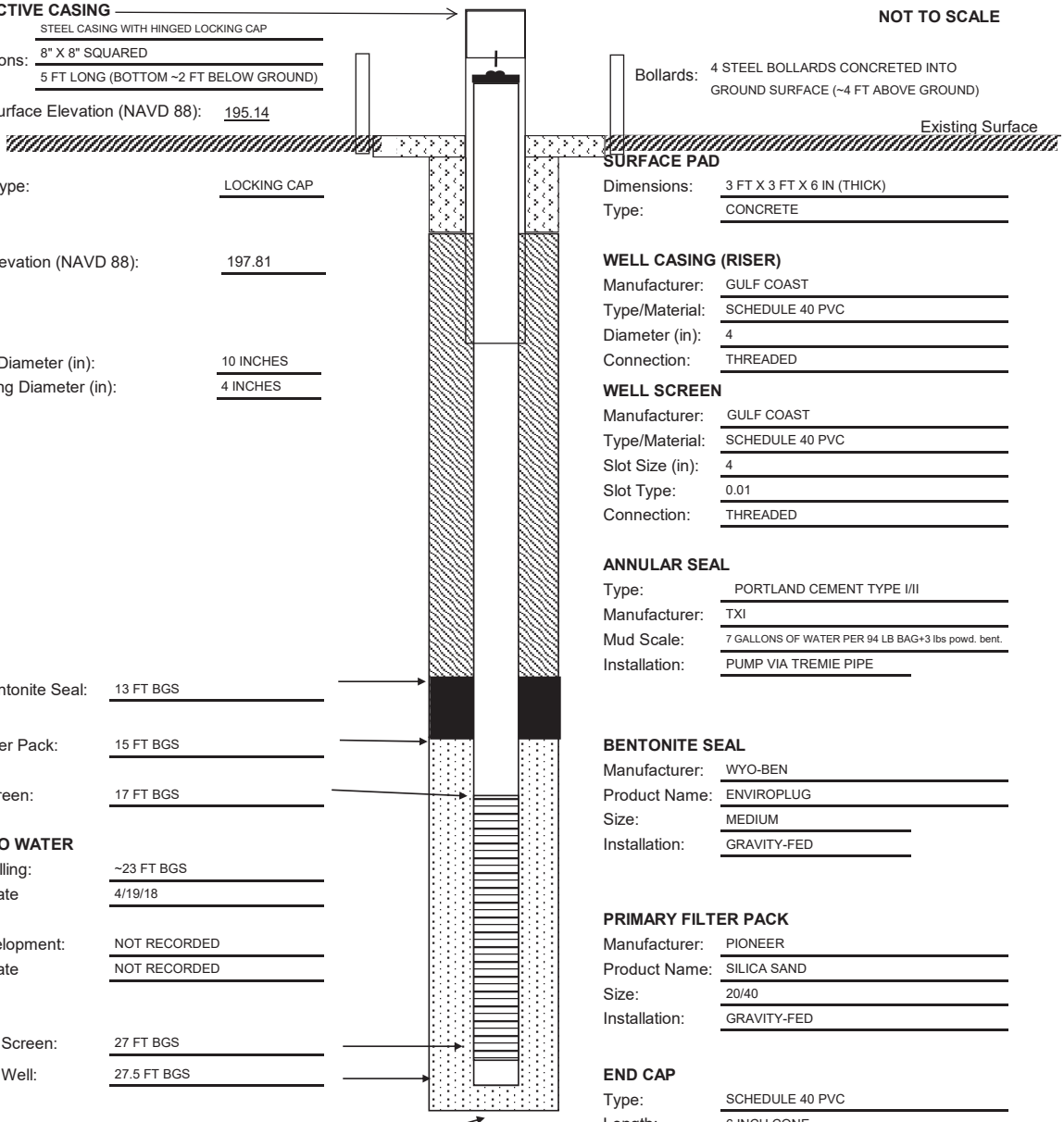
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 195.14

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 197.81

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 13 FT BGS

Top of Filter Pack: 15 FT BGS

Top of Screen: 17 FT BGS

DEPTH TO WATER

During Drilling: ~23 FT BGS

Date: 4/19/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 27 FT BGS

Bottom of Well: 27.5 FT BGS

Borehole Depth: 30

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW09
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/19/2018
Ended: 4/19/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 23 ft bgs on 19-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
0845		0						ML	**SANDY SILT**; light brown (7.5YR 6/4); dry; soft.		
								CH	**SILTY FAT CLAY**; light brown (7.5YR 6/3); dry; hard; mostly fines with medium plasticity; mottling is 7.5YR 7/8 Red.		
0850		0.1									Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
					5						
0855		0.2									
								ML-SM	**SANDY SILT WITH CLAY**; yellowish red (5YR 5/6); dry to moist; soft to firm; alternates silty sand to sandy clay.		
0900		0.3						CH	**SILTY FAT CLAY**; very pale brown (10YR 7/3); dry; hard to very hard; trace fine grained sand; mostly fines with high plasticity; iron staining; reddish brown.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
					10						
0910		0									
0915		0									
					15						
0920		0.1									
0925		0.3						SM	**SILTY SAND WITH CLAY**; yellowish red (5YR 5/6); moist; dense; some fines; mottling is 7.5YR 7/8 Red.		
								CL	**SILTY CLAY**; light brown (7.5YR 6/4); dry; soft; with high plasticity.		Used Pioneer silica sand 20/40
					20			CH	Light brown (7.5YR 6/4); increases in plasticity.		
0930		0									
0935		0			▽			SM	**SILTY SAND**; light brown (7.5YR 6/4); wet; loose; some fines.		
					25						
1000		0									
								CH	**SILTY CLAY**; light brown (7.5YR 6/4); dry to moist; firm; mostly fines with high plasticity; little recovery, contact with upper unit is difficult to identify.		bottom of screen at 27 ft bgs
1005											
					30						

Boring was terminated at approximately 30 feet bgs.

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW10
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/19/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953763.40
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314053.06

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 8" X 8" SQUARED

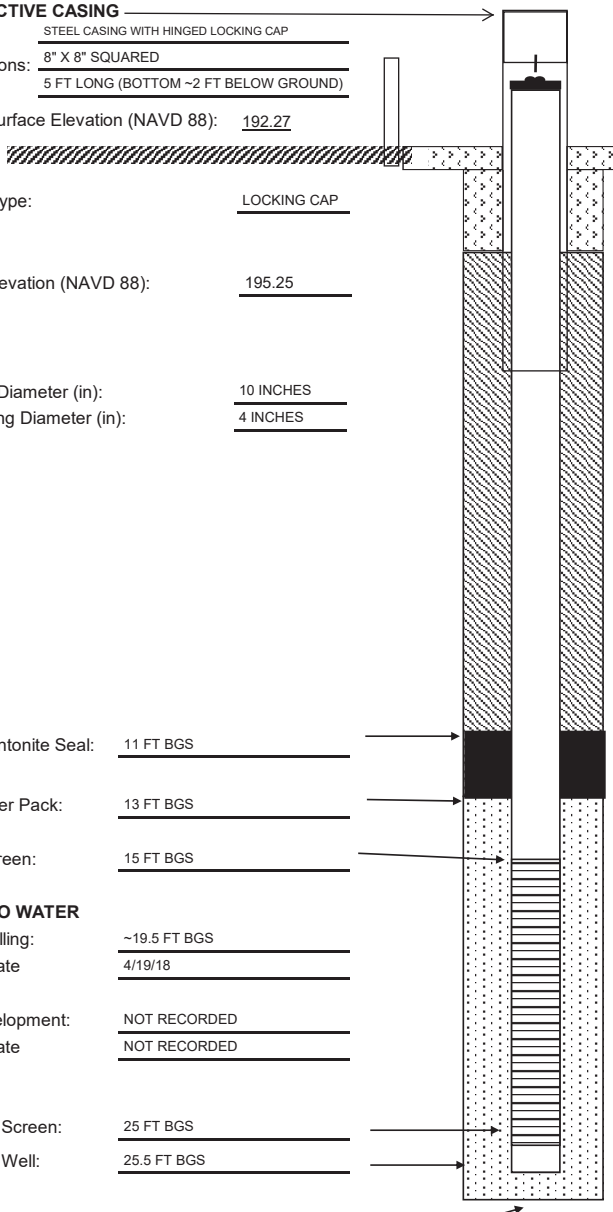
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 192.27

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 195.25

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 11 FT BGS

Top of Filter Pack: 13 FT BGS

Top of Screen: 15 FT BGS

DEPTH TO WATER

During Drilling: ~19.5 FT BGS

Date: 4/19/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 25 FT BGS

Bottom of Well: 25.5 FT BGS

Borehole Depth: 25.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): SCHEDULE 40 PVC

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW10
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 4/19/2018
Ended: 4/19/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

First Water: 19.5 ft bgs on 19-Apr-18 at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
1250		0.1							ML	**SANDY SILT**; light brown (7.5YR 6/4); dry; soft.		
									CH	**SILTY FAT CLAY**; light brown (7.5YR 6/3); dry; hard; mostly fines with medium plasticity; mottling is 7.5YR 7/8 Red.		
1255		0.4										
						5						
1300		0.1										Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
1305		0.3										
						10						
1310		0.2										
									CL	**SILTY CLAY WITH SAND**; light brown (7.5YR 6/4); dry to moist; soft; mostly fines with no to low plasticity.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
1315		0.3										
						15						
1320		0.1										
1325		0.3										
						20			SM	**SILTY SAND**; light brown (7.5YR 6/4); moist to wet; loose; some fines.		
1330		0.1							CH	**SILTY FAT CLAY**; light brown (7.5YR 6/4); dry; firm to hard; increases in plasticity.		Used Pioneer silica sand 20/40
1335		0.2										
						25				**Boring was terminated at approximately 25.5 feet bgs.**		Set well at 25.5; Screened from 15 to 25 ft bgs
						30						

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16RW10
Sheet: 1 **of** 1

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW11
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/3/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953828.09
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314545.02

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

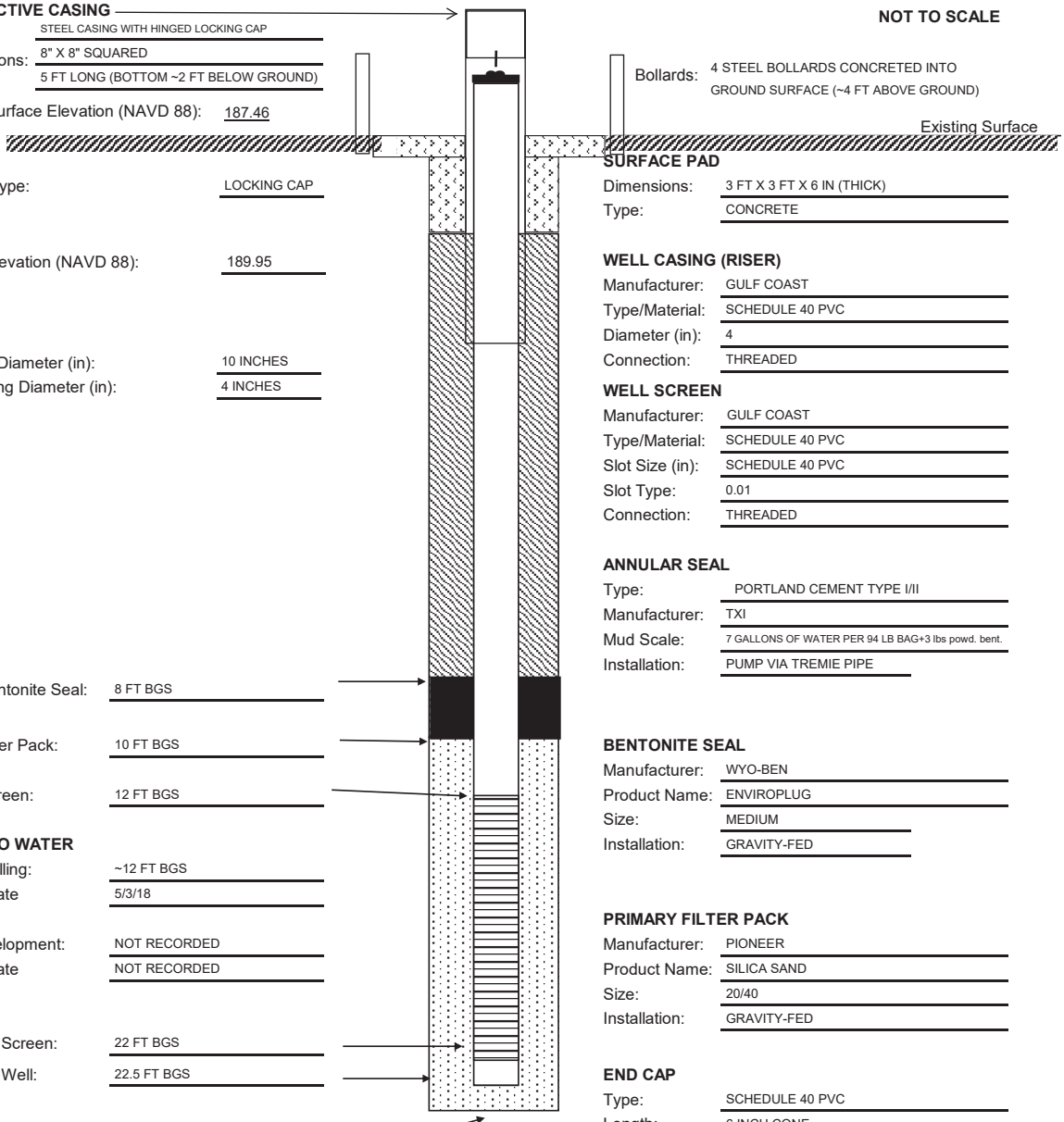
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 187.46

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 189.95

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 8 FT BGS

Top of Filter Pack: 10 FT BGS

Top of Screen: 12 FT BGS

DEPTH TO WATER

During Drilling: ~12 FT BGS

Date: 5/3/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 22 FT BGS

Bottom of Well: 22.5 FT BGS

Borehole Depth: 25

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): SCHEDULE 40 PVC

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW11
Sheet: 1 **of** 1

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 5/3/2018
Ended: 5/3/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 12 ft bgs on 03-May-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
		0.1						CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		
		0.3			5						Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
		0.2									
		0.5									
					10						
		0.1						ML-SM	**SILTY SAND WITH CLAY**; reddish yellow (7.5YR 6/8); dry; medium dense; iron staining; browish red.		
								SM	**SILTY SAND WITH CLAY**; very pale brown (10YR 7/4); moist to wet; loose to medium dense; alternates silty sand to sandy clay; brownish red.		
		0.1			15						
		0.3						CL-ML	**CLAYEY SILT WITH SAND**; very pale brown (10YR 7/4); moist; soft; more clay content than above.		Used Pioneer silica sand 20/40
		0.1		NR	20			CL-ML	**SILTY FAT CLAY WITH SAND**; light brown (7.5YR 6/4); dry; hard; mostly fines with high plasticity; organic content.		No recovery from 20-22.5 ft bgs
					25				**Boring was terminated at approximately 25 feet bgs.**		Set well at 22.5 ft bgs; set screen 12' bgs to 22' bgs
					30						

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

Project No.:
Location: ,

Boring/Well ID: 16RW11
Sheet: 1 **of** 1

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16RW12
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/4/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953887.58
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314501.01

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

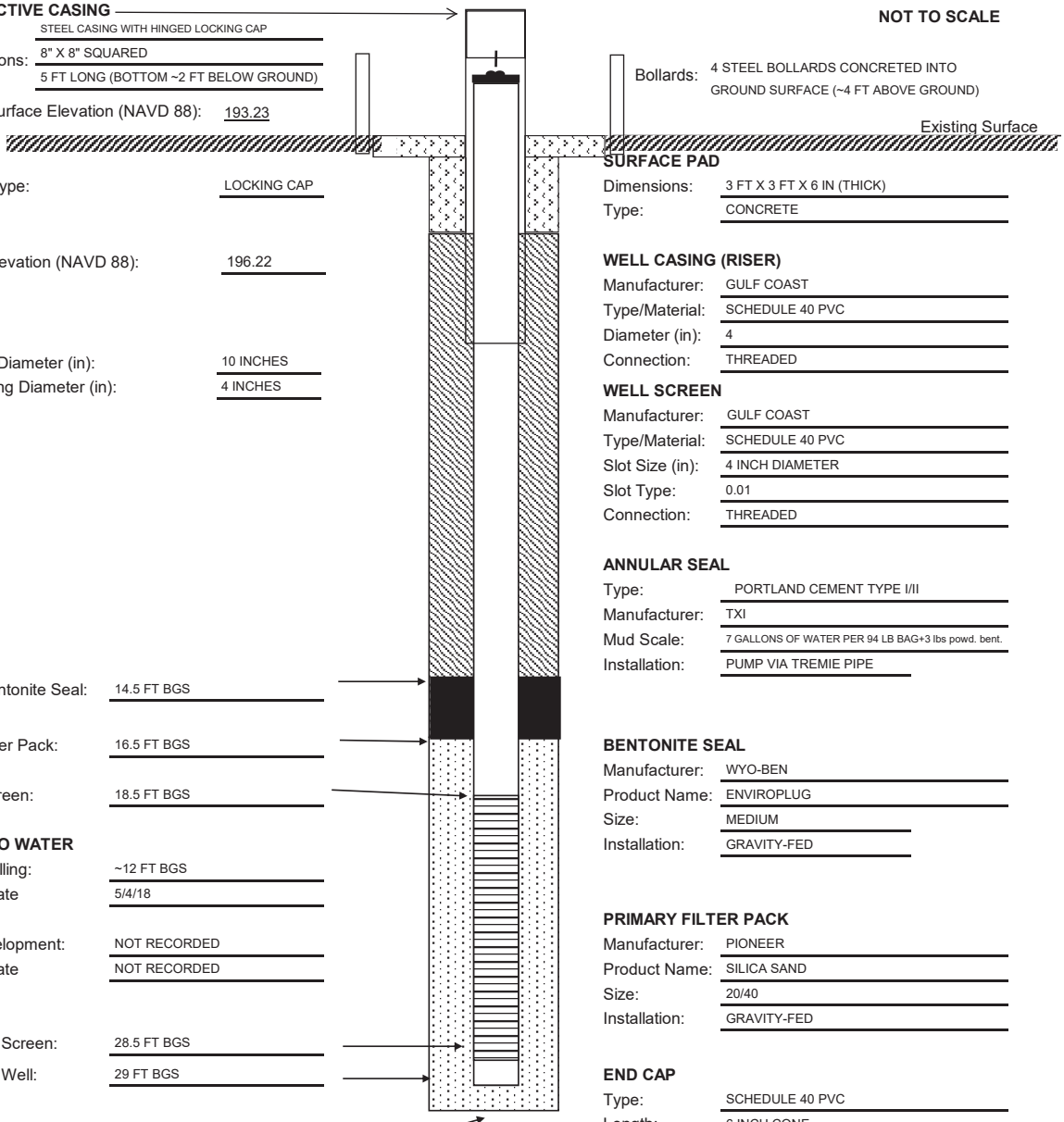
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 193.23

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 196.22

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 14.5 FT BGS

Top of Filter Pack: 16.5 FT BGS

Top of Screen: 18.5 FT BGS

DEPTH TO WATER

During Drilling: ~12 FT BGS

Date: 5/4/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 28.5 FT BGS

Bottom of Well: 29 FT BGS

Borehole Depth: 30

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

APTIM

Boring/Well ID: 16RW12
Sheet: 1 **of** 2

Project No.: 501032
Client: US ARMY
Location: LHAAP-16
Started: 5/4/2018
Ended: 5/4/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 10 **(inches)**

Logged By: Allen Willmore
Edited By: Allen Willmore
Checked By: Greg Jones
Number:

▽ First Water: 12 ft bgs on 04-May-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
		0.1						CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		
		0.0			5						
		0.0						ML-SM	**SILTY SAND WITH CLAY**; reddish yellow (7.5YR 6/8); moist; medium dense; iron staining; browish red.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
		0.3			10						
		0.0									
		0.0						CH	**SILTY FAT CLAY**; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts. Allowed to hydrate for 1 hour
		0.1			15						
		0.2						SM	**SILTY SAND WITH CLAY**; very pale brown (10YR 7/4); moist to wet; loose to medium dense; alternates silty sand to sandy clay; brownish red.		
		0		NR	20						No recovery from 20-22.5
		0.1									
		0.3			25				More clay content.		
								CL-ML	**SILTY FAT CLAY WITH SAND**; light brown (7.5YR 6/4); dry; hard; mostly fines with high plasticity; organic content.		Used Pioneer silica sand 20/40
					30						

Boring was terminated at approximately 30 feet bgs.

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

APTIM

BORING LOG

Boring/Well ID: 16RW12
Sheet: 2 **of** 2

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
						35						Set well at 29' bgs, screen from 18.5-28.5
						40						
						45						
						50						
						55						
						60						

Project No.:
Location: ,

Boring/Well ID: 16RW12
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 10/5/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW48
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	10/11/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	RICH HERMAN	**NORTHING:**	6953695.43
SCIENTIST:	W. FOSS	**EASTING:**	3314485.33

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

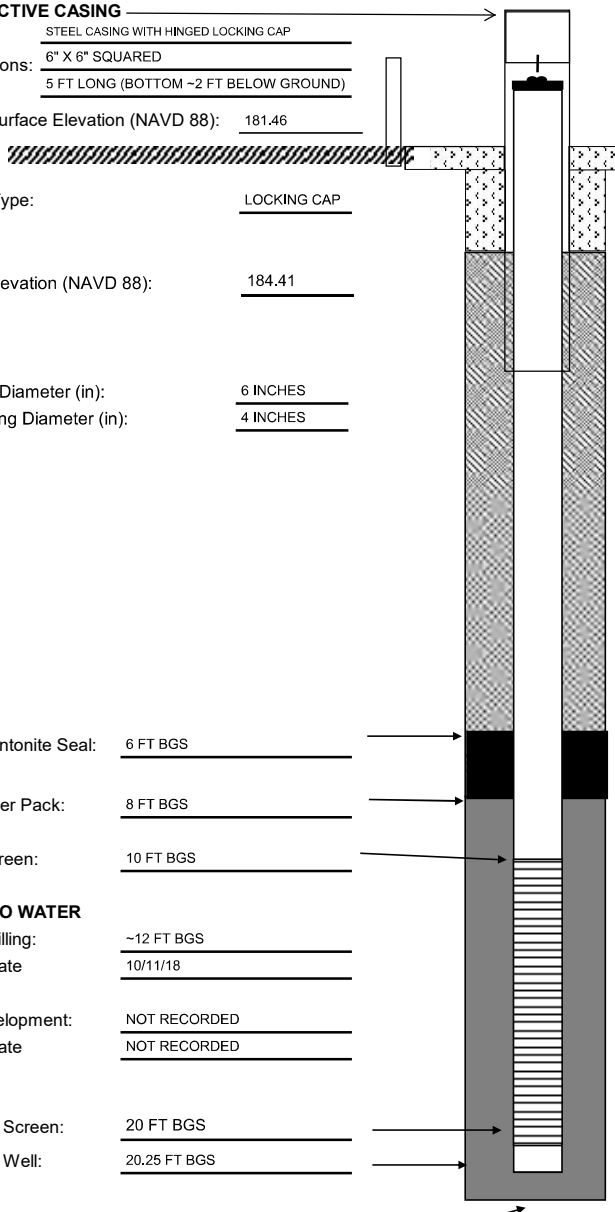
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 181.46

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 184.41

Borehole Diameter (in): 6 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 6 FT BGS

Top of Filter Pack: 8 FT BGS

Top of Screen: 10 FT BGS

DEPTH TO WATER

During Drilling: ~12 FT BGS

Date: 10/11/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 20 FT BGS

Bottom of Well: 20.25 FT BGS

Borehole Depth: 20.25 FT BGS

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW49
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	8/2/19
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	RICH HERMAN	**NORTHING:**	6953750.74
SCIENTIST:	W. FOSS	**EASTING:**	3314402.85

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

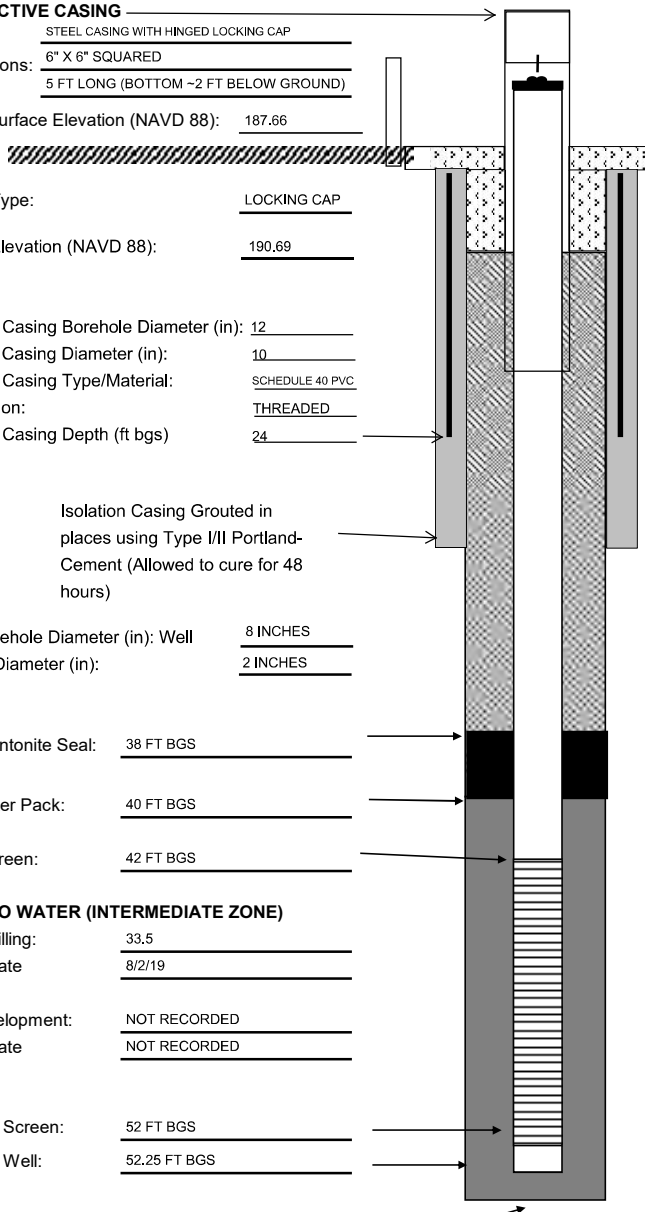
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 187.66

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 190.69

Isolation Casing Borehole Diameter (in): 12

Isolation Casing Diameter (in): 10

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 24

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 38 FT BGS

Top of Filter Pack: 40 FT BGS

Top of Screen: 42 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: 33.5

Date 8/2/19

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 52 FT BGS

Bottom of Well: 52.25 FT BGS

Borehole Depth: 54 FT BGS

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDRICAL CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

Drilling Log

Monitoring Well **16WW49**

Project *Longhorn Army Ammunition Plant* Owner *U.S. Army*

Location *LHAAP-16* Proj. No. *501032*

Surface Elev. *187.66* Total Hole Depth *54.0 ft.* North *6953750.74* East *3314402.85*

Top of Casing *190.69* Water Level Initial *~33.5' bgs* Static *NA* Diameter *8 in.*

Screen: Dia *4 in.* Length *10 ft.* Type/Size *SCH. 40 PVC/0.010 in.*

Casing: Dia *4 in.* Length *42 ft.* Type *SCH. 40 PVC*

Drill Co. *ETTL* Rig/Core *Dietrich B-50 Tracked Rig*

Driller *Rich Herman* Method *Hollow-Stem Auger*

Log By *W. Foss* Date *8/2/19* Driller # *59385*

COMMENTS

Probe to 60". Log from cuttings to 60".

12" PVC Surface casing set at 24' bgs. 4" Dia well set at 52' with 10' Sch. 40 0.010" slot screen.

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0				CL	**SILTY CLAY** TOPSOIL; reddish brown, firm, moist, trace sand, some roots.
2				CL	**SILTY CLAY**; light reddish brown, stiff to hard, damp.
4					
6				ML	**SANDY SILT**; light reddish brown with light gray lenses, medium dense, damp, trace clay increasing with depth.
8				CL	**SANDY CLAY**; reddish brown with gray lenses, stiff to hard, trace silt, trace iron manganese oxide (FEMnO) staining.
10				ML	**SANDY SILT**; light gray with red lenses, medium dense, moist, trace clay.
12					
14				SW	**SILTY SAND**; orangeish brown, loose to medium dense, moist to saturated @ 14', fine grain.
16					
18				ML	**SANDY SILT**; light brown, loose, saturated, fine grain, trace clay
20					
22				CL	**SILTY CLAY**; orangeish brown with gray lenses, stiff, moist, some FeMnO staining, gray decreasing with depth.
24					

Continued Next Page

Drilling Log

Monitoring Well **16WW49**

Project *Longhorn Army Ammunition Plant* Owner *U.S. Army*

Location *LHAAP-16* Proj. No. *501032*

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
					Continued
26	NR	100%		SC	Slough from material in place when casing was set. Sampler filled with **CLAYEY SAND**; light yellowish brown (10YR 6/4), loose, saturated, trace silt.
28		100%		CL	**SILTY CLAY**; yellowish brown (10YR 5/4), stiff, moist, some orangeish mottling, trace sand, sand content increasing with depth.
30		75%			
32		100%			
34		100%		SC	**CLAYEY SAND**; light yellowish brown (10YR 6/4), loose, saturated, some silt.
36		100%			
38		100%		SM	**SILTY SAND**; gray (10YR 6/1), loose to medium dense, saturated, trace clay
40		100%			
42		85%			Grain size increases from fine to medium @ 41',then back to fine at 41.5'.
44		100%			Color change to light brownish gray (10YR 6/2) @ 44.5'.
46		100%			Medium grained 42-45', increasing clay at 45-46'.
48		100%			
50		85%		CL	**SILTY CLAY**; dark gray (10YR 4/1), hard, damp, trace light gray mottles interbedded with **CLAYEY SILT**; light gray (10YR 7/1), with hard, damp, small sand lenses (<1" thick).
52		100%			
54					**END OF BORING AT 54 FEET.**
56					
58					

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW51
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	5/3/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953616.52
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314455.29

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

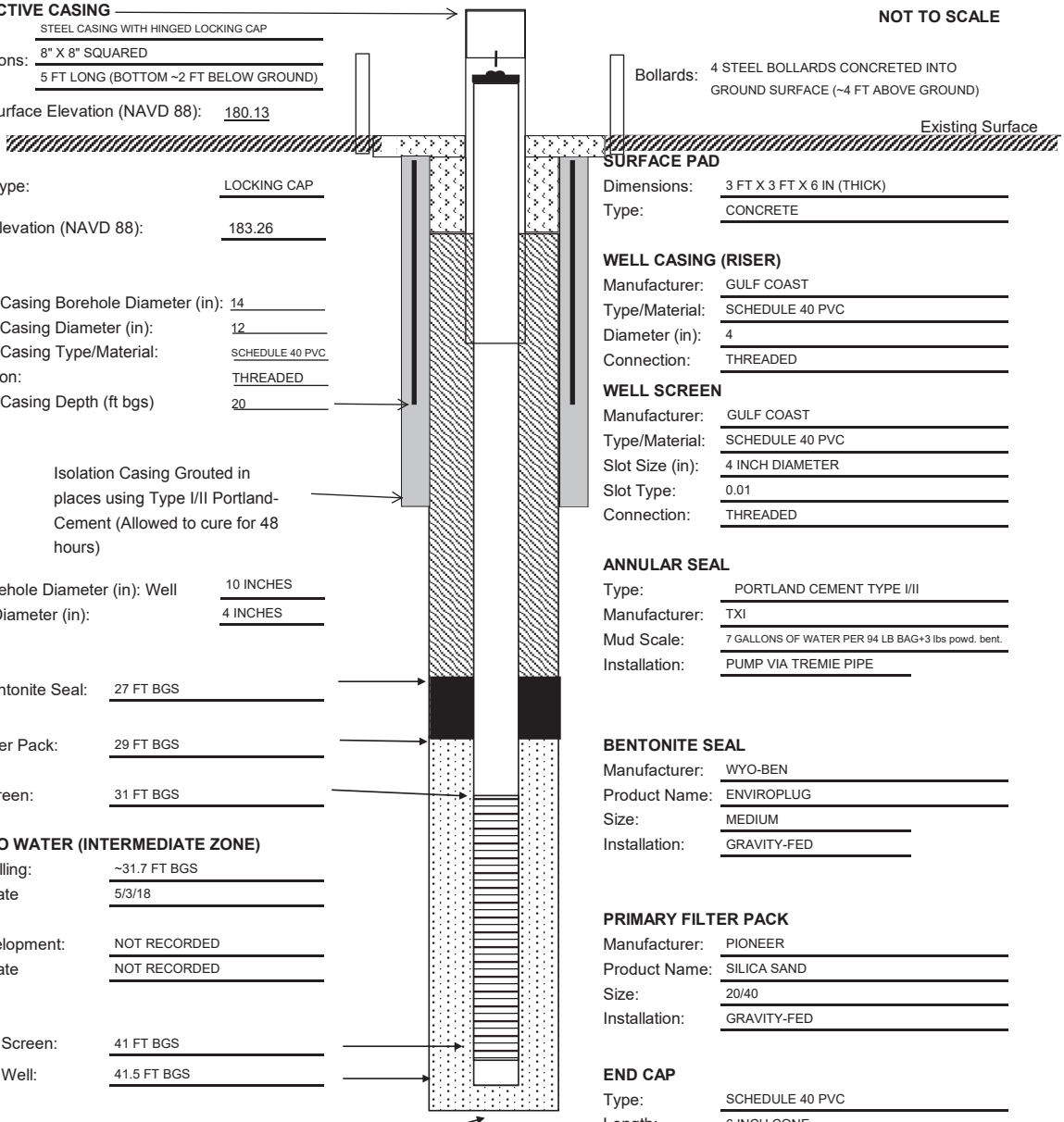
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 180.13

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 183.26

Isolation Casing Borehole Diameter (in): 14

Isolation Casing Diameter (in): 12

Isolation Casing Type/Material: SCHEDULE 40 PVC

Connection: THREADED

Isolation Casing Depth (ft bgs) 20

Isolation Casing Grouted in places using Type I/II Portland-Cement (Allowed to cure for 48 hours)

Well Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 27 FT BGS

Top of Filter Pack: 29 FT BGS

Top of Screen: 31 FT BGS

DEPTH TO WATER (INTERMEDIATE ZONE)

During Drilling: ~31.7 FT BGS

Date 5/3/18

Post Development: NOT RECORDED

Date NOT RECORDED

Bottom of Screen: 41 FT BGS

Bottom of Well: 41.5 FT BGS

Borehole Depth: 42.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

Boring/Well ID: 16WW51
Sheet: 1 of 2

Project No.: 501032
Client: USACE
Location: LONGHORN AAP, SITE 16
Started: 4/30/2018
Ended: 5/3/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drilling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By:
Checked By: G.N.Jones
Number:

First Water: ft bgs on at hrs
Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
		0							CH	**SILTY FAT CLAY** ; dry; hard; mostly fines with high plasticity; iron staining, reddish-brown.	Probed 5 holes for utility clearance. Pattern greater than diameter of auger
		0				5					
		0									
		0									
		0				10			SM	**SILTY SAND WITH CLAY** ; moist to wet; soft to firm; alternates silty sand to sandy clay; brownish red.	Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
		0							CL	**SILTY CLAY** ; dry; firm; with high plasticity.	
		0.2				15					
		0									
		0.3				20					Set 12" Isolation Casing at 20 ft bgs
		0									
		0				25					
		0.2				30					

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 5/15/18

Project No.:
Location: ,

Boring/Well ID: 16WW51
Sheet: 1 of 2

BORING LOG

Boring/Well ID: 16WW51
Sheet: 2 **of** 2

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	COMMENTS OR NOTES
		0									
		0							SP-SM	**SILTY SAND** ; greenish gray (5BG 5/1); wet; dense; mostly subangular to subrounded, fine grained sand; -Becomes Wet	
						35			SP	**POORLY GRADED SAND** ; wet; loose to medium dense; fine to medium grained sand; few silty fines.	
		0.2								Bluish black (10B 2.5/1); -more organic.	
						40			CH	**FAT CLAY** ; greenish gray (5BG 5/1); dry; firm to hard; trace sand; mostly fines with high plasticity.	set bottom of well at 41.5' bgs. Screen from 31 to 41
										Boring was terminated at approximately 42.5 feet bgs.	
						45					
						50					
						55					
						60					

Project No.:
Location: ,

Boring/Well ID: 16WW51
Sheet: 2 **of** 2

CB&I MEDIUM LOG LONGHORN.GPJ SHAWEI.GDT 5/15/18

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW55
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	4/18/18
DRILLING CONTRACTOR:	BEST DRILLING	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	SONNY TOBOLA	**NORTHING:**	6953802.81
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314115.62

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

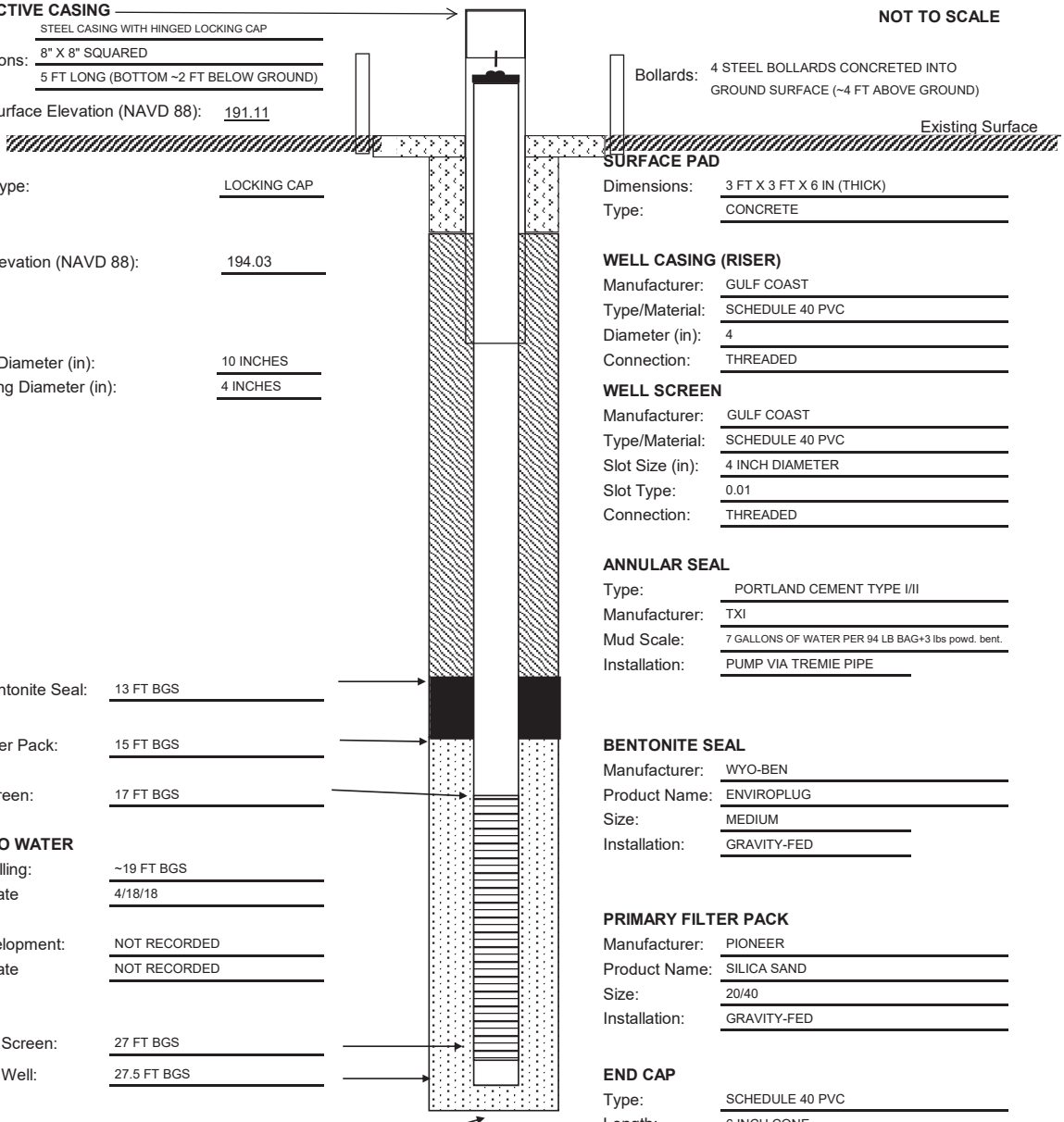
Dimensions: 8" X 8" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 191.11

NOT TO SCALE

Bollards: 4 STEEL BOLLARDS CONCRETED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 194.03

Borehole Diameter (in): 10 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 13 FT BGS

Top of Filter Pack: 15 FT BGS

Top of Screen: 17 FT BGS

DEPTH TO WATER

During Drilling: ~19 FT BGS

Date: 4/18/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 27 FT BGS

Bottom of Well: 27.5 FT BGS

Borehole Depth: 27.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 6 INCH CONE

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

Boring/Well ID: 16WW55
Sheet: 1 **of** 1

Project No.: 501032
Client: USACE
Location: LONGHORN AAP, SITE 16
Started: 4/18/2018
Ended: 4/18/2018

Drilling Co.: Best Drilling Services, Inc.
Drill Rig Model: CME-75
Driller: Sonny Tabola
Drlling Method: Hollow-Stem Auger
Hole Diameter: 12 **(inches)**

Logged By: Allen Willmore
Edited By:
Checked By: G.N.Jones
Number:

▽ First Water: 19 ft bgs on 18-Apr-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
1305		0.1						MLS	**SANDY ELASTIC SILT** ; moist; soft; mostly fines with no to low plasticity; iron staining, reddish-brown.		
								CH	**SILTY FAT CLAY** ; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		
		0.4			5						
		1.4									
								ML-SM	**SANDY SILT WITH CLAY** ; dry; soft to firm; alternates silty sand to sandy clay; brownish red.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag.
		0.6						CH	**SILTY FAT CLAY** ; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		
		0.2			10						
		0.3									
					15			SM	**SILTY SAND** ; moist; dense; some fines.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts Allowed to hydrate for 1 hour
		0.1						CL	**SILTY CLAY** ; dry; firm; with high plasticity.		
		0.6			▽						
					20			SM	**SILTY SAND** ; wet; loose; some fines.		
		0									
		0.0									
					25			CH	**SILTY CLAY** ; dry to moist; firm; mostly fines with high plasticity.		Used Pioneer silica sand 20/40
									Boring was terminated at approximately 27.5 feet bgs.		
					30						

CB&I MEDIUM LOG LONGHORN.GPJ SHAWE.GDT 5/15/18

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW56
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	11/01/18
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	PEDRO GONZALES	**NORTHING:**	6953958.38
SCIENTIST:	ALLEN WILLMORE	**EASTING:**	3314545.68

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

Dimensions: 6" X 6" SQUARED

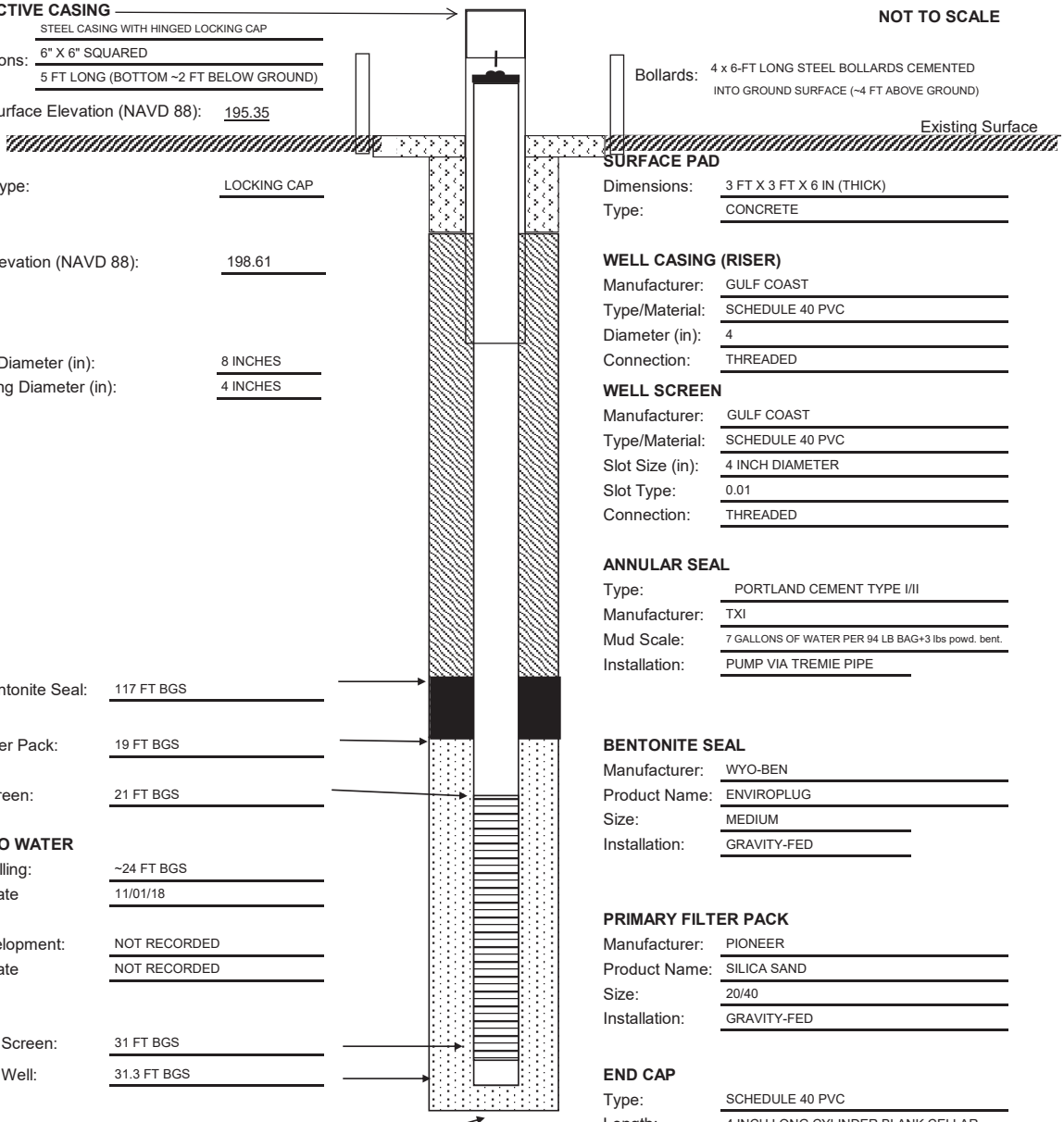
Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 195.35

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)

Existing Surface



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 198.61

Borehole Diameter (in): 8 INCHES

Well Casing Diameter (in): 4 INCHES

Top of Bentonite Seal: 117 FT BGS

Top of Filter Pack: 19 FT BGS

Top of Screen: 21 FT BGS

DEPTH TO WATER

During Drilling: ~24 FT BGS

Date: 11/01/18

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 31 FT BGS

Bottom of Well: 31.3 FT BGS

Borehole Depth: 31.5

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 4

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 4 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

BORING LOG

Boring/Well ID: 16WW56
Sheet: 1 of 2

Project No.: 501032
Client: USACE
Location: LONGHORN AAP, SITE 16
Started: 11/1/2018
Ended: 11/1/2018

Drilling Co.: ETTL
Drill Rig Model: Diedrich B-50
Driller: Pedro Gonzales
Drilling Method: Hollow-Stem Auger
Hole Diameter: 8 (inches)

Logged By: Allen Willmore
Edited By:
Checked By: G.N.Jones
Number:

▽ First Water: ft bgs on 01-Nov-18 at hrs
▼ Static Water: ft bgs on at hrs

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
						5			CH	**SILTY FAT CLAY** ; dry; hard; mostly fines with high plasticity; iron staining; reddish brown.		
									ML-SM	**SILTY SAND WITH CLAY** ; reddish yellow (7.5YR 6/8); moist; medium dense; iron staining; browish red.		Portland-Cement grout was mixed to a ratio of 7 gallons of water per 94lb bag
						10			CL	**SILTY FAT CLAY** ; pale brown (10YR 6/3); dry; very hard; mostly fines with medium plasticity; iron staining, drilling is hard.		Used Enviroplug Medium Bentonite Chips. Hydrated chips in1 ft lifts Allowed to hydrate for 1 hour
						15				-becomes softer.		
						20			SM	**SANDY SILT** ; pale brown (10YR 6/3); dry to moist; -becomes stiff.		

CB&I SHORT LOG LONGHORN.GPJ SHAWEI.GDT 4/8/20

Project No.: 501032
Location: LONGHORN AAP, SITE 16

Boring/Well ID: 16WW56
Sheet: 1 of 2

BORING LOG

Boring/Well ID: 16WW56
Sheet: 2 of 2

TIME	SAMPLE NUMBER	PID (ppm)	BLOWS (per 6 inch)	INTERVAL	RECOVERY	DEPTH (feet)	ELEVATION (feet msl)	GRAPHIC LOG	SOIL/ROCK SYMBOL	SOIL / ROCK DESCRIPTION	WELL DETAIL	COMMENTS OR NOTES
						25				Wet.		
									SP	**POORLY GRADED SAND** ; light reddish brown (5YR 6/3); wet; loose; subangular to subrounded, fine grained sand; some fines.		
						30			CL-ML	**SILTY FAT CLAY WITH SAND** ; pale brown (10YR 6/3); dry; hard; mostly fines with high plasticity; organic content.		Used Pioneer silica sand 20/40
										Boring was terminated at approximately 32 feet bgs.		
						35						
						40						

Project No.: 501032
Location: LONGHORN AAP, SITE 16

Boring/Well ID: 16WW56
Sheet: 2 of 2

CB&I SHORT LOG LONGHORN.GPJ SHAWELGDT 4/8/20

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW57
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	8/5/19
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	PEDRO GONZALES	**NORTHING:**	6953896.70
SCIENTIST:	W. FOSS	**EASTING:**	3314654.99

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

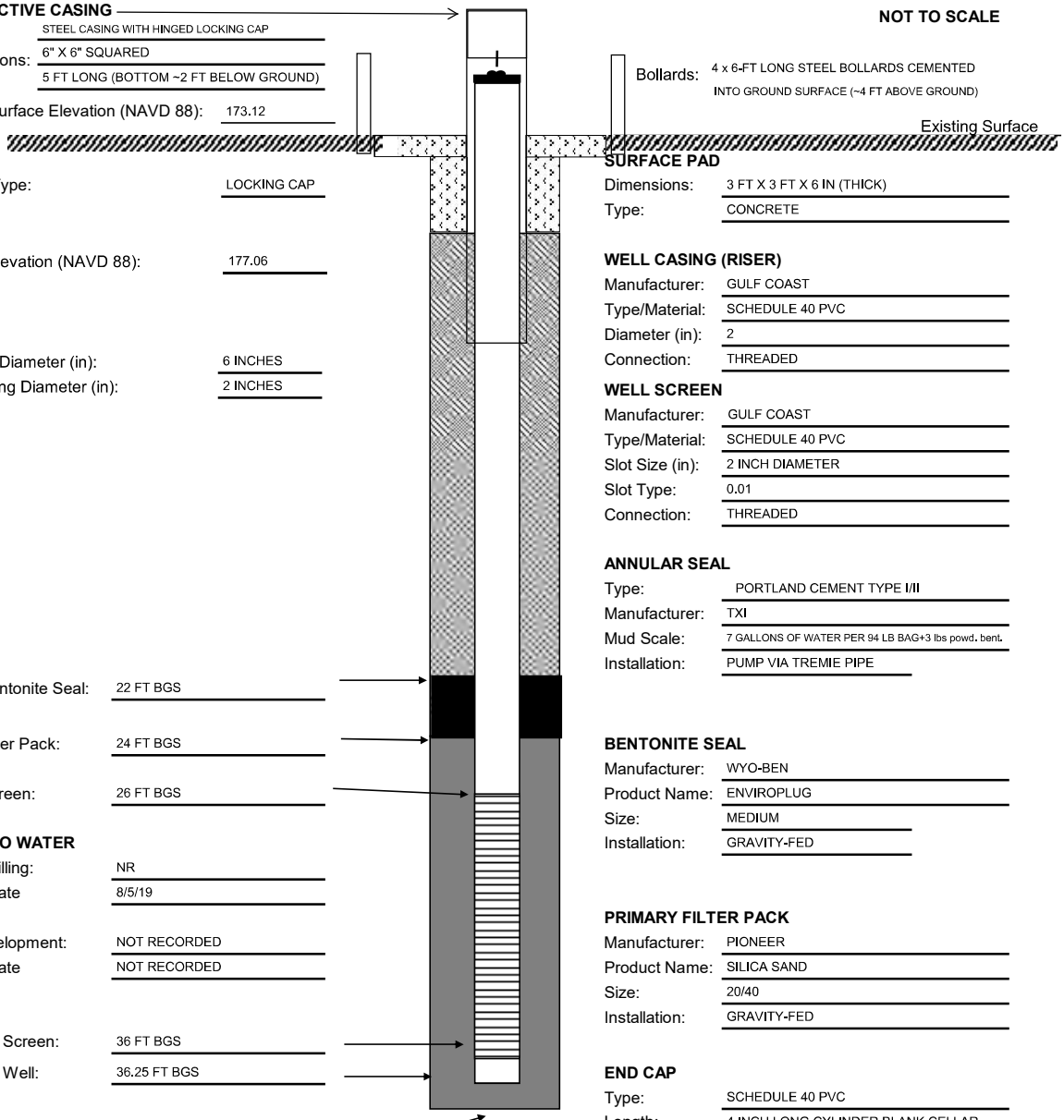
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 173.12

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 177.06

Borehole Diameter (in): 6 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 22 FT BGS

Top of Filter Pack: 24 FT BGS

Top of Screen: 26 FT BGS

DEPTH TO WATER

During Drilling: NR

Date: 8/5/19

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 36 FT BGS

Bottom of Well: 36.25 FT BGS

Borehole Depth: 38 FT BGS

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

Drilling Log

Monitoring Well **16WW57**

Project *Longhorn Army Ammunition Plant* Owner *U.S. Army*

Location *LHAAP-16* Proj. No. *501032*

Surface Elev. *173.12* Total Hole Depth *38.0 ft.* North *6953896.70* East *3314654.99*

Top of Casing *177.06* Water Level Initial *~23' bgs* Static *NA* Diameter *7.25 in.*

Screen: Dia *2 in.* Length *10 ft.* Type/Size *SCH. 40 PVC/0.010 in.*

Casing: Dia *2 in.* Length *26 ft.* Type *SCH. 40 PVC*

Drill Co. *ETTL* Rig/Core *Dietrich B-50 Tracked Rig*

Driller *Pedro Gonzales* Method *Hollow-Stem Auger*

Log By *W. Foss* Date *8/5/19* Driller # *59385*

COMMENTS

2" Dia. well set at 36' bgs with 10' Sch. 40 PVC 0.010" slot screen

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0				CL	**SANDY CLAY** TOPSOIL
		0%		CL	**SANDY CLAY**; light brownish gray (10YR 6/2) with yellowish red (5YR 6/6) mottles, firm, damp, trace silt.
2		100%		SC	**CLAYEY SAND**; light gray (10YR 7/1) with orange oxidation, loose, saturated, some iron manganese oxide (FeMnO) nodules.
4		100%			
6		0%			**SANDY CLAY**; grayish brown (10YR 5/2), soft, wet, trace oxidation staining.
8		100%			Color change to light gray (10YR 7/1) @ 7.5'. Clayey Sand lenses @ 8.5-9.5'.
10		100%			**SILTY CLAY**; light gray (2.5Y 7/1), soft, moist, trace oxidation staining.
12		100%			Color change to reddish yellow (5YR 6/8) @@ 11'.
14		100%		CL	Light gray (2.5Y 7/1) mottling from 12.5-14'. **SANDY CLAY**; pale brown (10YR 6/2) with light gray (10YR 7/1) mottles, firm, moist, some silt.
16		100%			
18		100%			Stiff at 17'.
20		100%			
22		100%			

Continued Next Page

Drilling Log

Monitoring Well **16WW57**

Project *Longhorn Army Ammunition Plant* Owner *U.S. Army*

Location *LHAAP-16* Proj. No. *501032*

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
					Continued
24		100%		SC	**CLAYEY SAND**; yellowish brown (10YR 5/6), medium dense, saturated, trace silt. Several small (<3") lenses with heavy iron oxidation staining and nodules
26					Silt and clay increasing with depth beyond 26.5'.
28					
30				SM	**SILTY SAND**; interbedded light gray (7.5YR 7/1) and brown (7.5YR 5/4) lenses, loose to medium dense, saturated, fine to medium grain sand.
32					Medium grained and color change to olive gray (5Y 5/2) at 32'. Silt content decreasing with depth.
34					
36					**SILTY CLAY**; dark gray (10YR 4/1), stiff to hard, damp.
38					**END OF BORING AT 38 FEET.**
40					
42					
44					
46					
48					
50					
52					

WELL CONSTRUCTION DIAGRAM (Above ground)

SITE:	LONGHORN ARMY AMMUNITION PLANT - SITE 16	**WELL/BORING ID:**	16WW58
PROJECT NAME:	REMEDIAL ACTION AT SITE 16	**DRILLING METHOD:**	HOLLOW STEM AUGER
PROJECT NO.:	501032	**DATE(S):**	8/7/19
DRILLING CONTRACTOR:	ETTL	**SURVEYOR:**	COLLINS SURVEYING AND MAPPING, INC.
DRILLER:	PEDRO GONZALES	**NORTHING:**	6953665.15
SCIENTIST:	W. FOSS	**EASTING:**	3314691.22

PROTECTIVE CASING

Type: STEEL CASING WITH HINGED LOCKING CAP

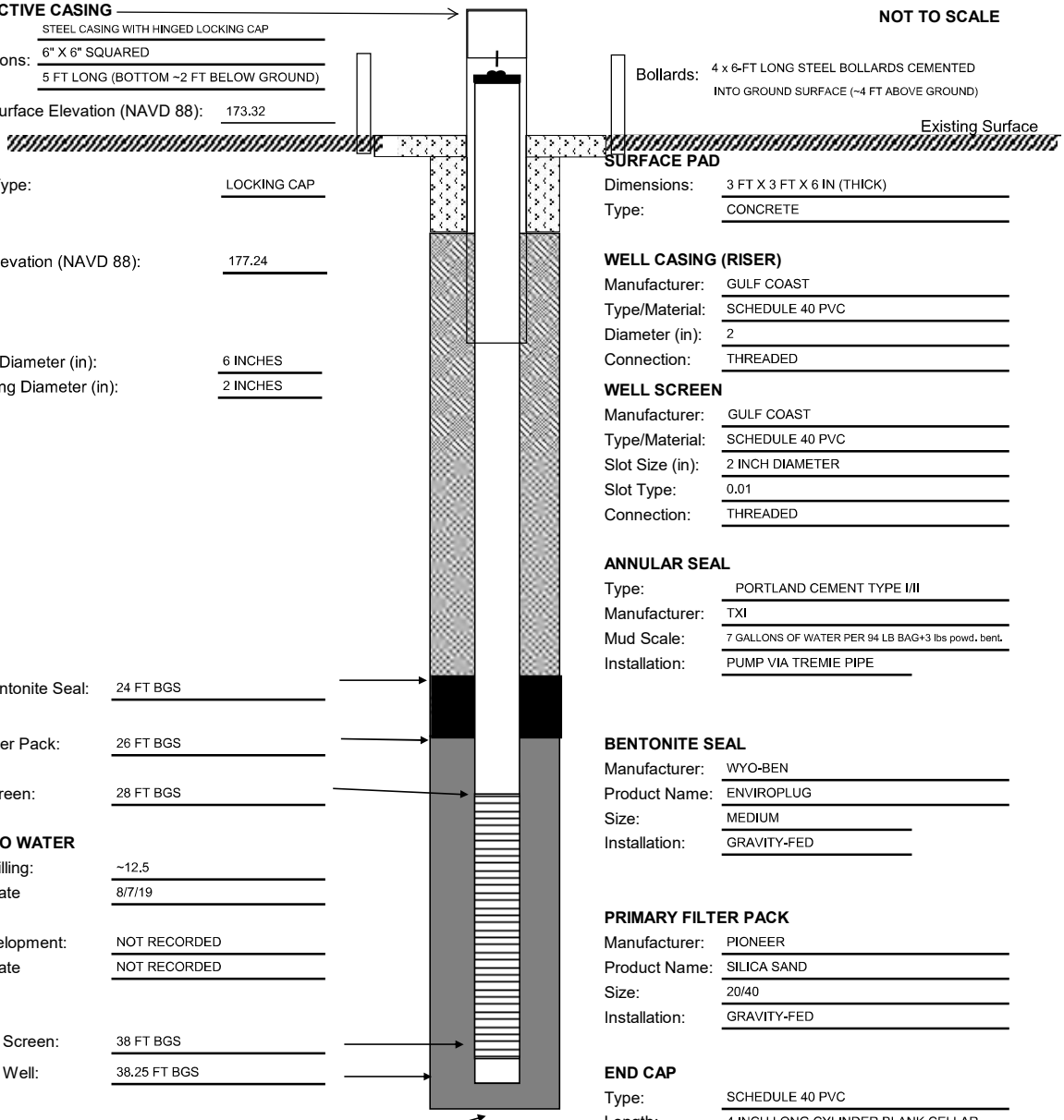
Dimensions: 6" X 6" SQUARED

Length: 5 FT LONG (BOTTOM ~2 FT BELOW GROUND)

Ground Surface Elevation (NAVD 88): 173.32

NOT TO SCALE

Bollards: 4 x 6-FT LONG STEEL BOLLARDS CEMENTED INTO GROUND SURFACE (~4 FT ABOVE GROUND)



Well Lid Type: LOCKING CAP

Casing Elevation (NAVD 88): 177.24

Borehole Diameter (in): 6 INCHES

Well Casing Diameter (in): 2 INCHES

Top of Bentonite Seal: 24 FT BGS

Top of Filter Pack: 26 FT BGS

Top of Screen: 28 FT BGS

DEPTH TO WATER

During Drilling: ~12.5

Date: 8/7/19

Post Development: NOT RECORDED

Date: NOT RECORDED

Bottom of Screen: 38 FT BGS

Bottom of Well: 38.25 FT BGS

Borehole Depth: 40 FT BGS

SURFACE PAD

Dimensions: 3 FT X 3 FT X 6 IN (THICK)

Type: CONCRETE

WELL CASING (RISER)

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Diameter (in): 2

Connection: THREADED

WELL SCREEN

Manufacturer: GULF COAST

Type/Material: SCHEDULE 40 PVC

Slot Size (in): 2 INCH DIAMETER

Slot Type: 0.01

Connection: THREADED

ANNULAR SEAL

Type: PORTLAND CEMENT TYPE I/II

Manufacturer: TXI

Mud Scale: 7 GALLONS OF WATER PER 94 LB BAG+3 lbs powd. bent.

Installation: PUMP VIA TREMIE PIPE

BENTONITE SEAL

Manufacturer: WYO-BEN

Product Name: ENVIROPLUG

Size: MEDIUM

Installation: GRAVITY-FED

PRIMARY FILTER PACK

Manufacturer: PIONEER

Product Name: SILICA SAND

Size: 20/40

Installation: GRAVITY-FED

END CAP

Type: SCHEDULE 40 PVC

Length: 4 INCH LONG CYLINDER BLANK CELLAR

BACKFILL MATERIAL

Type: 20/40 SILICA SAND

Comments: One foot of bentonite was introduced then allowed to hydrate for 30 minutes, then a second foot of bentonite was introduced and allowed to hydrate 30 minutes prior to introducing grout.

Drilling Log

Monitoring Well **16WW58**

Project *Longhorn Army Ammunition Plant* Owner *U.S. Army*

Location *LHAAP-16* Proj. No. *501032*

Surface Elev. *173.32* Total Hole Depth *40.0 ft.* North *6953665.15* East *3314691.22*

Top of Casing *177.24* Water Level Initial *~12.5' bgs* Static *NA* Diameter *7.25 in.*

Screen: Dia *2 in.* Length *10 ft.* Type/Size *SCH. 40 PVC/0.010 in.*

Casing: Dia *2 in.* Length *28 ft.* Type *SCH. 40 PVC*

Drill Co. *ETTL* Rig/Core *Dietrich B-50 Tracked Rig*

Driller *Pedro Gonzales* Method *Hollow-Stem Auger*

Log By *W. Foss* Date *8/7/19* Driller # *59385*

COMMENTS

2" Dia. well set at 38' bgs with 10' Sch. 40 PVC 0.010" slot screen

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
0				CL	**SANDY CLAY** TOPSOIL with roots
2		100%		CL	**SANDY CLAY**; brown (7.5YR 5/4), firm, damp, trace silt, trace oxidation, oxidation increasing with depth.
4		100%			Color change to light brownish gray (10YR 6/2) @ 3.5', soft, moist to wet **SANDY CLAY**; mottled light brownish gray (10YR 6/2) and yellowish red (5YR 4/6), soft, moist, trace iron manganese oxide (FeMnO) oxidation, trace silt.
6		100%			
8		50%		SC	**CLAYEY SAND**; light gray (10YR 7/1), medium dense, wet, oxidation mottles increasing with depth.
10		75%		CL	**SANDY CLAY**; light gray (10YR 7/1) with orange mottles, soft, moist, trace silt increasing with depth.
12		85%			Interbedded wet sandy lenses (<2") @ 10'.
14		100%		SM	**SILTY SAND**; light gray (10YR 7/1), loose, saturated, trace clay, clay increasing with depth.
16		100%			Color change to light brownish gray (10YR 6/2) @ 15'9".
18		100%			Large chunk of wood (~1.5") @ 18'.
20		0%			

Continued Next Page

Drilling Log

Monitoring Well **16WW58**

Project *Longhorn Army Ammunition Plant* Owner *U.S. Army*

Location *LHAAP-16* Proj. No. *501032*

Depth (ft.)	PID (ppm)	Sample ID % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Geologic Descriptions are Based on the USCS.
20		50%		SC	*Continued* **CLAYEY SAND**; dark gray (10YR 4/1), loose to medium dense, saturated, clay increasing with depth, fine to medium grain.
22				SM	**SILTY SAND**; light gray (10YR 7/1), firm, saturated, trace clay.
24		100%		SC	**CLAYEY SAND**; light gray (10YR 7/1), loose, saturated, some silt.
26		100%			Clay lenses 26'9" to 27'.
28		100%		SM	**SILTY SAND**; light gray (10YR 7/1), loose to medium dense, saturated, trace clay, fine medium grain.
30		100%			Medium to coarse grain sand @ 31'.
32		100%			Interbedded silt lenses @ 33'6".
34		75%			Back to fine to medium grain @ 34'3".
36		100%			
38		100%		CL	**SILTY CLAY**; gray (10YR 5/1), hard, damp, trace sand.
40					**END OF BORING AT 40 FEET.**
42					
44					
46					

WELL DEVELOPMENT LOG

APTIM

PROJECT:			WELL ID:
LHAAP-16			16 MW 09
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
MJM			11-13-18 / 11-14-18
Water Level Initial: 6.11	Final: 15.10	**Develop Method:** Purge/Surge Mini-Monsoon	**Total Vol. Dev:** 23 gallons
Weather: 11-13 OC 51°F / 11-14 OC 60°F	**Screen Interval:**	Top:	Bottom:
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Total Depth:** Initial: 22.23 Final: 22.23

Time	Cum Volume (Liters)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1600	5	19.84	6.35	0.752	2012.3	3.38	133.7	14.20	
1605	10	19.94	6.44	0.871	2001.1	3.08	124.4	21.00	
	pump off			DTW					
	11-14-18			DTW	6.12				
1130	5	19.72	5.76	0.576	2009.1	6.97	144.4	15.00	
1135	8	19.71	6.27	1.048	1921.5	6.15	169.8	22.00	
			DTW	1400	1337	/	pump on		
1342	5	20.33	5.98	1.073	2018.1	7.16	167.4	15.10	
	pump off								

Remarks

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW10**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/1/2018	**Development Date:** 5/3/2018
Water Level Final: Initial: 21.41 Final: 27.92	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 50
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 19.5	Bottom: 29.5
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Total Depth:** Initial: 30 Final: 30

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
8:30	4	17.38	4.69	4.583	432.705	9.95	129.8	NR	murky
9:31	13	17.27	6.99	5.363	48.03	9.37	116.0	NR	murky
10:32	22	17.19	7.00	6.143	15.82	8.09	102.2	NR	clear
11:33	41	17.15	6.99	6.145	7.82	7.79	100.9	NR	clear
12:35	50	17.16	6.97	6.146	7.8	7.77	101	27.92	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW20**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/3/2018	**Development Date:** 5/5/2018
Water Level Final: Initial: 16.61 Final: 23.19	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 25
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 15	Bottom: 25
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Total Depth:** Initial: 25.5 Final: 25.5

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
8:00	1	17.33	6.51	4.795	1032.1	6.26	134.7	NR	murky
8:45	10	17.22	6.50	5.575	114.6	5.68	120.9	NR	Dry
9:30	25	17.14	6.48	6.355	38.0	4.40	107.1	NR	clear, dry
10:15	20	17.10	6.47	6.357	18.9	4.10	105.8	NR	clear
11:00	25	17.11	6.45	6.358	18.9	4.08	105.9	23.19	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW25**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/1/2018	**Development Date:** 5/5/2018
Water Level Final: Initial: 32.4 Final: 43.61	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 55
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 43.5	Bottom: 53.5
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**			**Total Depth:** **Initial: 54** **Final: 54**

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
13:00	9	18.86	6.83	12.14	524.51	5.49	111.2	NR	murky
13:48	18	18.75	6.82	12.92	58.23	4.91	97.4	NR	murky
14:37	27	18.67	6.80	13.70	19.22	3.63	83.6	NR	clear
15:26	46	18.63	6.79	13.70	9.52	3.33	82.3	NR	clear
16:15	55	18.64	6.77	13.70	9.50	3.31	82.4	43.61	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW26**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/2/2018	**Development Date:** 5/5/2018
Water Level Final: Initial: 31.6 Final: 48.61	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 54
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 42.5	Bottom: 52.5
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Total Depth:** Initial: 53 Final: 53

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
12:00	8	19.15	6.73	5.74	967.31	5.60	108.4	NR	murky
13:07	17	19.04	6.72	6.52	107.43	5.02	94.6	NR	murky
14:15	26	18.96	6.70	7.30	35.62	3.74	80.8	NR	clear
15:22	45	18.92	6.69	7.30	17.72	3.44	79.5	NR	clear
16:30	54	18.93	6.67	7.30	17.70	3.42	79.6	48.61	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW27**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date: 5/2/2018**	**Development Date: 5/4/2018**
Water Level Final: Initial: 27.2 Final: 39.51	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev: 53**
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 47.5	Bottom: 57.5
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**		**Total Depth:** **Initial: 48**	**Final: 48**

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
8:00	7	18.52	6.21	2.126	826.91	3.11	-19.6	NR	murky
9:02	16	18.41	6.20	2.906	91.83	2.53	-33.4	NR	murky
10:05	25	18.33	6.18	3.686	30.42	1.25	-47.2	NR	clear
11:07	44	18.29	6.17	3.688	15.12	0.95	-48.5	NR	clear
12:10	53	18.30	6.15	3.689	15.10	0.93	-48.4	39.51	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW28**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/1/2018	**Development Date:** 5/4/2018
Water Level Final: Initial: 27.2 Final: 39.51	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 54
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 41.5	Bottom: 51.5
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Total Depth:** Initial: 52 Final: 52

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
8:00	8	18.63	6.51	2.671	514.79	3.86	10.4	NR	murky
8:56	17	18.52	6.50	3.451	57.15	3.28	-3.4	NR	murky
9:52	26	18.44	6.48	4.231	18.86	2.00	-17.2	NR	clear
10:48	45	18.40	6.47	4.233	9.34	1.70	-18.5	NR	clear
11:45	54	18.41	6.45	4.234	9.32	1.68	-18.4	39.51	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW29**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date: 5/1/2018**	**Development Date: 5/3/2018**
Water Level Final: Initial: 24.62 Final: 41.29	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev: 100**
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 38.5	Bottom: 48.5
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**		**Total Depth:** **Initial: 49**	**Final: 49**

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
13:00	54	18.47	6.27	1.322	108.705	3.12	21.4	NR	murky
13:48	63	18.36	6.26	2.102	12.03	2.54	7.6	NR	murky
14:37	72	18.28	6.24	2.882	3.82	1.26	-6.2	NR	clear
15:26	91	18.24	6.23	2.884	1.82	0.96	-7.5	NR	clear
16:15	100	18.25	6.21	2.885	1.8	0.94	-7.4	41.29	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16IW30**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date: 4/30/2018**	**Development Date: 5/3/2018**
Water Level Final: Initial: 30.51 Final: 38.61	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev: 54**
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 33.5	Bottom: 43.5
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**		**Total Depth:** **Initial: 44**	**Final: 44**

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
13:00	8	18.42	6.53	-0.163	551.51	2.11	-8.6	NR	murky
13:48	17	18.31	6.52	0.617	61.23	1.53	-22.4	NR	murky
14:37	26	18.23	6.50	1.397	20.22	0.25	-36.2	NR	clear
15:26	45	18.19	6.49	1.399	10.02	-0.06	-37.5	NR	clear
16:15	54	18.2	6.47	1.400	10.00	-0.07	-37.4	38.61	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

APTIM

PROJECT:			WELL ID:
LHAAP-16			16 & KWO1
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
[illegible]	[signature]		11-13-18 / 11-14-18
Water Level Initial: 18.80 Final: 24.19 ~~18.80~~		**Develop Method:** Purge/Surge Mini-Monsoon	**Total Vol. Dev:** 65 gallons
Weather: 11-13-18 O/C 51°F / 11-14-18 O/C 60°F	**Screen Interval:**	Top:	Bottom:
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 26.03	Final: 28.35

Time	Cum Volume (Liters)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1505	5	19.13	7.01	2.768		2.15	131.9	22.35	
1510	10	18.86	6.80	2.425	2012.7	0.96	141.9	23.80	
1515	15	18.91	5.31	2.379	1994.1	1.45	201.9	27.00	
	Purged	DRY							
		11-14-18	DTW	18.76'					
0945	5	18.85	4.95	2.551	220.1	2.55	208.1	21.10	
1005	10	18.76	5.17	2.301	638.1	3.84	222.4	23.00	
1015	15	18.75	5.20	2.227	890.1	4.25	216.1	23.40	
1054	20	19.02	5.20	2.167	415.1	4.03	207.1	25.25	
1100	25	18.	5.20	2.253	431.1	4.64	205.2	26.00	
	DRY /	DTW @ 8.62			Low Q - 0.1457				
		resample							
1450	5	19.07	5.51	2.549	476.1	3.67	184.1	22.80	
1503	10	18.37	5.73	2.222	204.1	5.43	204.4	23.60	
1520	15	19.02	5.72	2.188	198.4	4.88	201.+	24.45	
1534	20	18.87	5.15	2.168	241.1	4.49	209.1	24.35	
1546	25	18.81	5.11	2.168	341.8	4.39	197.8	24.16	Turned pump off

Remarks

WELL DEVELOPMENT LOG

APTIM

PROJECT:			WELL ID:
LHAAP - 16			16RW02
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
MSM		10-12-18	10-17-18 10-18-18
Water Level Initial 11.72 **Final:** Final pump DRY recharge	**Initial:**	**Develop Method:** purge/ Mini-monsoon surge	**Total Vol. Dev:** 41 gallons
Weather: 10-17-18 o/c 50 10-18-18 o/c 65	**Screen Interval:**	**Top:** 8	**Bottom:** 18
Wetted Volume: .016gal/ft 2" casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 20.43	Final: 20.43

Time	Cum Volume ~~(Liters)~~ Gallons	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
10-17-18		1206	pump	on					
1213	5	20.22	5.78	0.369	0.0	5.62	172.9	14.45	clear/surge
1220	10	21.17	5.72	0.345	0.0	6.49	181.7	16.40	clear/surge
1229	15	22.78	6.07	0.480	0.0	7.12	178.7	18.80	clear/surge
1235	17	19.91	6.34	0.572	0.0	7.08	172.0	20.42	clear/surge
	pump DRY / let recharge								
1338	DTW @ 1550 / 1340 pump on								
1345	5	20.10	6.13	0.366	0.0	6.63	172.1	17.46	clear/surge
1350	10	20.01	5.78	0.258	0.0	6.82	184.6	20.30	clear/surge
	pump DRY / let recharge overnight check again tomorrow								
10-18-18	1455 DTW @ 12.01 / 1517 Pump on								
1522	3	20.13	5.68	0.248	0.0	5.66	176.1	13.30	clear/surge
1532	6	21.21	5.32	0.217	0.0	6.63	189.6	14.70	clear/surge
1539	9	21.49	5.43	0.212	0.0	6.64	192.0	17.10	clear/surge
1541	12	21.48	5.44	0.214	0.0	6.67	194.1	19.60	clear/surge
1543	14	21.50	5.45	0.215	0.0	6.70	198.1	20.40	clear/surge
	pump DRY								

Remarks

WELL DEVELOPMENT LOG

APTIM

PROJECT:			WELL ID:
LHAAP-10			10RW03
Performed By:	Signature:	Completion Date:	Development Date:
MSM		10-11-18	10-17-18 10-18-18
Water Level Initial: 7.11 ft 18-71 Final: Final pump on discharge		Develop Method: purge / mini-monsoon surge	Total Vol. Dev: 3.5 gallons
Weather: 10-17-18 o/c 56 10-18-18 o/c 65	Screen Interval:	Top: 10'	Bottom: 20'
Wetted Volume: .016gal/ft 2" casing +.87 gal/ft sand pack for a borehole			Total Depth: Initial: 20.44 Final: 20.45

Time	Cum Volume (Liters)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
10-17-18			11:48 pump on						
1155	2.5	19.24	6.04	1.313	50.0	4.49	151.6	20.22	cloudy
	pump OFF / let discharge.								
1420	check discharge DTW @					19.70			
	will try development again tomorrow.								
10-18-18	1500 pump on								
1508	1.0	19.68	6.03	1.180	54.4	4.82	158.1	20.31	cloudy
	pump OFF								

Remarks

WELL DEVELOPMENT LOG

APTIM

PROJECT:			WELL ID:
LHAAP-16			16RW04
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
MSM			11-13-18 / 11-14-18
Water Level Initial: 18.11	Final: ~~19.05~~ 25.20	**Develop Method:** purge/surge Mini-monsoon	**Total Vol. Dev:** 46 gal/cms
Weather: 11-13 OC 51°F / 11-14 OC 60F	**Screen Interval:**	Top:	Bottom:
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 25.50	Final: 25.50

Time	Cum Volume (Liters)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1350	5	18.48	5.72	1.043	1997.9	2.27	200.5	19.85	
1357	10	19.22	5.71	1.040	407.4	2.69	177.4	21.50	
1409	15	19.99	5.56	1.048	343.4	2.59	173.8	23.10	
1419	20	18.90	5.57	1.024	1995.9	1.95	182.1	24.20	
1437	23.0	18.88	5.31	1.070	1991.9	3.15	162.7	25.25	
1438	Pump	DCY							
	11-14-18	DTW @ 18.03'							
0850	5	19.15	6.76	1.048	486	4.03	174.2	21.50	
0857	10	18.86	5.39	1.175	44.5	3.95	225.2	22.35	
0915	13	18.44	5.11	1.152	0.0	3.68	220.1	22.70	
0921	18	18.98	5.06	1.145	0.0	3.35	210.1	24.20	
0930	23	19.03	5.07	1.142	0.0	3.08	223.0	25.20	
	Pump	DCY							

Remarks

WELL DEVELOPMENT LOG

APTIM

PROJECT:	WELL ID:
LHAAP-16	16RW05

Performed By:	Signature:	Completion Date:	Development Date:
MSM		10-11-18	10-17-18 10-18-18

Water Level Initial: 11.47' Final: purged dry/Recharging	Initial:	Develop Method: purge / Mini Monsoon surge	Total Vol. Dev: 10-17-18 / 10-18-18 / 28.5 gallons

Weather: 10-17-18 o/c 50 10-18-18 o/c 65	Screen Interval:	Top: 10'	Bottom: 20'

Wetted Volume: .016gal/ft 2" casing +.87 gal/ft sand pack for a borehole	Total Depth: Initial: 20.45	Final: 20.45

Time	Cum Volume (~~Liters~~) gallons	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
10-17-18	START								
1055	pump on								
1102	5	19.59	6.38	1.515	808.9	0.61	157.2	14.00	silty / Surge
1110	10	20.50	6.59	1.442	8.9	6.34	149.4	17.40	clear / Surge
1117	15	20.24	6.44	1.923	13.4	0.95	149.4	18.80	clear / Surge
1125	17	19.54	6.04	1.665	405.3	4.81	150.2	20.00	silty / Surge
	STOP pump / pump dry / let Recharge								
1143	Took a DTW to check recharge DTW @ 19.40'								
1359	DTW @ 18.22								
1410	pump on								
1415	2.5	19.44	6.30	1.928	219.4	6.29	163.9	20.10	silty / pump dry
	purged dry / let Recharge overnight / try again tomorrow 10-18-18								
10-18-18	Initial DTW 15.58' / Time 14:19 pump on								
1424	2.5	~~17.20~~ 19.65	6.60	1.781	203.9	6.54	146.0	17.20	silty / Surge
1429	5.0	~~18.55~~ 19.81	6.39	1.784	41.2	6.83	150.3	18.55	cloudy / Surge
1434	7.5	19.89	6.37	1.743	41.3	6.80	154.3	19.99	cloudy / Surge
1435	pump dry / pump off / let Recharge.								
1450	DTW @ 19.00' / pump on								
1458	10.5	19.85	6.38	1.740	39.2	6.81	157.2	20.30	cloudy
	DRY								

Remarks

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			WELL ID: 16RW06
Performed By: BEST DRILLING	Oversight: ALLEN WILLMORE	Completion Date: 4/23/2018	Development Date: 4/25/2018
Water Level Initial: 19.7 Final: 26 Final:	Develop Method: PUMPING AND SURGING		Total Vol. Dev: 55
Weather: SEE FADL	Screen Interval (ft BTOC)	Top: 18.5	Bottom: 28.5
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		Total Depth: Initial: 29	Final: 29

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
15:15	9	17.38	6.97	4.583	432.71	9.95	129.8	NR	murky
15:56	18	17.27	6.99	5.363	48.03	9.37	116.0	NR	murky
16:37	27	17.19	7.00	6.143	15.82	8.09	102.2	NR	clear
17:18	46	17.15	6.99	6.145	7.82	7.79	100.9	NR	clear
18:00	55	17.16	6.97	6.146	7.8	7.77	101	26	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT:				WELL ID:
Longhorn AAP, Site 16 Monitoring and Injection Wells				16RW07
Performed By:	**Development Oversight:**		**Completion Date:**	**Development Date:**
Best Drilling	Allen Willmore (Aptim)		4/20/2018	4/25/18
Water Level	**Initial:**	**Develop Method:**		**Total Vol. Dev:**
Final: 22.16	21.8 ft btoc	pumping and surging		~95 gallons
Weather: See Field Activity Daily Log	**Screen Interval:**		Top: 15 ft bgs	Bottom: 25 ft bgs
Wetted Volume:			**Total Depth:**	
.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole			**Initial:** 25.5 ft bgs	**Final:** 25.5 ft bgs

Time	Cum Volume (Gallons)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
12:05	5	26.41	6.70	3.214	300.1	2.11	166.2	21.18	Turbidity too high to record
12:35	20	26.32	6.70	3.507	290.1	1.99	104.1	21.65	Turbidity too high to record
13:05	35	26.21	6.71	4.109	117.5	NR	98.5	NR	
13:35	45	26.17	6.70	4.848	68.6	NR	97.1	NR	
14:05	55	26.31	6.71	4.851	44.1	NR	96.8	NR	
14:35	65	26.21	6.71	4.858	23.6	1.54	88.2	21.85	
15:05	75	26.13	6.70	4.855	18.3	1.62	86.7	21.92	
15:35	85	26.31	6.70	4.852	8.7	1.69	87.2	22.10	
16:05	95	26.41	6.70	4.853	1.5	1.65	86.9	22.16	
NO DATA BELOW THIS LINE									

Remarks

Volumes purged are estimated.

WELL DEVELOPMENT LOG

PROJECT:				WELL ID:
Longhorn AAP, Site 16 Monitoring and Injection Wells				16RW08
Performed By:	**Development Oversight:**		**Completion Date:**	**Development Date:**
Best Drilling	Allen Willmore (Aptim)		4/19/2018	4/25/18
Water Level	**Initial:**	**Develop Method:**		**Total Vol. Dev:**
Final: 26.61	23.5 ft btoc	pumping and surging		~70 gallons
Weather: See Field Activity Daily Log	**Screen Interval:**	Top: 15.5 ft bgs		Bottom: 25.5 ft bgs
Wetted Volume:				**Total Depth:**
.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole				**Initial:** 27 ft bgs **Final:** 27 ft bgs

Time	Cum Volume (Gallons)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
12:00	5	26.08	6.69	2.803	NR	3.82	166.2	23.8	Turbidity too high to record
12:30	20	26.16	6.68	2.912	NR	2.42	104.1	24.1	Turbidity too high to record
13:00	35	26.29	6.68	3.729	952.5	2.19	98.5	24.51	
13:30	45	26.37	6.67	4.209	568.3	2.18	97.1	25.62	
13:45	55	26.43	6.65	4.341	315.2	2.32	96.8	25.69	
14:00	57.5	26.52	6.64	4.678	235.3	2.30	88.2	25.70	
14:10	60	26.75	6.62	4.710	120.3	2.28	86.7	25.72	
14:15	70	26.82	6.62	4.712	61.1	2.21	87.2	25.75	
14:20	80	26.90	6.62	4.714	35.1	2.19	86.9	25.78	
14:25	90	26.94	6.62	4.715	23.2	2.19	86.8	26.57	
14:30	100	26.98	6.62	4.715	15.5	2.18	86.2	26.61	
NO DATA BELOW THIS LINE									

Remarks

Volumes purged are estimated.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			WELL ID: 16RW09
Performed By: BEST DRILLING	Oversight: ALLEN WILLMORE	Completion Date: 4/19/2018	Development Date: 4/24/2018
Water Level Final: Initial: 25.3 Final: 32.1	Develop Method: PUMPING AND SURGING		Total Vol. Dev: 55
Weather: SEE FADL	Screen Interval (ft BTOC)	Top: 20	Bottom: 30
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		Total Depth: Initial: 30.5	Final: 30.5

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
15:00	9	27.20	6.75	3.152	1113.105	4.36	115.0	NR	murky
15:47	18	27.09	6.74	3.932	123.63	3.78	101.2	NR	murky
16:35	27	27.01	6.72	4.712	41.02	2.50	87.4	NR	clear
17:22	46	26.97	6.71	4.714	20.42	2.20	86.1	NR	clear
18:10	55	26.98	6.69	4.715	20.4	2.18	86.2	32.1	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16RW10**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 4/19/2018	**Development Date:** 4/24/2018
Water Level Final: Initial: 21.2 Final: 28.2	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 90
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 18	Bottom: 28
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 30.5	Final: 30.5

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
15:10	44	27.20	6.51	3.115	610.905	4.44	156.9	NR	murky
15:51	53	27.09	6.53	3.895	67.83	3.86	143.1	NR	murky
16:32	62	27.01	6.54	4.675	22.42	2.58	129.3	NR	clear
17:13	81	26.97	6.53	4.677	11.12	2.28	128.0	NR	clear
17:55	90	26.98	6.51	4.678	11.1	2.26	128.1	28.2	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16RW11**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/3/2018	**Development Date:** 5/5/2018
Water Level Final: Initial: 16.78 Final: 22.34	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 25
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 15	Bottom: 25
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 25.5	Final: 25.5

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
8:00	1	17.30	6.88	3.849	357.11	6.24	131.2	NR	murky
8:45	10	17.19	6.87	4.629	39.63	5.66	117.4	NR	Dry
9:30	25	17.11	6.85	5.409	13.02	4.38	103.6	NR	clear, dry
10:15	20	17.07	6.84	5.411	6.42	4.08	102.3	NR	clear
11:00	25	17.08	6.82	5.412	6.40	4.06	102.4	22.34	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16RW12**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/4/2018	**Development Date:** 5/6/2018
Water Level Final: Initial: 23.62 Final: 29.42	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 43
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 21.5	Bottom: 31.5
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**		**Total Depth:** **Initial: 32**	**Final: 32**

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
9:00	-3	18.05	6.90	5.663	1086.11	4.13	115.7	NR	murky
9:55	6	17.94	6.92	6.443	120.63	3.55	101.9	NR	murky
10:50	15	17.86	6.93	7.223	40.02	2.27	88.1	NR	clear
11:45	34	17.82	6.92	7.225	19.92	1.97	86.8	NR	clear
12:40	43	17.83	6.90	7.226	19.90	1.95	86.9	29.42	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

APTIM

PROJECT:			WELL ID:
CHHAPS-16			MW48
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
MSM		10-6-18	10-13-18 10-17-18
Water Level Initial: 12.29 **Final:** Final 13.60 & Recharging	**Initial:**	**Develop Method:** purge/Mini Monsoon Surge	**Total Vol. Dev:** 65 gallons
Weather: 10-13-18 76° Sunny 10-17-18 d/c 56°/Rain 65 d/c	**Screen Interval:**	**Top:** 10'	**Bottom:** 20'
Wetted Volume: .016gal/ft 2" casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 20.40'	Final: 20.43'

	Time	Cum Volume ~~(Liters)~~ Gallons	Water Quality Parameters: Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)	Water Level (Feet)	Comments
10-13-18	1529	5	20.27	6.45	5.829	1308.1	1.75	138.9	17.40	silty brown
10-13-18	1532	10	20.83	6.10	6.197	1794.5	1.42	153.2	18.50	silty brown
10-13-18	1536	15	20.25	6.00	6.000	1787.2	1.93	150.4	20.00	silty brown
10-13-18	1537	DRY	/ Heavy Rain & Thunderstorms							
	will let well Recharge & try again another day.									
	10-17-18	Continue again on well Development								
	0913	pump on								
	0919	5	19.35	5.92	6.078	1462.2	2.13	181.4	13.20	Heavy Silt / Surge
	0929	10	20.34	5.92	6.085	2322.5	2.93	173.8	13.40	Heavy Silt / Surge
	0936	15	20.41	5.87	6.852	1190.0	3.07	172.8	13.55	Heavy Silt / Surge
	0942	20	20.35	5.82	6.821	1806	2.45	170.5	13.65	cloudy / Surge
	0949	25	20.43	5.81	6.857	186.4	2.09	167.5	13.74	cloudy / Surge
	0959	30	20.32	5.78	6.833	181.4	1.60	165.7	13.60	cloudy / Surge
	1006	35	20.33	5.77	6.841	94.5	1.40	165.1	13.60	cloudy / Surge
	1012	40	20.25	5.77	6.852	0.0	1.43	164.0	13.60	clear / Surge
	1019	45	20.32	5.77	6.887	0.0	1.41	163.9	13.60	clear / Surge
	1026	50	20.32	5.78	6.872	0.0	1.40	165.9	13.60	clear / Surge
		pump off			to	20.43'				

Remarks

WELL DEVELOPMENT LOG

PROJECT: Longhorn AAP / LHAAP 16			**WELL ID:** 16WW49
Performed By: Michael Martinez	**Signature:**	**Completion Date:**	**Development Date:** August 28, 2019
Water Level **Initial:** 18.46' **Final:**	**Develop Method:** SP/SURGE		**Total Vol. Dev:** 40 gallons this event.
Weather: PC, Hi 92/Lo 73	**Screen Interval:**	Top:	Bottom:
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**			**Total Depth:** **Initial:** 54.70' **Final:**

Time	Cum Volume (Liters)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1150	5.0	20.33	6.28	2.227	21.1	1.93	3.8	28.95	clear ,no odor/surge
1157	22.5	19.48	6.49	2.221	10.9	1.87	-47.8	44.80	clear ,no odor/surge
1202	35.0	19.46	6.67	2.164	11.6	1.77	-39.9	53.71	clear ,no odor/surge
1204	Well pumped dry. Well had been pured a few previously to this event of pumping on well.								

Remarks 1148 pump on.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			**WELL ID: 16WW51**
Performed By: BEST DRILLING	**Oversight: ALLEN WILLMORE**	**Completion Date:** 5/3/2018	**Development Date:** 5/5/2018
Water Level Final: Initial: 28.6 Final: 40.87	**Develop Method: PUMPING AND SURGING**		**Total Vol. Dev:** 70
Weather: SEE FADL	**Screen Interval (ft BTOC)**	Top: 34	Bottom: 44
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 44.5	Final: 44.5

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
10:20	24	18.45	4.69	2.530	972.705	4.00	9.3	NR	murky
10:57	33	18.34	6.47	3.310	108.03	3.42	-4.5	NR	murky
11:35	42	18.26	6.48	4.090	35.82	2.14	-18.3	NR	clear
12:12	61	18.22	6.47	4.092	17.82	1.84	-19.6	NR	clear
12:50	70	18.23	6.45	4.093	17.80	1.82	-19.5	40.87	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

PROJECT: LONGHORN AAP, SITE 16 MONITORING AND INJECTION WELLS			WELL ID: 16WW55
Performed By: BEST DRILLING	Oversight: ALLEN WILLMORE	Completion Date: 4/18/2018	Development Date: 4/24/2018
Water Level Initial: 19.2 Final: 28.4	Develop Method: PUMPING AND SURGING		Total Vol. Dev: 55
Weather: SEE FADL	Screen Interval (ft BTOC)	Top: 20	Bottom: 30
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		Total Depth: Initial: 30.5	Final: 30.5

Time	Cumulutive Volume (gallons)	Water Quality Parameters						Water Level (ft-btoc)	Comments
		Temp	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
12:55	9	18.89	4.69	5.136	1069.905	7.85	124.7	NR	murky
13:26	18	18.78	5.68	5.916	118.83	7.27	110.9	NR	murky
13:57	27	18.70	5.69	6.696	39.42	5.99	97.1	NR	clear
14:28	46	18.66	6.73	6.698	19.62	5.69	95.8	NR	clear
15:00	55	18.67	6.71	6.699	19.6	5.67	95.9	28.4	clear

Remarks: Spot checked for parameters. Geologist was logging holes and could not continuously record readings. Well Periodically went dry.

WELL DEVELOPMENT LOG

APTIM

PROJECT:		WELL ID:	
LHAAP - 16		16 MW 56	
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
MSM			11-13-18
Water Level Initial: 27.18	Final: 29.80	**Develop Method:** Purge/ Mini-monsoon Surge	**Total Vol. Dev:** 55 gallons
Weather: 11-13 OCS 10°F / 11-14 @ 60°F	**Screen Interval:**	Top:	Bottom:
Wetted Volume: .016gal/ft 2' casing +.87 gal/ft sand pack for a borehole		**Total Depth:** Initial: 34.03	Final: 34.03

Time	Cum Volume (~~Liters~~) Gallons	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1111	5	17.56	6.56	5.217	1972.6	2.36	171.6	25.90	Turbid Silt Added
1117	10	17.41	6.57	3.446	1979.1	2.94	165.1	28.40	
1124	15	18.62	6.25	3.431	330.1	1.25	159.7	28.70	
1130	20	18.56	6.24	3.484	288.1	1.78	157.7	28.85	
1135	25	18.57	6.21	3.514	284.1	1.40	157.9	29.00	
1141	30	18.53	6.43	3.558	170.4	1.35	159.1	29.10	
1146	35	18.56	6.20	3.603	48.5	1.87	161.9	29.39	
1153	40	18.52	6.21	3.674	65.3	1.94	163.2	29.58	
1200	45	18.53	6.22	3.678	75.6	1.94	162.6	29.74	
1205	50	18.10	6.36	3.740	75.6	1.96	159.1	29.85	
1210	55	18.46	6.25	3741	75.2	1.98	160.2	29.90	

Remarks

WELL DEVELOPMENT LOG

PROJECT: Longhorn AAP / LHAAP 16			**WELL ID:** 16WW57
Performed By: Michael S. Martinez	**Signature:**	**Completion Date:**	**Development Date:** August 12, 2019
Water Level **Initial:** 4.90 **Final:** 5.70	**Develop Method:** SP/SURGE		**Total Vol. Dev:** 55 gallons
Weather: Sunny 96 F	**Screen Interval:** 10'	Top: 29.80'	Bottom: 39.80'
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**			**Total Depth:** **Initial:** 39.80 **Final:** 39.80

Time	Cum Volume (GAL)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1300	15 gallons	28.06	6.04	5.166	19.0	1.49	36.2	11.65'	clear ,no odor/surge
1305	30 gallons	20.20	6.05	5.185	13.5	2.44	12.4	12.00'	clear, no odor/surge
1313	40 gallons	19.40	6.05	5.260	15.6	4.65	12.2	12.60'	clear, no odor /surge
1320	55 gallons	19.42	6.05	5.244	13.8	4.63	9.8	12.65'	clear, no odor/surge

Remarks

WELL DEVELOPMENT LOG

PROJECT: Longhorn Army Ammunition Plant - LHAAP 16			**WELL ID:** 16WW58
Performed By: Michael S. Maritnez	**Signature:** Michael S. Maritnez	**Completion Date:**	**Development Date:** August 12, 2019
Water Level **Initial:** 6.54'	**Final:** 10.60'	**Develop Method:** SP/SURGE	**Total Vol. Dev:** 110 gallons
Weather: Sunny, 96 F	**Screen Interval:** 10'	Top: 31.80'	Bottom: 41.80'
Wetted Volume: **.016gal/ft 2' casing +.87 gal/ft sand pack for a borehole**		**Total Depth:** **Initial:** 41.80'	**Final:** 41.80'

Time	Cum Volume (GAL)	Water Quality Parameters						Water Level (Feet)	Comments
		Temp (°C)	pH	Cond (mS/cm)	Turb (NTU)	D.O. (mg/L)	Redox (mV)		
1345	25 gallons	20.24	6.45	2.577	151.0	1.06	151.0	30.00	light silt, no odor/surge
1350	stiop pump and let recharge, DTW @ 32.60'								
1400	DTW RECHARGE @ 9.00'								
14.05	Restart pump								
1410	38	19.22	6.37	2.591	41.4	7.02	-68.1	29.60	light silt, no odor/surge
1415	48	19.39	6.35	2.575	45.6	1.67	-74.7	32.95	light silt, no odor/surge
	Drum full/ETTL HAD TO GO AND GET ANOTHER DRUM								
1425	DTW @ 10 60' / RESTART PUMP								
1427	5	19.63	6.35	2.625	51.4	2.94	-69.7	29.80	light silt, no odor/surge
1430	13.5	19.83	6.30	2.603	24.3	2.95	-87.1	34.92	light silt, no odor/surge
1437	30	19.90	6.31	2.675	28.3	2.99	-68.1	35.00	light silt, no odor/surge
1440	37.5	19.80	6.31	2.587	28.7	3.00	-61.2	35.70	light silt, no odor/surge
1450	55	19.90	6.31	2.613	29.7	2.59	-64.1	36.10	light silt, no odor/surge
	Done with well development/ Purged a total of 110 gallons./ Well recharges very quickly.								

Remarks 1334 Start pump

Appendix C

Sample Collection Logs

Note: The sample collection logs (SCLs) include revisions to values that had previously been based on database information that was later determined to be erroneous. These values include screen interval, constructed depth, and depth to well bottom. The original monitoring well logs and survey information (top of casing and ground surface elevations) were used where necessary to correct these values. Also, the "Sample Interval" has been struck from the upper right corner of some forms where it was used to represent the range of depth-to-water values recorded during the purging of the wells.

At some sample locations, the sample was collected before all field parameters had fully stabilized per the criteria presented in the Installation-Wide Work Plan (Bhate 2018b).

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW02**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW02-181009

DATE/TIME: 10/9/2018 / 13:40

Pump Inlet Depth (ft): 24.5

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First Gauge: 24.48. Second Gauge: 24.59. Perchlorate sample field filtered with 0.2 micron groundwater filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 6

Purge Start Date/Time: 10/9/2018 / 13:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 13:40

Constructed Depth to Well Bottom (ft) ~~31~~ 29.75 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~22.00 - 27.00~~ 21.75-26.75 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 13:10

APTIM

Sample Collection Log

Location ID: 16EW02				Sample No: 16EW02-181009						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	13:10	75	.375	24.48	3.000	24.8	6.54	181.0	87.8	3.89
10/9/2018	13:15	75	.750	24.51	5.343	24.03	6.13	181.5	81.2	2.30
10/9/2018	13:20	100	1.250	24.53	5.301	24.01	6.08	181.1	80.7	2.04
10/9/2018	13:25	125	1.875	24.56	5.189	23.97	6.02	181.2	79.0	1.64
10/9/2018	13:30	125	2.500	24.56	5.055	23.99	6.00	181.3	80.3	1.35
10/9/2018	13:35	125	3.125	24.57	4.986	24.12	6.00	181.4	77.0	1.26
10/9/2018	13:40	125	3.750	24.59	4.950	24.23	6.00	181.6	80.2	1.16

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW05**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Clear, Air Temp:52, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW05-181011 **DATE/TIME: 10/11/2018 / 11:01** **Pump Inlet Depth (ft): 49.5**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged well twice for water level 28.58' / 28.58'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		Kevin Schmitt
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 6

Purge Start Date/Time: 10/11/2018 / 10:17

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/11/2018 / 11:01

Constructed Depth to Well Bottom (ft) ~~55~~ 54.43 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~47.00 - 52.00~~ 46.43-51.43 FT BTOC

L George 05/21/2020

Pump Start Time: 10/11/2018 / 10:17

Location ID: 16EW05 Sample No: 16EW05-181011										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/11/2018	10:36	125	1.0	28.76	10.16	19.58	6.19	168.9	195.3	1.03
10/11/2018	10:41	125	1.625	28.53	10.25	19.84	6.18	476.5	197.7	0.83
10/11/2018	10:46	125	2.25	28.89	10.29	19.89	6.18	488.7	191.7	0.96
10/11/2018	10:51	125	2.875	28.94	10.28	19.92	6.18	168.2	190.9	0.95
10/11/2018	10:56	125	3.5	28.99	10.29	19.89	6.17	167.1	190.1	0.74
10/11/2018	11:01	125	4.125	29.06	10.32	19.94	6.17	167.9	189.9	0.74

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW06**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Light Rain, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW06-181009

DATE/TIME: 10/9/2018 / 14:55

Pump Inlet Depth (ft): 52.5

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 24.26. Second gauge: 24.26. Perchlorate field filtered with 0.2 micron groundwater filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 6

Purge Start Date/Time: 10/9/2018 / 14:25

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 14:55

Constructed Depth to Well Bottom (ft) ~~58~~ 57.72 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~50.00 - 55.00~~ 49.72-54.72 FT BTOC

L George 05/21/2020

Pump Start Time: 10/9/2018 / 14:25

APTIM

Sample Collection Log

Location ID: 16EW06		Sample No: 16EW06-181009								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	14:25	100	0.500	24.26	9.536	25.31	5.96	158.7	89.2	2.96
10/9/2018	14:30	100	1.00	24.27	9.890	24.90	5.90	29.4	78.2	2.06
10/9/2018	14:35	125	1.625	24.28	10.08	24.72	5.86	168.1	69.2	1.63
10/9/2018	14:40	125	2.250	24.31	10.17	24.70	5.86	142.0	62.1	1.24
10/9/2018	14:45	125	2.875	24.32	10.22	24.64	5.85	83.0	59.6	1.10
10/9/2018	14:50	125	3.500	24.33	10.22	24.69	5.85	171.0	58.7	1.04
10/9/2018	14:55	125	4.125	24.33	10.25	24.76	5.84	154.6	59.3	0.95

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW07**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:70, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW07-181013

DATE/TIME: 10/13/2018 / 11:00

Pump Inlet Depth (ft): 43.5

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 14.36, Second Gauge: 14.36

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 6

Purge Start Date/Time: 10/13/2018 / 11:00

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 11:00

Constructed Depth to Well Bottom (ft) 49 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): 41.00 - 46.00 FT BTOC
L George 05/21/2020

Pump Start Time: 10/13/2018 / 11:00

APTIM

Sample Collection Log

Location ID: 16EW07		Sample No: 16EW07-181013								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	10:25	300	1.500	14.36	10.32	19.71	6.04	13.1	294.7	6.30
10/13/2018	10:30	175	2.375	14.52	10.52	19.56	6.45	6.7	83.6	4.66
10/13/2018	10:35	175	3.250	14.59	10.54	19.60	6.72	4.1	-19.1	3.10
10/13/2018	10:40	175	4.125	14.59	10.54	19.65	6.85	3.0	-60.7	2.66
10/13/2018	10:45	175	5.000	14.63	10.56	19.69	6.99	1.5	-96.7	2.13
10/13/2018	10:50	200	6.000	14.64	10.55	19.71	7.04	0.0	-111.4	1.91
10/13/2018	10:55	150	6.750	14.66	10.55	19.72	7.09	-0.8	-122.7	1.74
10/13/2018	11:00	200	7.750	14.67	10.56	19.74	7.12	-1.0	-130.9	1.62

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW08**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:71, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW08-181013

DATE/TIME: 10/13/2018 / 10:45

Pump Inlet Depth (ft): 36.5

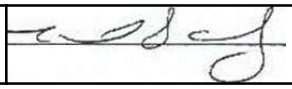
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		Mike Martinez
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 6

Purge Start Date/Time: 10/13/2018 / 10:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 10:45

Constructed Depth to Well Bottom (ft) ~~42~~ 41.76 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~34.00 - 39.00~~ 33.76-38.76 FT BTOC

L George 05/21/2020

Pump Start Time: 10/13/2018 / 10:10

Location ID: 16EW08 Sample No: 16EW08-181013

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	10:15	140	1.0	9.50	1.085	19.09	6.44	9.1	-24.9	1.23
10/13/2018	10:20	140	1.7	9.52	1.096	19.08	6.33	11.9	-23.6	0.98
10/13/2018	10:25	140	2.4	9.54	1.099	19.08	6.29	10.9	-22.8	0.54
10/13/2018	10:30	140	3.1	9.58	1.103	19.11	6.27	9.9	-22.4	0.52
10/13/2018	10:35	140	3.8	9.60	1.112	19.13	6.25	9.7	-20.9	0.48
10/13/2018	10:40	140	4.5	9.61	1.119	19.15	6.23	7.7	-16.9	0.46
10/13/2018	10:45	140	3.2	9.61	1.117	19.13	6.23	8.8	-16.0	0.48

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW11**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:76, Wind Speed:Slight Winds

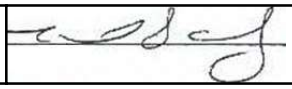
SAMPLING INFORMATION

Sample No: 16EW11-181013 **DATE/TIME: 10/13/2018 / 12:55** **Pump Inlet Depth (ft): 24.5**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged DTW twice 20.76' / 20.76'.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		Mike Martinez
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/13/2018 / 12:20

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 12:55

Constructed Depth to Well Bottom (ft) 33 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~19.50 - 29.50~~ 23-33 FT BTOC
L George 05/21/2020

Pump Start Time: 10/13/2018 / 12:20

Location ID: 16EW11 Sample No: 16EW11-181013										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	12:25	100	1.0	21.21	5.802	20.50	6.27	7.6	-75.3	1.21
10/13/2018	12:30	100	1.5	21.31	5.802	20.13	6.24	16.0	-77.3	0.57
10/13/2018	12:35	100	2.0	21.35	5.799	20.31	6.26	8.1	-77.6	0.42
10/13/2018	12:40	100	2.5	21.35	5.793	20.42	6.28	7.4	-77.6	0.38
10/13/2018	12:45	100	3.0	21.35	5.797	20.40	6.30	8.8	-78.1	0.30
10/13/2018	12:50	100	3.5	21.35	5.794	20.43	6.31	8.9	-78.3	0.29
10/13/2018	12:55	100	4.0	21.35	5.791	20.45	6.31	9.0	-79.2	0.28

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW12B**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:76, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW12B-181013

DATE/TIME: 10/13/2018 / 13:30

Pump Inlet Depth (ft): 18

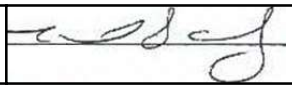
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged DTW twice 17.46' / 17.46'.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		Mike Martinez
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/13/2018 / 13:00

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 13:30

Constructed Depth to Well Bottom (ft)

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~13.00 - 23.00~~
L George 05/21/2020

Pump Start Time: 10/13/2018 / 13:00

Location ID: 16EW12B Sample No: 16EW12B-181013

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	13:05	100	1.0	17.80	6.256	20.26	6.26	0.4	-61.7	1.03
10/13/2018	13:10	100	1.5	17.84	6.251	20.27	6.24	0.0	-63.4	0.78
10/13/2018	13:15	100	2.0	17.88	6.246	20.30	6.23	0.0	-66.2	0.34
10/13/2018	13:20	100	2.5	17.90	6.248	20.25	6.23	0.0	-71.7	0.28
10/13/2018	13:25	100	3.0	17.90	6.246	20.28	6.23	0.0	-72.5	0.24
10/13/2018	13:30	100	3.5	17.90	6.245	20.29	6.23	0.0	-72.7	0.25

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW13**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:76, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW13-181013

DATE/TIME: 10/13/2018 / 14:05

Pump Inlet Depth (ft): 25

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 17.40, Second Gauge: 17.40

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/13/2018 / 13:35

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 14:05

Constructed Depth to Well Bottom (ft) 29.3 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~25.00 - 25.00~~ 18.3-28.3 FT BTOC
L George 05/21/2020

Pump Start Time: 10/13/2018 / 13:35

APTIM

Sample Collection Log

Location ID: 16EW13		Sample No: 16EW13-181013								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	13:35	100	.500	17.40	12.29	21.34	5.88	38.1	15.5	2.80
10/13/2018	13:40	100	1.000	17.75	12.24	20.95	5.81	30.8	-15.0	2.15
10/13/2018	13:45	100	1.500	17.76	12.19	21.18	5.80	30.6	-33.1	1.56
10/13/2018	13:50	100	2.000	17.78	12.19	21.25	5.80	27.3	-36.4	1.36
10/13/2018	13:55	100	2.500	17.79	12.19	21.30	5.80	25.0	-39.1	1.23
10/13/2018	14:00	200	3.500	17.87	12.20	21.34	5.81	21.6	-40.7	1.13
10/13/2018	14:05	200	4.500	17.93	12.19	20.97	5.81	24.4	-43.2	1.05

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW14B**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Sunny, Air Temp:76, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW14B-181013

DATE/TIME: 10/13/2018 / 13:20

Pump Inlet Depth (ft): 19.5

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 16.73, Second Gauge: 16.73

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/13/2018 / 12:40

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 13:20

Constructed Depth to Well Bottom (ft)

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~14.50 - 24.50~~

L George 05/21/2020

Pump Start Time: 10/13/2018 / 12:40

APTIM

Sample Collection Log

Location ID: 16EW14B		Sample No: 16EW14B-181013								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	12:40	100	.500	16.73	13.42	22.26	6.23	209.0	38.8	3.82
10/13/2018	12:45	100	1.000	16.91	14.59	20.97	5.73	9.7	21.9	2.49
10/13/2018	12:50	100	1.500	16.92	15.31	21.08	5.70	4.6	15.5	1.88
10/13/2018	13:00	100	2.000	16.92	14.97	21.12	5.72	6.8	10.7	1.49
10/13/2018	13:10	125	2.625	16.93	14.50	21.21	5.72	4.2	7.4	1.28
10/13/2018	13:15	125	3.250	16.93	14.36	21.18	5.72	6.2	6.7	1.21
10/13/2018	13:50	125	3.875	16.94	14.00	21.13	5.72	19.9	4.8	1.14

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16EW15**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Partly Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16EW15-181013

DATE/TIME: 10/13/2018 / 12:20

Pump Inlet Depth (ft): 19

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 17.84. Second Gauge: 17.84

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/13/2018 / 11:45

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/13/2018 / 12:20

Constructed Depth to Well Bottom (ft) 27 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~14.00 - 24.00~~ 17-27 FT BTOC
L George 05/21/2020

Pump Start Time: 10/13/2018 / 11:45

APTIM

Sample Collection Log

Location ID: 16EW15	Sample No: 16EW15-181013									
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/13/2018	11:45	200	1.000	17.84	17.17	22.65	7.00	79.1	-36.6	5.01
10/13/2018	11:50	200	2.000	18.33	17.25	21.85	7.06	76.8	-115.0	3.12
10/13/2018	11:55	100	2.500	18.50	17.22	22.90	7.07	70.8	-130.9	2.04
10/13/2018	12:00	100	3.000	18.62	17.23	23.66	7.08	75.2	-133.8	1.69
10/13/2018	12:05	100	3.500	18.73	17.27	24.02	7.07	73.5	-131.6	1.53
10/13/2018	12:10	100	4.000	18.84	17.30	24.60	7.08	77.7	-131.4	1.31
10/13/2018	12:15	100	4.500	18.96	17.28	25.25	7.08	78.4	-130.7	1.15
10/13/2018	12:20	100	5.000	18.97	17.29	25.77	7.07	75.5	-134.0	1.09

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16SW01**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Clear, Air Temp:71, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: **16SW01-181011**

DATE/TIME: 10/11/2018 / 13:55

Pump Inlet Depth (ft):

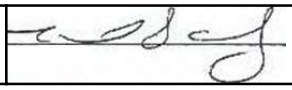
Sampling Method: GR

Sample Purpose: REG

Sample Matrix: SW

Sample Notes: 16SW01-181011-FD + MS/MSD. Gauged DTW twice at 16WW46, 22.02FT / 22.02FT. Perchlorate field filtered w/ 0.2 micron filter. Collecte samples with disposable bailer.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-SW-ALSHT-181011-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16SW01**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Clear, Air Temp:71, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: **16SW01-181011-FD**

DATE/TIME: 10/11/2018 / 13:30

Pump Inlet Depth (ft):

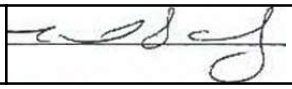
Sampling Method: GR

Sample Purpose: FD

Sample Matrix: SW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16SW02**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Clear, Air Temp:71, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: **16SW02-181011**

DATE/TIME: 10/11/2018 / 15:10

Pump Inlet Depth (ft):

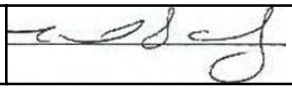
Sampling Method: GR

Sample Purpose: REG

Sample Matrix: SW

Sample Notes: Gauged DTW twice at 16WW40, 12.31' / 12.31'. Perchlorate field filtered w/ 0.2 micron filter. Collecte samples with disposable bailer

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-SW-ALSHT-181011-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16SW03**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Clear, Air Temp:71, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: **16SW03-181011**

DATE/TIME: 10/11/2018 / 16:30

Pump Inlet Depth (ft):

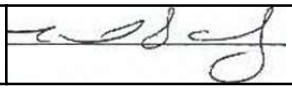
Sampling Method: GR

Sample Purpose: REG

Sample Matrix: SW

Sample Notes: Gauged DTW twice at 16WW43, 10.43' / 10.43". Perchlorate field filtered w/ 0.2 micron filter. Collecte samples with disposable bailer

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-SW-ALSHT-181011-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW12**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW12-181012

DATE/TIME: 10/12/2018 / 13:50

Pump Inlet Depth (ft): 19

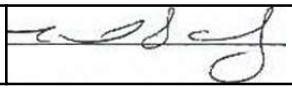
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Perchlorate field filtered w/ 0.2 micron filter. Gauged DTW twice 18.63' / 18.63'

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 13:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 13:50

Constructed Depth to Well Bottom (ft) ~~24~~ 26.64 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~14.00 - 24.00~~ 16.64-26.64 FT BTOC

L George 05/21/2020

Pump Start Time: 10/12/2018 / 13:10

APTIM

Sample Collection Log

Location ID: 16WW12		Sample No: 16WW12-181012								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	13:15	200	1.0	18.78	6.655	19.43	5.81	51.5	109.1	1.01
10/12/2018	13:20	200	2.0	18.78	6.628	19.31	5.73	34.3	117.1	0.96
10/12/2018	13:25	200	3.0	18.78	6.630	19.25	5.73	22.4	121.7	0.77
10/12/2018	13:30	200	4.0	18.78	6.622	19.28	5.74	10.1	123.6	0.54
10/12/2018	13:35	200	5.0	18.78	6.617	19.30	5.74	9.9	126.5	0.48
10/12/2018	13:40	200	6.0	18.78	6.616	19.17	5.74	4.6	128.8	0.36
10/12/2018	13:45	200	7.0	18.78	6.610	19.14	5.74	0.0	129.2	0.36
10/12/2018	13:50	200	8.0	18.78	6.607	19.13	5.74	0.0	130.1	0.36

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW13**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW13-181012

DATE/TIME: 10/12/2018 / 15:15

Pump Inlet Depth (ft): 19

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 9.06; Second gauge: 9.06. Perchlorate Sample field filtered with 0.2 micron water filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 14:45

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 15:15

Constructed Depth to Well Bottom (ft) ~~24~~ 26.73 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~14.00 - 24.00~~ 16.73-26.73 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 14:45

APTIM

Sample Collection Log

Location ID: 16WW13		Sample No: 16WW13-181012								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	11:45	300	1.500	9.06	10.85	20.80	4.73	182.4	294.3	3.77
10/12/2018	14:50	200	2.500	9.54	10.95	20.39	4.68	189.0	271.5	2.85
10/12/2018	14:55	125	3.125	9.78	10.96	21.07	4.68	203.5	244.9	1.78
10/12/2018	15:00	125	3.750	9.94	10.97	21.06	4.67	208.5	236.3	1.44
10/12/2018	15:05	125	4.375	10.03	10.96	21.08	4.67	209.9	229.3	1.24
10/12/2018	15:10	125	5.000	10.06	10.95	21.07	4.67	218.6	223.4	1.08
10/12/2018	15:15	125	5.625	10.07	10.94	21.16	4.68	222.8	225.7	1.02

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW14**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW14-181010 **DATE/TIME: 10/10/2018 / 12:02** **Pump Inlet Depth (ft): 22**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged well twice for water level 26.71' / 26.71'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:			

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 11:33

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 12:02

Constructed Depth to Well Bottom (ft) ~~29~~ 32.63 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~17.00 - 27.00~~ 20.63-30.63 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 11:33

Location ID: 16WW14 Sample No: 16WW14-181010										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	11:37	150	1.0	26.88	4.428	21.24	6.39	141.7	47.4	1.25
10/10/2018	11:42	150	1.75	26.88	4.392	21.23	6.03	108.4	51.3	0.68
10/10/2018	11:47	150	2.50	26.92	4.387	21.40	5.97	152.4	52.5	0.62
10/10/2018	11:52	150	3.25	26.96	4.376	24.56	5.94	167.1	54.3	0.52
10/10/2018	11:57	150	4.0	26.96	4.368	21.63	5.93	59.6	55.8	0.48
10/10/2018	12:02	150	4.75	26.96	4.360	21.67	5.93	38.1	57.1	0.44

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW16**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Mostly Cloudy, Air Temp:78, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW16-181010

DATE/TIME: 10/10/2018 / 13:15

Pump Inlet Depth (ft): 24

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 23.28; Second Gauge: 23.28; Perchlorate sample field filtered through 0.2 micron filter for groundwater

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 12:40

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 13:15

Constructed Depth to Well Bottom (ft) ~~29~~ 31.62 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~19.00 - 29.00~~ 21.62-31.62 FT BTOC

L George 05/21/2020

Pump Start Time: 10/10/2018 / 12:40

APTIM

Sample Collection Log

Location ID: 16WW16		Sample No: 16WW16-181010								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	12:40	200	1.0	23.28	6.358	21.41	6.13	134.3	297.8	3.21
10/10/2018	12:45	175	1.875	23.38	6.355	21.53	6.11	129.4	283.7	2.27
10/10/2018	12:50	150	2.625	23.39	3.365	21.89	6.06	142.1	268.6	1.70
10/10/2018	12:55	150	3.375	23.39	6.379	21.75	6.07	139.9	240.5	1.32
10/10/2018	13:00	150	4.125	23.40	6.405	22.33	6.03	134.7	225.5	1.17
10/10/2018	13:05	150	4.875	23.40	6.477	21.55	6.10	137.1	214.3	1.11
10/10/2018	13:10	150	5.625	23.43	6.398	21.12	6.19	132.2	200.9	1.03
10/10/2018	13:15	150	6.375	23.43	6.424	20.82	6.10	136.2	193.6	0.96

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW21**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW21-181012

DATE/TIME: 10/12/2018 / 15:40

Pump Inlet Depth (ft): 95

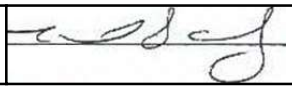
Sampling Method: Bladder Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged DTW twice, 26.75' / 26.75''. Perchlorate field filtered w/ 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 14:55

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 15:40

Constructed Depth to Well Bottom (ft) ~~101~~ 103.21 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~90.00 - 100.00~~ 93.21-103.21 FT BTOC

L George 05/21/2020

Pump Start Time: 10/12/2018 / 14:55

APTIM

Sample Collection Log

Location ID: 16WW21				Sample No: 16WW21-181012						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	15:05	100	1.0	26.90	0.696	20.36	6.80	79.8	127.1	2.30
10/12/2018	15:10	100	1.5	26.90	0.663	20.19	6.12	77.5	140.8	1.73
10/12/2018	15:15	100	2.0	26.90	0.573	20.06	5.67	74.8	154.2	1.16
10/12/2018	15:20	100	2.5	26.90	0.549	20.14	5.58	75.3	159.0	0.91
10/12/2018	15:25	100	3.0	26.90	0.545	20.15	5.56	81.4	159.8	0.83
10/12/2018	15:30	100	3.5	26.90	0.543	20.16	5.55	88.0	161.0	0.80
10/12/2018	15:35	100	4.0	26.90	0.541	20.13	5.52	89.4	165.4	0.83
10/12/2018	15:40	100	4.5	26.90	0.540	20.15	5.52	86.3	166.4	0.82

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW22**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Sunny, Air Temp:85, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW22-181010

DATE/TIME: 10/10/2018 / 15:00

Pump Inlet Depth (ft): 26

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First Gauge: 29.17; Second Gauge: 29.17. Perchlorate Sample field filtered with 0.2 micron groundwater filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 14:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 15:00

Constructed Depth to Well Bottom (ft) ~~32~~ 33.94 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~21.00 - 31.00~~ 23.94-33.94 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 14:30

APTIM

Sample Collection Log

Location ID: 16WW22 Sample No: 16WW22-181010										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	14:30	200	1.00	29.17	5.631	22.51	5.67	133.9	114.5	2.20
10/10/2018	14:35	200	2.00	29.35	5.624	22.42	5.63	136.2	110.4	2.02
10/10/2018	14:40	175	2.875	29.41	5.631	22.20	5.61	139.7	96.9	1.46
10/10/2018	14:45	125	3.50	29.44	5.681	22.12	5.64	135.1	87.7	1.26
10/10/2018	14:50	125	4.125	29.51	5.800	21.62	5.77	134.4	74.6	1.06
10/10/2018	14:55	100	4.625	29.51	5.877	21.46	5.79	133.1	70.0	1.00
10/10/2018	15:00	100	5.25	29.53	5.988	20.82	5.86	135.7	68.3	0.89

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW23**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:74, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW23-181012 **DATE/TIME: 10/12/2018 / 11:55** **Pump Inlet Depth (ft): 29**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: First gauge: 9.23, Second gauge: 9.23. Perchlorate Sample field filttered with 0.2 micron water filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 11:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 11:55

Constructed Depth to Well Bottom (ft) ~~35~~ 37.2 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~24.00 - 34.00~~ 27.2-37.2 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 11:30

Location ID: 16WW23 Sample No: 16WW23-181012										
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	11:30	300	1.500	9.23	7.075	19.30	5.25	82.1	261.7	5.64
10/12/2018	11:35	200	2.500	9.54	7.674	19.02	5.44	155.9	90.7	3.03
10/12/2018	11:40	200	3.500	9.59	7.635	19.06	5.46	160.6	64.6	2.20
10/12/2018	11:45	200	4.500	9.62	7.560	19.15	5.47	180.1	45.2	1.67
10/12/2018	11:50	200	5.500	9.63	7.608	19.16	5.48	200.5	28.7	1.38
10/12/2018	11:55	200	6.500	9.64	7.916	19.18	5.49	183.8	13.2	1.23

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW24**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:78, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW24-181009

DATE/TIME: 10/9/2018 / 14:45

Pump Inlet Depth (ft): 13.5

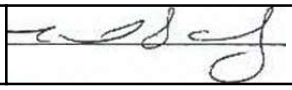
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: 16WW24-181009-FD + MS/MSD Perchlorate field filtered w/ 0.2 micron filter. Gauged depth to water twice 10.17FT / 10.17FT.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 14:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 14:45

Constructed Depth to Well Bottom (ft) ~~17~~ 19.29 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~11.00 - 16.00~~ 14.29-19.29 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 14:10

APTIM

Sample Collection Log

Location ID: 16WW24		Sample No: 16WW24-181009								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	14:15	100	1.0	10.65	2.501	23.34	3.75	2.1	257.2	0.77
10/9/2018	14:20	100	1.5	10.95	2.486	23.31	3.59	0.2	269.8	0.51
10/9/2018	14:25	100	2.0	11.05	2.573	23.33	3.61	1.9	264.7	0.57
10/9/2018	14:30	100	2.5	11.10	2.541	23.41	3.57	0.0	275.1	0.43
10/9/2018	14:35	100	3.0	11.10	2.532	23.45	3.56	0.0	278.3	0.42
10/9/2018	14:40	100	3.5	11.10	2.538	23.46	3.54	0.0	280.1	0.19
10/9/2018	14:45	100	4.0	11.10	2.542	23.49	3.54	0.0	282.6	0.17

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW24**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:78, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW24-181009-FD

DATE/TIME: 10/9/2018 / 14:45

Pump Inlet Depth (ft): 13.5

Sampling Method: Peristaltic Pump

Sample Purpose: FD

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 14:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 14:45

Constructed Depth to Well Bottom (ft) ~~17~~ 19.29 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~11.00 - 16.00~~ 14.29-19.29 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 14:10

Location ID: 16WW24 Sample No: 16WW24-181009-FD

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW24**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:78, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW24-181009MS

DATE/TIME: 10/9/2018 / 14:45

Pump Inlet Depth (ft): 13.5

Sampling Method: Peristaltic Pump

Sample Purpose: MS

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 14:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 14:45

Constructed Depth to Well Bottom (ft) ~~17~~ 19.29 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~11.00 - 16.00~~ 14.29-19.29 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 14:10

Location ID: 16WW24 Sample No: 16WW24-181009MS										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW24**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:78, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW24-181009MSD **DATE/TIME: 10/9/2018 / 14:45** **Pump Inlet Depth (ft): 13.5**

Sampling Method: Peristaltic Pump **Sample Purpose: MSD** **Sample Matrix: GW**

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 14:10

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 14:45

Constructed Depth to Well Bottom (ft) ~~17~~ 19.29 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~11.00 - 16.00~~ 14.29-19.29 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 14:10

Location ID: 16WW24 Sample No: 16WW24-181009MSD										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW25**

Project No: **501032**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Light Rain, Air Temp:86, Wind Speed:Strong Winds

SAMPLING INFORMATION

Sample No: 16WW25-181009

DATE/TIME: 10/9/2018 / 13:12

Pump Inlet Depth (ft): 44

Sampling Method: Low Flow

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged well twice for water level 19.28' / 19.28'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 12:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 13:12

Constructed Depth to Well Bottom (ft) ~~50~~ 52.25 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~39.00 - 49.00~~ 42.25-52.25 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 12:30

Location ID: 16WW25 Sample No: 16WW25-181009

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	12:47	100	1.0	19.43	5.270	22.74	5.13	25.5	94.3	0.96
10/9/2018	12:52	100	1.5	19.48	6.853	21.89	5.51	51.5	40.2	0.78
10/9/2018	12:57	100	2.0	19.51	8.510	21.28	5.94	69.1	-7.4	0.51
10/9/2018	13:02	100	2.5	19.55	8.453	21.88	5.95	78.1	-10.1	0.66
10/9/2018	13:07	100	3.0	19.61	8.462	21.85	5.95	72.5	-11.0	0.57
10/9/2018	13:12	100	4.0	19.67	8.457	21.80	5.95	30.7	-13.4	0.31

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW26**

Project No: **501032**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Partly Cloudy, Air Temp:82, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW26-181009

DATE/TIME: 10/9/2018 / 11:18

Pump Inlet Depth (ft): 15

Sampling Method: Low Flow

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Guaged well twice and the water level was 18.39. Perchlorate field filtered w 0.2 micron filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 10:45

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 11:18

Constructed Depth to Well Bottom (ft) ~~18.5~~ 20.97 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~12.50 - 17.50~~ 15.97-20.97 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 10:45

Location ID: 16WW26 Sample No: 16WW26-181009										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	10:50	100	1.0	18.54	2.297	20.79	5.14	59.5	155.5	1.70
10/9/2018	10:58	100	1.5	18.82	2.293	21.17	4.88	24.0	170.3	0.70
10/9/2018	11:03	100	2.0	18.94	2.289	21.17	4.87	19.4	174.6	0.68
10/9/2018	11:08	100	2.5	19.03	2.273	21.16	4.90	13.3	161.4	0.69
10/9/2018	11:13	100	3.0	19.28	2.259	21.25	5.09	9.9	71.9	0.73
10/9/2018	11:18	100	3.5	19.39	2.277	21.06	5.08	5.8	50.4	0.66

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW27**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:74, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW27-181012

DATE/TIME: 10/12/2018 / 13:10

Pump Inlet Depth (ft): 31

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 8.91, Second Gauge: 8.91. Perchlorate sample field filtered with 0.2 micron groundwater filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 12:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 13:10

Constructed Depth to Well Bottom (ft) ~~50~~ 39.1 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~26.00 - 36.00~~ 29.1-39.1 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 12:30

APTIM

Sample Collection Log

Location ID: 16WW27		Sample No: 16WW27-181012								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	12:30	300	1.500	8.91	2.540	20.11	4.32	71.5	235.2	5.31
10/12/2018	12:35	200	2.500	9.16	8.324	19.72	5.28	101.5	136.9	3.76
10/12/2018	12:40	200	3.500	9.22	8.427	19.74	5.43	132.9	57.3	2.59
10/12/2018	12:45	200	4.500	9.26	8.452	19.77	5.47	146.2	277	1.87
10/12/2018	12:50	200	5.500	9.28	8.469	19.69	5.48	155.7	9.3	1.51
10/12/2018	12:55	200	6.500	9.29	8.467	19.62	5.49	157.3	0.8	1.30
10/12/2018	13:00	200	7.500	9.31	8.474	19.59	5.50	176.5	-4.7	1.16
10/12/2018	13:05	200	8.500	9.31	8.491	19.59	5.50	185.1	-8.0	1.06
10/12/2018	13:10	200	9.500	9.32	8.499	19.61	5.54	186.5	-11.4	0.98

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW29**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:65, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW29-181015

DATE/TIME: 10/15/2018 / 10:05

Pump Inlet Depth (ft): 39.5

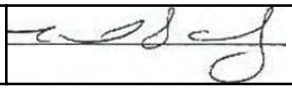
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged DTW twice, 8.73' / 8.73'. Perchlorate field filtered w/ 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181015-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/15/2018 / 09:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/15/2018 / 10:05

Constructed Depth to Well Bottom (ft) ~~43~~ 45.08 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~37.00 - 42.00~~ 40.08-45.08 FT BTOC
L George 05/21/2020

Pump Start Time: 10/15/2018 / 09:30

APTIM

Sample Collection Log

Location ID: 16WW29		Sample No: 16WW29-181015								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/15/2018	09:35	160	1.0	8.83	0.608	18.32	5.19	0.0	78.7	1.57
10/15/2018	09:40	160	1.8	8.83	0.571	18.36	5.68	0.0	38.9	1.41
10/15/2018	09:45	160	2.6	8.83	0.550	18.41	5.98	0.0	29.4	1.27
10/15/2018	09:50	160	3.4	8.83	0.535	18.38	6.10	0.0	27.2	1.25
10/15/2018	09:55	160	4.2	8.83	0.523	18.37	6.15	0.0	25.8	1.17
10/15/2018	10:00	160	5.0	8.83	0.522	18.39	6.18	0.0	25.4	1.16
10/15/2018	10:05	160	5.8	8.83	0.522	18.39	6.19	0.0	25.1	1.16

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW29**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16WW29-181015MS

DATE/TIME: 10/15/2018 / 09:30

Pump Inlet Depth (ft): 39.5

Sampling Method:

Sample Purpose: MS

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment:

Casing ID (in.): 4

Purge Start Date/Time: - / -

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/15/2018 / 09:30

Constructed Depth to Well Bottom (ft) ~~43~~ 45.08 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~37.00 - 42.00~~ 40.08-45.08 FT BTOC
L George 05/21/2020

Pump Start Time:

Location ID: 16WW29 Sample No: 16WW29-181015MS										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW30**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Clear, Air Temp:65, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW30-181012

DATE/TIME: 10/12/2018 / 10:30

Pump Inlet Depth (ft): 27.5

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 9.27, second gauge: 9.27. Perchlorate Sample field filtered with 0.2 micron water filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 09:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 10:30

Constructed Depth to Well Bottom (ft) ~~31~~ 33.14 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~25.00 - 30.00~~ 28.14-33.14 FT BTOC

L George 05/21/2020

Pump Start Time: 10/12/2018 / 09:30

APTIM

Sample Collection Log

Location ID: 16WW30		Sample No: 16WW30-181012								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	09:30	125	.625	9.27	2.957	19.02	6.16	92.4	136.0	4.76
10/12/2018	09:35	200	1.625	9.46	2.954	19.09	5.99	143.5	94.0	2.73
10/12/2018	09:40	200	2.625	9.50	2.932	19.12	5.97	137.0	87.2	2.11
10/12/2018	09:45	200	3.625	9.53	2.926	19.25	5.96	155.2	75.7	1.66
10/12/2018	09:50	200	4.625	9.55	3.216	19.28	5.93	170.2	67.5	1.44
10/12/2018	~~19:55~~ 09:55	200	5.625	9.56	3.881	19.27	5.83	177.1	50.1	1.30
10/12/2018	10:05	200	7.625	9.56	5.020	19.32	5.74	117.0	18.8	1.12
10/12/2018	10:15	200	9.625	9.60	5.272	19.31	5.85	205.4	-23.8	1.00
10/12/2018	10:25	200	11.625	9.62	5.307	19.28	5.86	197.3	-34.7	0.92
10/12/2018	10:30	200	12.625	9.62	5.319	19.34	5.86	212.0	-39.1	0.87

Time corrected - GNJ

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW31**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW31-181010

DATE/TIME: 10/10/2018 / 14:30

Pump Inlet Depth (ft): 44

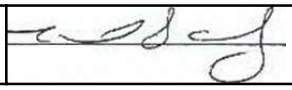
Sampling Method: Bladder Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: 16WW31-181010-FD + MS/MSD. Gauged DTW twice, 31.45FT / 31.45FT. Perchlorate field filtered w/ 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 13:50

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 14:30

Constructed Depth to Well Bottom (ft) ~~50~~ 51.78 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~39.00 - 49.00~~ 41.78-51.78 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 13:50

APTIM

Sample Collection Log

Location ID: 16WW31		Sample No: 16WW31-181010								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	13:55	200	1.0	31.55	1.391	21.00	5.65	101.1	179.3	1.72
10/10/2018	14:00	200	2.0	31.55	1.369	21.29	5.64	99.3	181.1	1.39
10/10/2018	14:05	200	3.0	31.55	1.392	21.64	5.62	89.0	187.5	1.13
10/10/2018	14:10	200	4.0	31.55	1.396	21.99	5.45	66.1	201.0	0.89
10/10/2018	14:15	200	5.0	31.55	1.401	22.16	5.41	62.5	205.1	0.77
10/10/2018	14:20	200	6.0	31.55	1.404	22.26	5.37	57.2	209.0	0.75
10/10/2018	14:25	200	7.0	31.55	1.405	22.29	5.32	56.4	215.7	0.72
10/10/2018	14:30	200	8.0	31.55	1.417	22.25	5.32	55.9	219.1	0.71

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW31**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW31-181010-FD

DATE/TIME: 10/10/2018 / 14:30

Pump Inlet Depth (ft): 44

Sampling Method: Bladder Pump

Sample Purpose: FD

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: - / -

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 14:30

Constructed Depth to Well Bottom (ft) ~~50~~ 51.78 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~39.00 - 49.00~~ 41.78-51.78 FT BTOC
L George 05/21/2020

Pump Start Time:

Location ID: 16WW31 Sample No: 16WW31-181010-FD

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW31**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW31-181010MS

DATE/TIME: 10/10/2018 / 14:30

Pump Inlet Depth (ft): 44

Sampling Method: Bladder Pump

Sample Purpose: MS

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: - / -

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 14:30

Constructed Depth to Well Bottom (ft) ~~50~~ 51.78 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~39.00 - 49.00~~ 41.78-51.78 FT BTOC
L George 05/21/2020

Pump Start Time:

Location ID: 16WW31 Sample No: 16WW31-181010MS

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW31**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW31-181010MSD **DATE/TIME: 10/10/2018 / 14:30** **Pump Inlet Depth (ft): 44**

Sampling Method: Bladder Pump **Sample Purpose: MSD** **Sample Matrix: GW**

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: - / -

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 14:30

Constructed Depth to Well Bottom (ft) ~~50~~ 51.78 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~39.00 - 49.00~~ 41.78-51.78 FT BTOC
L George 05/21/2020

Pump Start Time:

Location ID: 16WW31 Sample No: 16WW31-181010MSD										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW32**

Project No: **501032**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Cloudy, Air Temp:70, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW32-181011

DATE/TIME: 10/11/2018 / 09:28

Pump Inlet Depth (ft): 27

Sampling Method: Bladder Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged well twice for water level 31.58' / 31.58'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181011-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:			

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/11/2018 / 08:55

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/11/2018 / 09:28

Constructed Depth to Well Bottom (ft) ~~33~~ 35.01 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~22.00 - 32.00~~ 25.01-35.01 FT BTOC
L George 05/21/2020

Pump Start Time: 10/11/2018 / 08:55

Location ID: 16WW32 Sample No: 16WW32-181011										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/11/2018	09:01	125	1.0	31.82	1.187	17.84	6.75	108.3	85.3	3.02
10/23/2018	09:08	300	3.5	31.93	1.173	18.18	5.96	72.1	90.6	3.11
10/23/2018	09:13	125	4.125	32.03	1.170	18.20	5.82	42.1	101.7	2.86
10/23/2018	09:18	125	4.75	32.12	1.170	18.26	5.76	36.4	106.6	2.82
10/23/2018	09:23	125	5.375	32.13	1.172	18.29	5.71	32.0	110.4	2.54
10/23/2018	09:28	125	6.0	32.24	1.171	18.30	5.64	25.9	115.4	1.94

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW33**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW33-181010

DATE/TIME: 10/10/2018 / 10:20

Pump Inlet Depth (ft): 44

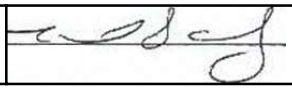
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged DTW twice, 31.39' / 31.39'. Perchlorate field filtered w/ 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 09:45

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 10:20

Constructed Depth to Well Bottom (ft) ~~50~~ 52.17 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~39.00 - 49.00~~ 42.17-52.17 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 09:45

APTIM

Sample Collection Log

Location ID: 16WW33		Sample No: 16WW33-181010								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	09:50	100	1.0	31.60	1.994	20.41	6.47	24.3	125.0	1.34
10/10/2018	09:55	100	1.5	31.70	2.009	20.40	6.42	21.1	129.3	1.42
10/10/2018	10:00	100	2.0	31.75	2.065	20.38	6.41	20.3	131.8	1.50
10/10/2018	10:05	100	2.5	31.75	2.111	20.39	6.43	50.1	132.3	1.48
10/10/2018	10:10	100	3.0	31.75	2.123	20.40	6.44	49.3	133.4	1.42
10/10/2018	10:15	100	3.5	31.75	2.189	20.38	6.48	48.5	131.2	1.40
10/10/2018	10:20	100	4.0	31.75	2.174	20.40	6.49	49.2	132.3	1.39

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW34**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW34-181010

DATE/TIME: 10/10/2018 / 13:05

Pump Inlet Depth (ft): 29.5

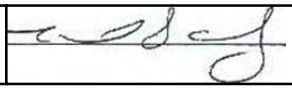
Sampling Method: Bladder Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Perchlorate field filtered w/ 0.2 micron filter. Gauged depth to water twice 31.35' / 31.35'

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 12:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 13:05

Constructed Depth to Well Bottom (ft) ~~32.5~~ 34.81 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~27.00 - 32.00~~ 29.81-34.81 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 12:30

APTIM

Sample Collection Log

Location ID: 16WW34		Sample No: 16WW34-181010								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	12:35	100	1.0	31.60	1.201	20.22	6.09	123.7	10.1	1.04
10/10/2018	12:40	100	1.5	31.70	1.244	20.19	6.10	113.1	14.3	0.86
10/10/2018	12:45	100	2.0	31.74	1.287	20.41	6.13	109.6	13.5	0.88
10/10/2018	12:50	100	2.5	31.76	1.306	20.59	6.15	86.9	12.7	0.96
10/10/2018	12:55	100	3.0	31.81	1.308	20.60	6.17	84.8	12.1	0.94
10/10/2018	13:00	100	3.5	31.82	1.308	20.62	6.17	84.7	13.0	0.92
10/10/2018	13:05	100	4.0	31.82	1.305	20.63	6.15	84.1	13.2	0.92

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW35**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Cloudy, Air Temp:74, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW35-181010 **DATE/TIME: 10/10/2018 / 13:11** **Pump Inlet Depth (ft): 38.5**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged well twice for water level 19.48' / 19.48'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:			

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 12:40

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 13:11

Constructed Depth to Well Bottom (ft) ~~44~~ 46.58 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~33.50 - 43.50~~ 36.58-46.58 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 12:40

Location ID: 16WW35 Sample No: 16WW35-181010

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	12:48	125	1.0	19.88	13.66	21.26	6.25	21.4	170.1	1.67
10/10/2018	12:53	125	1.625	19.94	13.44	21.11	6.16	12.8	166.7	1.15
10/10/2018	12:58	125	2.25	20.15	13.76	21.11	6.16	16.3	161.8	0.66
10/10/2018	13:03	125	2.875	20.29	13.56	21.16	6.17	17.6	161.0	0.55
10/10/2018	13:08	125	3.5	20.29	13.53	21.18	6.17	5.4	159.8	0.41
10/10/2018	13:11	125	4.125	20.29	13.52	21.27	6.17	5.1	158.6	0.42

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW36**

Project No: **501032**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Light Rain, Air Temp:84, Wind Speed:Strong Winds

SAMPLING INFORMATION

Sample No: 16WW36-181009

DATE/TIME: 10/9/2018 / 14:53

Pump Inlet Depth (ft): 19

Sampling Method: Low Flow

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged well twice with water level at 18.88. Perchlorate sample field filtered w 0.2 mircon filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 14:20

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 14:53

Constructed Depth to Well Bottom (ft) ~~22~~ 24.49 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~16.50 - 21.50~~ 19.49-24.49 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 14:20

Location ID: 16WW36 Sample No: 16WW36-181009

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	14:28	100	1.0	19.12	11.01	21.56	6.03	24.9	70.0	0.93
10/9/2018	14:33	100	1.5	19.16	11.00	21.80	6.04	18.2	90.5	0.54
10/9/2018	14:38	100	2.0	19.22	11.03	22.14	6.06	9.8	94.1	0.43
10/9/2018	14:43	100	2.5	19.27	11.11	22.22	6.06	5.7	105.8	0.46
10/9/2018	14:48	100	3.0	19.33	11.14	22.21	6.06	3.5	106.5	0.36
10/9/2018	14:53	100	3.5	19.41	11.03	22.32	6.07	1.8	116.1	0.39

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW37**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Cloudy, Air Temp:74, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW37-181010 **DATE/TIME: 10/10/2018 / 10:39** **Pump Inlet Depth (ft): 43**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged well twice for water level 29.28' / 29.28'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft)

Constructed Depth to Well Bottom (ft) ~~46~~ 48.72 FT BTOC
L George 05/26/2020

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~40.50 - 45.50~~ 43.72-48.72 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 10:05

Purging Method/Equipment: Low Flow

Purge Start Date/Time: 10/10/2018 / 10:05

Purge End Date/Time: 10/10/2018 / 10:39

PID Reading: N/A

Location ID: 16WW37 Sample No: 16WW37-181010

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	10:14	100	1.0	29.72	4.610	21.40	6.59	37.9	12.3	1.39
10/10/2018	10:19	100	1.5	29.78	4.601	21.23	6.64	38.5	11.9	1.00
10/10/2018	10:24	100	2.0	29.98	4.583	21.16	6.66	36.2	24.2	0.70
10/10/2018	10:29	100	2.5	30.09	4.577	21.30	6.69	33.2	31.8	0.62
10/10/2018	10:34	100	3.0	30.20	4.579	21.78	6.71	40.6	43.0	0.57
10/10/2018	10:39	100	3.5	30.29	4.617	21.51	6.73	43.2	48.3	0.57

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW38**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW38-181010 **DATE/TIME: 10/10/2018 / 09:40** **Pump Inlet Depth (ft): 24**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged well twice for water level 29.18' / 29.18'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 09:16

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 09:40

Constructed Depth to Well Bottom (ft) ~~30~~ 32.3 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~19.00 - 29.00~~ 22.3-32.3 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 09:16

Location ID: 16WW38 Sample No: 16WW38-181010

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	09:24	100	1.0	29.47	2.637	20.73	5.93	17.1	-24.8	1.02
10/10/2018	09:29	100	1.5	29.68	2.557	20.84	5.97	15.6	-32.3	0.74
10/10/2018	09:34	100	2.0	29.48	2.528	21.00	5.97	30.7	-36.8	0.63
10/10/2018	09:39	100	2.5	29.48	2.551	21.01	5.95	22.4	-40.2	0.52
10/10/2018	09:44	100	3.0	29.49	2.606	21.01	5.95	23.1	-44.3	0.44
10/10/2018	09:49	100	3.5	29.48	2.604	20.99	5.94	24.4	-44.9	0.38

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW39**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW39-181010 **DATE/TIME: 10/10/2018 / 15:39** **Pump Inlet Depth (ft): 99**

Sampling Method: Peristaltic Pump **Sample Purpose: REG** **Sample Matrix: GW**

Sample Notes: Gauged well twice for water level 21.66' / 21.66'. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt
QC'ed By:	[redacted]	

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 2

Depth to Water - Initial (DTWi) (ft)

Constructed Depth to Well Bottom (ft) ~~26.5~~ 29.5 FT BTOC
L George 05/26/2020

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~99.00 99.00~~ 18-28 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 14:50

Purging Method/Equipment: Low Flow

Purge Start Date/Time: 10/10/2018 / 14:50

Purge End Date/Time: 10/10/2018 / 15:39

PID Reading: N/A

Location ID: 16WW39 Sample No: 16WW39-181010										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	15:14	125	1.0	22.02	6.806	20.75	5.91	18.4	123.4	0.67
10/10/2018	15:19	125	1.625	22.02	6.438	20.74	5.77	35.3	130.1	0.48
10/10/2018	15:24	125	2.25	22.02	6.186	20.73	5.74	53.4	128.6	0.44
10/10/2018	15:29	125	2.875	22.02	5.919	20.57	5.74	11.1	122.8	0.48
10/10/2018	15:34	125	3.5	22.04	5.839	20.49	5.74	13.7	119.4	0.41
10/10/2018	15:39	125	4.125	22.04	5.745	20.60	5.74	15.7	115.9	0.48

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW40**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW40-181012

DATE/TIME: 10/12/2018 / 12:35

Pump Inlet Depth (ft): 99

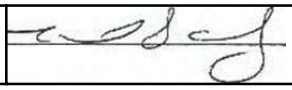
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: 16WW40-181012-FD + MS/MSD Perchlorate field filtered w/ 0.2 micron filter. Gauged depth to water twice 12.31FT / 12.31FT.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 2

Depth to Water - Initial (DTWi) (ft)

Purging Method/Equipment: Low Flow

Purge Start Date/Time: 10/12/2018 / 11:50

Purge End Date/Time: 10/12/2018 / 12:35

Constructed Depth to Well Bottom (ft) ~~18.5~~ 21.3 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~-99.00 - -99.00~~ 10.8-20.8 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 11:50

APTIM

Sample Collection Log

Location ID: 16WW40		Sample No: 16WW40-181012								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	11:55	150	1.0	12.56	7.009	20.61	6.12	9.2	-22.4	0.95
10/12/2018	12:00	150	1.75	12.56	7.318	20.88	3.01	8.3	-54.3	0.51
10/12/2018	12:05	150	2.50	12.56	7.440	20.93	5.91	7.0	-62.5	0.40
10/12/2018	12:10	150	3.25	12.56	7.439	20.99	6.02	2.4	-74.1	0.51
10/12/2018	12:15	150	4.00	12.56	7.387	21.04	5.92	0.0	-60.8	0.49
10/12/2018	12:20	150	4.75	12.56	7.240	21.11	5.92	0.0	-55.5	0.45
10/12/2018	12:25	150	5.50	12.56	7.042	21.24	5.90	0.0	-49.2	0.33
10/12/2018	12:30	150	6.25	12.56	7.031	21.24	5.90	0.0	-46.3	0.32
10/12/2018	12:35	150	7.00	12.56	7.029	21.27	5.90	0.0	-44.1	0.30

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW40**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW40-181012-FD **DATE/TIME: 10/12/2018 / 12:35** **Pump Inlet Depth (ft): 99**

Sampling Method: Peristaltic Pump **Sample Purpose: FD** **Sample Matrix: GW**

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 2

Purge Start Date/Time: 10/12/2018 / 11:50

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 12:35

Constructed Depth to Well Bottom (ft) ~~18.5~~ 21.3 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~-99.00 - -99.00~~ 10.8-20.8 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 11:50

Location ID: 16WW40 Sample No: 16WW40-181012-FD										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW40**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW40-181012MS

DATE/TIME: 10/12/2018 / 12:35

Pump Inlet Depth (ft): 99

Sampling Method: Peristaltic Pump

Sample Purpose: MS

Sample Matrix: GW

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 2

Purge Start Date/Time: 10/12/2018 / 11:50

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 12:35

Constructed Depth to Well Bottom (ft) ~~18.5~~ 21.3 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~-99.00 - -99.00~~ 10.8-20.8 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 11:50

Location ID: 16WW40 Sample No: 16WW40-181012MS										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW40**

Project No: **501032**

Sampler(s):

FIELD CONDITIONS

Cloudy, Air Temp:75, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW40-181012MSD **DATE/TIME: 10/12/2018 / 12:35** **Pump Inlet Depth (ft): 99**

Sampling Method: Peristaltic Pump **Sample Purpose: MSD** **Sample Matrix: GW**

Sample Notes:

Chain of Custody	COC Notes	Analysis Group	Analytic Method
No COC Specified	None		

Sampler:	[redacted]		
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 2

Purge Start Date/Time: 10/12/2018 / 11:50

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 12:35

Constructed Depth to Well Bottom (ft) ~~18.5~~ 21.3 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~-99.00 - -99.00~~ 10.8-20.8 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 11:50

Location ID: 16WW40 Sample No: 16WW40-181012MSD										
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW41**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW41-181009

DATE/TIME: 10/9/2018 / 11:25

Pump Inlet Depth (ft): 45

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 27.76. Second Gauge: 27.76. Perchlorate sample field filtered with 0.2 micron water filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 10:45

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 11:25

Constructed Depth to Well Bottom (ft) ~~51~~ 53.6 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~40.00 - 50.00~~ 42.6-52.6 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 10:45

APTIM

Sample Collection Log

Location ID: 16WW41		Sample No: 16WW41-181009								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	10:45	125	.625	27.76	14.29	21.34	6.22	-287.2	272.1	3.08
10/9/2018	10:50	125	1.250	27.85	14.52	21.32	6.23	123.3	271.8	2.07
10/9/2018	10:55	100	1.750	27.94	14.55	21.47	6.22	129.2	271.4	1.27
10/9/2018	11:00	100	2.250	27.99	14.56	21.59	6.21	112.9	270.9	1.09
10/9/2018	11:05	100	2.750	28.09	14.57	21.68	6.21	129.3	269.9	0.96
10/9/2018	11:10	100	3.250	28.13	14.55	21.82	6.21	80.1	268.9	0.87
10/9/2018	11:15	100	3.725	28.18	14.58	21.92	6.21	97.7	267.9	0.81
10/9/2018	11:20	100	4.250	28.22	14.58	22.01	6.21	81.5	266.7	0.77
10/9/2018	11:25	100	4.725	28.24	14.58	22.04	6.21	86.2	266.0	0.79

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW42**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:70, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW42-181012

DATE/TIME: 10/12/2018 / 14:25

Pump Inlet Depth (ft): 7

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 10.95, second gauge: 10.95. Perchlorate sample field filtered with 0.2 micron groundwater filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 13:55

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 14:25

Constructed Depth to Well Bottom (ft) ~~12~~ 16.57 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~2.00 - 12.00~~ 6.57-16.57 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 13:55

APTIM

Sample Collection Log

Location ID: 16WW42		Sample No: 16WW42-181012								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	13:55	300	1.500	10.95	2.884	21.18	5.40	170.1	212.8	4.92
10/12/2018	14:00	200	2.500	11.45	2.217	21.29	5.47	191.7	154.3	3.22
10/12/2018	14:05	150	3.250	11.64	1.851	21.35	5.47	204.5	128.8	2.17
10/12/2018	14:10	125	3.825	11.80	1.504	21.43	5.42	209.0	117.5	1.62
10/12/2018	14:15	100	4.325	11.95	1.225	21.48	5.32	208.7	118.6	1.37
10/12/2018	14:20	100	4.825	12.09	1.039	21.47	5.26	209.0	116.5	1.26
10/12/2018	14:25	100	5.325	12.24	0.984	21.50	5.27	209.3	113.6	1.21

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW43**

Project No: **501032**

Sampler(s): **Kevin Schmitt**

FIELD CONDITIONS

Mostly Cloudy, Air Temp:82, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW43-181009

DATE/TIME: 10/9/2018 / 09:49

Pump Inlet Depth (ft): 7

Sampling Method: Low Flow

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged well twice with water level at 10.38. Perchlorate field filtered w 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181009-01	None	PERCHLORATE	6850

Sampler:		Kevin Schmitt	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/9/2018 / 09:20

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/9/2018 / 09:49

Constructed Depth to Well Bottom (ft) ~~12~~ 14.59 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~2.00 - 12.00~~ 4.59-14.59 FT BTOC
L George 05/21/2020

Pump Start Time: 10/9/2018 / 09:20

Location ID: 16WW43 Sample No: 16WW43-181009										
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/9/2018	09:24	100	1.0	10.79	0.323	21.76	6.14	14.5	6.1	1.11
10/9/2018	09:29	100	1.5	10.91	0.314	21.91	6.13	22.3	0.1	0.96
10/9/2018	09:34	100	2.0	11.07	0.311	21.89	6.13	22.0	9.9	0.86
10/9/2018	09:39	100	2.5	11.18	0.299	21.90	6.09	24.5	18.9	0.75
10/9/2018	09:44	100	3.0	11.28	0.298	21.88	6.09	21.2	-0.2	1.09
10/9/2018	09:49	100	3.5	11.37	~~.0300~~ 0.300	21.93	6.12	20.6	-1.7	1.46

Cond. corrected - GNJ

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW44**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:70, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW44-181010

DATE/TIME: 10/10/2018 / 10:05

Pump Inlet Depth (ft): 25

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 25.80; Second Gauge 25.80. Perchlorate sample field screened with 0.2 micron groundwater filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 09:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 10:05

Constructed Depth to Well Bottom (ft) ~~30~~ 32.18 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~20.00 - 30.00~~ 22.18-32.18 FT BTOC

L George 05/21/2020

Pump Start Time: 10/10/2018 / 09:30

APTIM

Sample Collection Log

Location ID: 16WW44		Sample No: 16WW44-181010								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	09:30	250	1.250	26.10	0.460	20.18	5.58	133.3	161.0	4.42
10/10/2018	09:35	200	2.250	26.18	0.429	20.07	5.74	89.5	129.0	3.58
10/10/2018	09:40	175	3.125	26.30	0.402	20.10	5.90	134.8	88.1	2.62
10/10/2018	09:45	175	4.00	26.37	0.394	20.06	5.94	138.4	79.8	2.30
10/10/2018	09:50	175	4.875	26.48	0.386	20.15	5.96	138.5	69.3	2.07
10/10/2018	09:55	150	5.625	26.58	0.382	20.37	5.98	139.0	62.8	1.94
10/10/2018	10:00	150	6.375	26.65	0.380	20.66	6.00	139.6	57.7	1.89
10/10/2018	10:05	150	7.125	26.76	0.381	20.51	5.99	139.3	53.5	1.80

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW45**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:72, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW45-181010

DATE/TIME: 10/10/2018 / 11:10

Pump Inlet Depth (ft): 45

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gauge: 25.81. Second Gauge: 25.81. Perchlorate sample field filtered with 0.2 micron water filter

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181010-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/10/2018 / 10:25

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/10/2018 / 11:10

Constructed Depth to Well Bottom (ft) ~~51~~ 53.63 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~40.00 - 50.00~~ 42.63-52.63 FT BTOC
L George 05/21/2020

Pump Start Time: 10/10/2018 / 10:25

APTIM

Sample Collection Log

Location ID: 16WW45		Sample No: 16WW45-181010								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/10/2018	10:25	150	.750	25.81	0.420	21.77	6.33	143.2	308.1	6.00
10/10/2018	10:30	150	1.500	26.16	0.756	20.72	6.71	142.1	259.1	5.14
10/10/2018	10:35	150	2.250	26.28	0.746	20.60	6.77	142.8	250.1	4.44
10/10/2018	10:40	100	3.250	26.47	0.852	20.51	6.83	142.9	96.8	3.00
10/10/2018	10:50	100	4.250	26.62	0.897	20.68	6.94	143.4	-8.6	1.55
10/10/2018	11:00	100	5.250	26.69	0.906	20.81	6.95	143.4	-30.3	1.29
10/10/2018	11:05	100	5.750	26.72	0.902	21.03	7.04	143.9	-35.0	1.19
10/10/2018	11:10	100	6.250	26.73	0.897	21.04	7.05	144.1	-25.0	1.25

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW46**

Project No: **501032**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:70, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW46-181012

DATE/TIME: 10/12/2018 / 11:05

Pump Inlet Depth (ft): 15

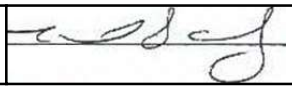
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Perchlorate field filtered w/ 0.2 micron filter. Gauged depth to water twice 15.83' / 15.83'

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181012-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/12/2018 / 10:30

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/12/2018 / 11:05

Constructed Depth to Well Bottom (ft) ~~21~~ 23.29 FT BTOC
L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~10.00 - 20.00~~ 12.29-22.29 FT BTOC
L George 05/21/2020

Pump Start Time: 10/12/2018 / 10:30

APTIM

Sample Collection Log

Location ID: 16WW46		Sample No: 16WW46-181012								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/12/2018	10:35	140	1.0	16.00	2.975	18.74	6.20	20.0	35.2	0.93
10/12/2018	10:40	140	1.7	16.09	2.841	18.75	6.05	19.8	38.3	0.72
10/12/2018	10:45	140	2.4	16.09	2.815	18.76	5.99	19.6	41.7	0.47
10/12/2018	10:50	140	3.1	16.09	2.900	18.80	6.18	19.1	42.3	0.47
10/12/2018	10:55	140	3.8	16.09	2.908	18.82	6.21	18.3	43.2	0.48
10/12/2018	11:00	140	4.5	16.09	2.912	18.81	6.24	17.5	43.8	0.49
10/12/2018	11:05	140	5.2	16.09	2.912	18.84	6.24	18.2	43.9	0.49

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW48**

Sampler(s): **Mike Martinez**

FIELD CONDITIONS

Cloudy, Air Temp:68, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW48-181018

DATE/TIME: 10/18/2018 / 12:40

Pump Inlet Depth (ft): 15

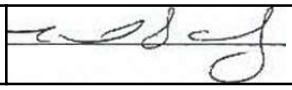
Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: Gauged DTW twice, 11.87' / 11.87'. Perchlorate field filtered w/ 0.2 micron filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181016-01	None	PERCHLORATE	6850

Sampler:		Mike Martinez	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow

Casing ID (in.): 4

Purge Start Date/Time: 10/18/2018 / 12:00

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/18/2018 / 12:40

Constructed Depth to Well Bottom (ft) 22.95 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~10.00 - 20.00~~ 12.95-22.95 FT BTOC

L George 05/21/2020

Pump Start Time: 10/18/2018 / 12:00

APTIM

Sample Collection Log

Location ID: 16WW48		Sample No: 16WW48-181018								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/18/2018	12:05	160	1.0	11.95	6.565	19.53	5.72	0.0	181.5	1.51
10/18/2018	12:10	160	1.8	11.95	6.730	19.50	5.92	0.0	166.4	1.32
10/18/2018	12:15	160	2.6	11.95	6.729	19.50	5.73	0.0	177.4	1.44
10/18/2018	12:20	160	3.4	11.95	6.745	19.68	5.73	0.0	176.4	1.30
10/18/2018	12:25	160	4.2	11.95	6.753	19.72	5.74	0.0	175.3	1.05
10/18/2018	12:30	160	5.0	11.95	6.776	19.77	5.78	0.0	176.0	0.99
10/18/2018	12:35	160	5.8	11.95	6.772	19.79	5.73	0.0	179.1	0.97
10/18/2018	12:40	160	6.6	11.95	6.771	19.79	5.75	0.0	173.1	0.98

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Location ID: **16WW55**

Project No: **501032**

Sampler(s): **Lindsey Luetge**

FIELD CONDITIONS

Cloudy, Air Temp:65, Wind Speed:Slight Winds

SAMPLING INFORMATION

Sample No: 16WW55-181015

DATE/TIME: 10/15/2018 / 10:30

Pump Inlet Depth (ft): 22

Sampling Method: Peristaltic Pump

Sample Purpose: REG

Sample Matrix: GW

Sample Notes: First gague: 22.88, Second Gauge: 22.88. Perchlorate sample field filtered with 0.2 micron groundwater filter.

Chain of Custody	COC Notes	Analysis Group	Analytic Method
LHAAP16-OCT2018-GW-ALSHT-181015-01	None	PERCHLORATE	6850

Sampler:	Lindsey Luetge	Lindsey Luetge	
QC'ed By:	[redacted]		

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic Pump

Casing ID (in.): 4

Purge Start Date/Time: 10/15/2018 / 09:40

Depth to Water - Initial (DTWi) (ft)

Purge End Date/Time: 10/15/2018 / 10:30

Constructed Depth to Well Bottom (ft) ~~27.5~~ 30.42 FT BTOC

L George 05/26/2020

PID Reading: N/A

Measured Depth of Well (ft): N/A

Screen Interval (ft): ~~17.00 - 27.00~~ 19.92-29.92 FT BTOC

L George 05/21/2020

Pump Start Time: 10/15/2018 / 09:40

APTIM

Sample Collection Log

Location ID: 16WW55		Sample No: 16WW55-181015								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/15/2018	09:40	100	.500	22.88	2.893	18.88	7.04	2.7	331.7	7.32
10/15/2018	09:45	150	1.250	22.95	6.160	19.00	6.30	10.9	342.0	5.43
10/15/2018	09:50	200	2.250	22.97	6.162	19.02	6.24	55.2	340.8	4.44
10/15/2018	10:00	100	3.250	22.99	6.155	19.09	6.21	6.1	336.8	3.37
10/15/2018	10:10	100	4.250	23.00	6.147	19.11	6.18	-8.5	319.2	2.70
10/15/2018	10:20	200	6.250	23.00	6.136	19.17	6.18	1.2	320.7	2.28
10/15/2018	10:25	200	8.250	23.00	6.136	19.12	6.19	-8.6	320.4	2.18
10/15/2018	10:30	200	9.250	23.01	6.130	19.10	6.19	-8.6	319.9	2.08

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW02**

Sampler(s): Kennie Moore

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16EW02-190918

DATE/TIME: 9/18/19 / 1455

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples 16 LFABP-FB-190918

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LF/BP

Casing ID (in.): 6

Purge Start Date/Time: 9/18/19/1425

Depth to Water - Initial (DTWi) (ft) 24.58

Purge End Date/Time: 9/18/19/1455

Depth to Well Bottom (ft) ~~31~~ 26.52

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~22-27~~ 21.75-26.75 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): ~~24.5~~ 26

Pump Start Time: 1455

Ferrous Iron (Required Y or N) N mg/L

Second DTW 24.58

APTIM

Sample Collection Log

Location ID: 16EW02 **Sample No: 16EW02-1909_18**

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	1425	100	.5	24.64	5.78	22.43	6.45	0.0	140	0.97
	1430	100	1.0	24.67	5.70	21.36	6.20	0.0	162	0.64
	1435	100	1.5	24.69	5.65	21.20	6.16	0.0	169	0.90
	1440	100	2.0	24.71	5.62	21.20	6.16	0.0	170	1.05
	1445	100	2.5	24.73	5.60	21.18	6.16	0.0	170	1.07
	1450	100	3.0	24.75	5.60	21.19	6.17	0.0	171	1.08
	1455	100	3.5	24.77	5.59	21.17	6.16	0.0	171	1.11

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW06**

Sampler(s): Kennie Moore

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16EW06-190918

DATE/TIME: 9/18/19 / 1335

~~**Sample Interval:** 23.6 - 23.8~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples 16EW06-190918

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LF/BP

Casing ID (in.): 6

Purge Start Date/Time: 9/18/19/1310

Depth to Water - Initial (DTWi) (ft) 23.03

Purge End Date/Time: 9/18/19/1335

Depth to Well Bottom (ft) ~~58~~ 56.20

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~50 - 55~~ 49.72-54.72 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 52.5

Pump Start Time: 1318

Ferrous Iron (Required Y or N) N mg/L

Second DTW 23.03

APTIM

Sample Collection Log

Location ID: 16EW06		Sample No: 16EW06-1909_18								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	1310	100	.5	23.08	9.64	23.97	6.73	4.1	44	1.09
	1315	100	1.0	23.10	9.90	22.35	6.30	7.4	49	0.64
	1320	100	1.5	23.12	9.85	22.12	6.23	8.1	53	0.59
	1325	100	2.0	23.14	9.82	22.03	6.19	7.9	56	0.54
	1330	100	2.5	23.16	9.80	22.01	6.19	7.8	56	0.53
	1335	100	3.0	23.18	9.79	22.02	6.18	7.8	58	0.53

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW12**

Sampler(s): L Hau

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW12-190918

DATE/TIME: 9/18/19 / 0859

~~**Sample Interval:** __ - __~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample Clear

Assoc. QC Samples LLAAP-TB-190918

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LFPP

Casing ID (in.): 4

Purge Start Date/Time: 9/18/19 922

Depth to Water - Initial (DTWi) (ft) 17.55

Purge End Date/Time: 9/19/19

Depth to Well Bottom (ft) ~~24~~ Not recorded

Discharge Tube Length: _____

PID Reading: 0.1

Screen Interval (ft): 16.64-26.64 FT BTOC

L George 05/21/2020

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Approximate depth of pump inlet*(ft): 19

Pump Start Time: 922

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW12		Sample No: 16WW12-1909 14								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	929	250		17.60	5.802	20.84	5.74	0.0	160.1	0.00
	934			17.61	5.795	20.50	5.77	17.3	160.8	0.77
	939			17.62	5.788	20.44	5.78	17.3	161.5	0.57
	944			17.62	5.779	20.41	5.78	17.5	161.9	0.48
	949			17.63	5.774	20.37	5.79	17.9	162.5	0.39
	954			17.64	5.774	20.31	5.79	16.8	163.0	0.33
	959			17.64	5.774	20.29	5.79	16.5	163.3	0.34

Logged by: _____ Date: 9/18/19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW13**

Project No: **501032**

Sampler(s): Kennie Moore

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16WW13-190918

DATE/TIME: 9/18/19 / 0845

~~Sample Interval: 9.21 - 9.58~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples 16LHAAP-753-20190918

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: SF/BP

Casing ID (in.): 4

Purge Start Date/Time: 9/18/19/0845

Depth to Water - Initial (DTWi) (ft) 9.21ft

Purge End Date/Time: 9/18/19/0910

Depth to Well Bottom (ft) ~~24~~ 22.86

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~14-24ft~~ 16.73-26.73 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 19

Pump Start Time: 0845

Ferrous Iron (Required Y or N) N mg/L

Second DTW 9.21ft

APTIM

Sample Collection Log

Location ID: 16WW13		Sample No: 16WW13-190918								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	0845	100	.5	9.27	1.69	20.80	5.52	2.6	199	0.39
	0850	100	1.0	9.30	1.66	20.58	5.52	1.4	194	0.32
	0855	100	1.5	9.32	1.60	20.54	5.52	1.3	191	0.19
	0900	100	2.0	9.34	1.57	20.52	5.53	1.3	191	0.17
	0905	100	2.5	9.36	1.55	20.54	5.53	1.2	190	0.17
	0910	100	3.0	9.38	1.54	20.56	5.52	1.3	190	0.16

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW14**

Sampler(s): Wesley Garcia

FIELD CONDITIONS

Sunny

SAMPLING INFORMATION

Sample No: 16WW14-190916

DATE/TIME: 9/16/19 1343

~~**Sample Interval:** __ - __~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample: Orange

Assoc. QC Samples: WLHAAP-TB1-190916

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 24.60

Depth to Well Bottom (ft) ~~29~~ Not recorded

Screen Interval (ft): 20.63-30.63 FT BTOC

L George 05/21/2020

Approximate depth of pump inlet*(ft): 22

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: Pump

Purge Start Date/Time: 9/16/19 1306

Purge End Date/Time: " 1345

Discharge Tube Length: _____

PID Reading: 0.0

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 1306

APTIM

Sample Collection Log

Location ID: 16WW14 **Sample No: 16WW14-190916**

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		~~±10% or 0.2~~ mg/L
9/16/19	1312	250		24.98	0.007	24.40	6.77	173.5	-27.4	~~3.41~~ 1.57
	1322			25.05	3.682	22.22	6.22	187.7	16.2	1.45
	1327			25.13	3.674	22.59	6.20	164.4	18.0	0.93
	1332			25.17	3.661	22.56	6.19	114.6	21.0	0.88
	1337			25.14	3.678	22.63	6.17	101.2	22.0	0.87
	1342			25.19	3.683	22.39	6.17	96.4	24.0	0.88

Logged by: _____ Date: 9/16/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW16**

Project No: **501032** Sampler(s): LWacey

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW16-190916 **DATE/TIME:** 9/16/19 1434 / **~~Sample Interval:~~** L George 05/21/2020

Sampling Method: LF **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample Clear **Assoc. QC Samples** 16LHAAP-TBL-190916 **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: LFPP

Casing ID (in.): 4 Purge Start Date/Time: 9/16/19 @ 1358

Depth to Water - Initial (DTWi) (ft) 21.37 Purge End Date/Time: 9/16/19 @ 1438

Depth to Well Bottom (ft) ~~29~~ Not recorded Discharge Tube Length: _____ PID Reading: 0.0

Screen Interval (ft): 21.62-31.62 FT BTOC Discharge Tube Diameter: _____ Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 24 Pump Start Time: 1358

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW16 Sample No: 16WW16-1909_16

Date of Reading	Time of Reading	Purge Rate	~~Total~~ Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	PTW	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/16/19	1403	280	21.50	21.50	4.664	21.62	6.22	1806	80.6	0.70
	1413		21.50	21.89	4.627	21.89	6.11	0.0	60.6	0.00
	1418		21.90	21.89	4.605	21.88	6.32	191.7	63.0	0.28
	1423		21.50	21.88	4.577	21.87	6.07	220	62.4	0.32
	1428		21.90	21.82	4.566	21.82	6.16	116.2	60.5	0.24
	1433		21.50	21.66	4.548	21.66	6.12	110.2	58.9	0.28

Logged by: _____ Date: 9/16/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW22**

Sampler(s): LG

FIELD CONDITIONS

Sunny

SAMPLING INFORMATION

Sample No: 16WW22-190917

DATE/TIME: 9/17/19 937

~~**Sample Interval:** __ - __~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample: Clear

Assoc. QC Samples: FB-LHAAP-JTL-190917

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Peristaltic LF

Casing ID (in.): 4

Purge Start Date/Time: 9/17/19 857

Depth to Water - Initial (DTWi) (ft) 27.22

Purge End Date/Time: 9/17/19 940

Depth to Well Bottom (ft) ~~32~~ Not recorded

Discharge Tube Length: _____

PID Reading: 0.1

Screen Interval (ft): 23.94-33.94 FT BTOC

L George 05/21/2020

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Approximate depth of pump inlet*(ft): 26

Pump Start Time: 857

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW22 Sample No: 16WW22-190917

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	901	250		27.30	3.600	20.49	6.22	397.1	-9.5	8.8
	911			27.43	3.594	20.49	6.25	97.1	-18.1	0.36
	916			27.51	3.599	20.56	6.37	113.1	-21.9	0.31
	921			27.62	3.642	20.77	6.18	79.1	-20.8	0.26
	926			27.74	3.652	20.82	6.14	35.7	-20.1	0.25
	931			27.78	3.668	20.80	6.09	30.9	-19.7	0.24
	936			27.80	3.671	20.93	6.05	28.4	-17.7	0.23

Logged by: _____ Date: 9/17/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW23**

Sampler(s): Kennie Moore

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16WW23-190917

DATE/TIME: 9/17/19 / 1350

~~**Sample Interval:** 8.35 - 8.54~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples (6) LFHAAP-MS-190917

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LF/BP

Casing ID (in.): 4

Purge Start Date/Time: 9/17/19 / 1320

Depth to Water - Initial (DTWi) (ft) 8.35ft

Purge End Date/Time: 9/17/19/1350

Depth to Well Bottom (ft) ~~35~~ 37.20ft

Discharge Tube Length: _____

PID Reading: _____

Screen Interval (ft): ~~22-37ft~~ 27.2-37.2 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): ~~29~~ ~~30.00~~ 32ft

Pump Start Time: _____

Ferrous Iron (Required Y or N) N mg/L

Second DTW 8.35ft

APTIM

Sample Collection Log

Location ID: 16WW23				Sample No: 16WW23-190917						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1320	100	.5	8.41	2.19	23.45	5.99	66.4	21	0.46
	1325	100	1.0	8.43	2.40	22.16	6.07	37.8	14	0.16
	1330	100	1.5	8.45	2.43	21.54	6.09	32.8	8	0.16
	1335	100	2.0	8.47	2.43	21.50	6.09	32.9	8	0.16
	1340	100	2.5	8.49	2.43	21.48	6.07	33.1	7	0.14
	1345	100	3.0	8.51	2.43	21.44	6.07	32.8	8	0.14
	1350	100	3.5	8.54	2.43	21.45	6.07	32.8	8	0.14

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW24**

Sampler(s): Kennie Moore

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16WW24-190917

DATE/TIME: 9/17/19 / 1455

~~**Sample Interval:** 10.29 ft~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples 16LHAAP-TB2-190917

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LF/BP

Casing ID (in.): 4

Purge Start Date/Time: 9/17/19/1430

Depth to Water - Initial (DTWi) (ft) 10.29

Purge End Date/Time: 9/17/19/1455

Depth to Well Bottom (ft) ~~17~~ 19.26 ft

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~14 - 19 ft~~ 14.29-19.29 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): ~~13.5~~ 16.5 ft

Pump Start Time: 1430

Ferrous Iron (Required Y or N) N mg/L

APTIM

Sample Collection Log

Location ID: 16WW24		Sample No: 16WW24-190917								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1430	100	.5	10.35	2.37	21.80	3.93	7.6	338	0.61
	1435	100	1.0	10.37	2.38	21.66	3.86	7.4	344	0.49
	1440	100	1.5	10.39	2.29	21.63	3.80	6.5	354	0.44
	1445	100	2.0	10.42	2.26	21.60	3.77	6.3	355	0.44
	1450	100	2.5	10.45	2.23	21.59	3.76	6.3	357	0.43
	1455	100	3.0	10.48	2.22	21.57	3.76	6.2	357	0.44

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW25**

Project No: **501032** Sampler(s): W Gavin

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW25-190919 **DATE/TIME:** 9/19/19 / 930

~~**Sample Interval:** __ - __~~

L George 05/21/2020

Sampling Method: LF **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample Clear

Assoc. QC Samples 16WW25-190919-FD; 16LHAAP-TB6-190919

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LFPD

Casing ID (in.): 4

Purge Start Date/Time: 9/19/19 856

Depth to Water - Initial (DTWi) (ft) 18.39

Purge End Date/Time: 9/19/19 932

Depth to Well Bottom (ft) ~~50~~ Not recorded

Discharge Tube Length: _____ PID Reading: 0-2

Screen Interval (ft): 42.25-52.25 FT BTOC

Discharge Tube Diameter: _____ Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 44

Pump Start Time: 856

Ferrous Iron (Required Y or N) _____ mg/L

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW25**

Sampler(s): LKB

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW25-190919-FD (~~16WW25~~)

DATE/TIME: 9/19/19 / 930

~~Sample Interval: ___ - ___~~

L George 05/21/2020

Sampling Method: LP

Sample Purpose: FD

Sample Matrix: GW

Appearance of Sample: Clear

Assoc. QC Samples: 16LHAAP-TB6-190919 vo ~~16WW25-190919-FD~~ 16WW25-190919

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 18.39

Depth to Well Bottom (ft) ~~50~~ Not recorded

Screen Interval (ft): 42.25-52.25 FT BTOC

L George 05/21/2020

Approximate depth of pump inlet*(ft): 44

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: LPP

Purge Start Date/Time: 9/19/19 856

Purge End Date/Time: 9/19/19 932

Discharge Tube Length: _____

PID Reading: 0.2

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 456

APTIM

Sample Collection Log

Location ID: 16WW25		Sample No: 16WW25-190919								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/19/19	900	750		18.49	2.935	21.31	5.95	62.4	40.0	2.21
	905			18.56	7.700	20.21	5.36	160.4	12.4	0.43
	910			18.64	7.766	19.94	5.42	199.2	5.1	0.37
	915			18.71	7.830	20.01	5.62	162.4	-5.9	0.31
	920			18.75	7.945	19.92	5.59	174.2	-14.6	0.26
	925			18.77	7.905	19.98	5.64	179.1	-15.7	0.22
	930			18.78	7.927	20.01	5.68	188.7	-18.2	0.20

Logged by: _____ Date: 9/19/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW26**

Sampler(s): L George

FIELD CONDITIONS

Sunny

SAMPLING INFORMATION

Sample No: 16WW26-190917

DATE/TIME: 9/17/19 1555

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

tan

Assoc. QC Samples

16LHAAP-TB3-190918

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 16.96

Depth to Well Bottom (ft) ~~18.5~~ Not recorded

Screen Interval (ft): 15.97-20.97 FT BTOC

L George 05/21/2020

Approximate depth of pump inlet*(ft): 15

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: LFPP

Purge Start Date/Time: 9/17/19 1518

Purge End Date/Time: 9/17/19 1555

Discharge Tube Length: _____

PID Reading: 0.1

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 15.19

APTIM

Sample Collection Log

Location ID: 16WW26		Sample No: 16WW26-190917								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/16	1523	250	—	17.24	3.182	21.95	5.24	140.3	250	0.43
	1526			16.52	3.172	21.90	5.23	56.2	28.7	0.00
	1537			16.71	3.154	21.92	5.20	0.0	23.4	0.00
	1538			16.99	3.140	21.93	5.19	-8.0	24.3	0.00
	1543			17.95	3.074	21.94	5.20	146.4	6.2	0.36
	1546			16.00	3.040	21.95	5.21	102.3	3.7	0.45
	1553			18.03	3.020	22.05	5.24	101.4	-1.6	0.44

Logged by: _____ Date: 9/17/16

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW27**

Project No: **501032** Sampler(s): Kennie Moore

FIELD CONDITIONS Clear/Sunny

SAMPLING INFORMATION

Sample No: 16WW27-190917 **DATE/TIME:** 190917 / 1025 **Sample Interval:** ~~8.21~~ - ~~8.38~~

L George 05/21/2020

Sampling Method: **Sample Purpose: REG** **Sample Matrix: GW**

Appearance of Sample Assoc. QC Samples: 16LHAAP-TB1-190917 **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: LF/BP

Casing ID (in.): 4 Purge Start Date/Time: 190917/1000

Depth to Water - Initial (DTWi) (ft) 8.21ft Purge End Date/Time: 190917/1025

Depth to Well Bottom (ft) ~~30~~ 39.31ft Discharge Tube Length: _____ PID Reading: _____

Screen Interval (ft): ~~29-39~~ 29.1-39.1 FT BTOC, Discharge Tube Diameter: 1/4 Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): ~~30~~ 34ft Pump Start Time: _____

Ferrous Iron (Required Y or N) N mg/L

Second DTW 8.21ft

APTIM

Sample Collection Log

Location ID: 16WW27				Sample No: 16WW27-190917						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
190917	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
	1000	100	.5	8.27	3.57	21.11	5.89	400	-16	0.45
	1005	100	1.0	8.29	3.62	20.53	5.97	107	-23	0.06
	1010	100	1.5	8.31	3.62	20.52	5.98	93.0	-26	0.06
	1015	100	2.0	8.33	3.63	20.53	5.98	92.3	-27	0.05
	1020	100	2.5	8.36	3.63	20.53	5.99	92.1	-26	0.04
	1025	100	3.0	8.38	3.63	20.53	5.99	91.7	-26	0.04

Logged by: _____ Date: 190917

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW29**

Sampler(s): ZW Gm

FIELD CONDITIONS

Sunny

SAMPLING INFORMATION

Sample No: 16WW29-1909 16

DATE/TIME: 6/14/19 1007 /

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: L F

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples 16LIAAP-TB5-190916

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 16.06 ~~16.08~~

Depth to Well Bottom (ft) ~~43~~ Not recorded

Screen Interval (ft): 40.08-45.08 FT BTOC

L George 05/21/2020

Approximate depth of pump inlet*(ft): 39.5

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: LFPP

Purge Start Date/Time: ~~6~~ 9/14/19 @ 1124

Purge End Date/Time: 9/14/19 1209

Discharge Tube Length: _____

PID Reading: 0.0

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 1124

APTIM

Sample Collection Log

Location ID: 16WW29				Sample No: 16WW29-1909 14						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/14/19	1137	250		17.04	1.438	21.07	6.33	7.7	53.8	3.43
	1142			17.07	1.440	20.66	6.29	0.0	78.2	0.00
	1157			17.10	1.432	20.69	6.29	5.5	-80.3	3.12
	1152			17.15	1.433	20.57	6.29	5.2	-89.3	3.09
	1157			17.18	1.430	20.58	5.99	5.3	-36.4	0.55
	1202			17.20	1.428	20.59	5.93	5.0	-28.7	0.46
	1207			17.22	1.427	20.60	5.85	5.1	-39.1	0.42

Logged by: _____ Date: 9/14/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW30**

Project No: **501032** Sampler(s): [illegible]

FIELD CONDITIONS [illegible]

SAMPLING INFORMATION

Sample No: 16WW30-190919 **DATE/TIME:** 9/18/19 1114 ~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample [illegible] **Assoc. QC Samples** 6LHAAP TB3-190918 **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: LF PP

Casing ID (in.): 4 Purge Start Date/Time: 9/18/19 1050

Depth to Water - Initial (DTWi) (ft) 15.86 Purge End Date/Time: 9/18/19 1114

Depth to Well Bottom (ft) ~~31~~ Not recorded Discharge Tube Length: _____ PID Reading: 0.4

Screen Interval (ft): 28.14-33.14 FT BTOC Discharge Tube Diameter: _____ Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 27.5 Pump Start Time: 1034

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW30 Sample No: 16WW30-1909[19]

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/16/15	1041	250		1642	1.362	20.49	6.25	66.8	-47.6	1.16
	1046			1686	1.332	20.20	6.16	53.6	-46.5	0.49
	1051			16.98	1.331	20.16	6.14	31.6	-46.1	0.48
	1056			17.11	1.306	20.19	6.13	19.3	-47.7	0.32
	1101			17.26	1.286	20.01	6.14	9.9	-44.2	0.27
	1106			17.31	1.271	20.13	6.14	4.3	-50.0	0.24
	1111			17.37	1.269	20.11	6.14	3.2	-54.3	0.22

Logged by: _____ Date: 9/16/15

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW35**

Sampler(s): Kennie Moore

FIELD CONDITIONS

SAMPLING INFORMATION

Sample No: 16WW35-1909 18

DATE/TIME: 9/18/19 / 1055

~~**Sample Interval:** 17.57 - 17.72~~

L George 05/21/2020

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples 16LHMP TB3-190918

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LF/BP

Casing ID (in.): 4

Purge Start Date/Time: 9/18/19/1030

Depth to Water - Initial (DTWi) (ft) 17.57ft

Purge End Date/Time: 9/18/19/1055

Depth to Well Bottom (ft) ~~44~~ 46.51ft

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~36.5-46.5ft~~ 36.58-46.58 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): ~~38.5~~ 41.5ft

Pump Start Time: 10.30

Ferrous Iron (Required Y or N) N mg/L

Second DTW 17.57ft

APTIM

Sample Collection Log

Location ID: 16WW35 Sample No: 16WW35-190918

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	1030	100	.5	17.62	13.6	22.36	6.37	12.0	161	0.48
	1035	100	1.0	17.64	13.9	21.16	6.56	13.4	152	0.36
	1040	100	1.5	17.66	14.0	20.67	6.62	14.3	144	0.32
	1045	100	2.0	17.68	14.0	20.64	6.63	14.1	144	0.27
	1050	100	2.5	17.70	14.1	20.62	6.63	14.1	143	0.27
↓	1055	100	3.0	17.72	14.2	20.59	6.64	14.0	143	0.26

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW36**

Sampler(s): LG

FIELD CONDITIONS

Sunny

SAMPLING INFORMATION

Sample No: 16WW36-190916

DATE/TIME: 9/16/19 1537

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample: golden

Assoc. QC Samples: 16WW36-TB1-190916

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 17.01

Depth to Well Bottom (ft) ~~22~~ Not recorded

Screen Interval (ft): 19.49-24.49 FT BTOC

L George 05/21/2020

Approximate depth of pump inlet*(ft): 19

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: LFP

Purge Start Date/Time: 9/16/19 1501

Purge End Date/Time: 9/16/19 1540

Discharge Tube Length: _____

PID Reading: 0.0

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 1501

APTIM

Sample Collection Log

Location ID: 16WW36 **Sample No: 16WW36-190916**

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/16/19	1506	250		17.30	9.972	22.50	5.96	12.3	121.9	1.85
	1516			17.38	9.182	22.22	5.97	22.2	117.6	0.31
	1521			17.40	8.954	22.21	5.97	1.6	115.5	0.29
	1526			17.41	8.589	22.05	5.97	1.5	106.5	0.25
	1531			17.42	8.564	21.88	5.99	2.0	89.0	0.23
	1536			17.45	8.561	21.86	5.98	1.1	87.4	0.21

Logged by: J Gamez Date: 9/16/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW39**

Sampler(s): VGarcia

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW39-190917

DATE/TIME: 9/17/19 / ~~1129~~ 1143

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample Clear

Assoc. QC Samples 16LHAAP-TB2-190917

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LFPP

Casing ID (in.): 2

Purge Start Date/Time: 9/17/19 1105

Depth to Water - Initial (DTWi) (ft) 21.0

Purge End Date/Time: 9/17/19 1148

Depth to Well Bottom (ft) ~~26.5~~ Not recorded

Discharge Tube Length: _____

PID Reading: 0.1

Screen Interval (ft): 18-28 FT BTOC

Discharge Tube Diameter: _____

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): -99

Pump Start Time: 1105

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW39 Sample No: 16WW39-190917

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1108	250		20.43	5.807	21.26	5.98	86.0	120.3	0.37
	1113			20.50	5.763	21.23	5.97	123.4	115.7	0.35
	1119			20.55	5.744	21.19	5.97	179.3	105.3	0.34
	1123			20.57	5.668	20.95	5.98	104.0	104.0	0.27
	1129			20.60	5.657	20.99	5.95	44.2	359	0.26
	1133			20.62	5.640	20.81	5.99	96.4	25.4	0.25
	1139			20.65	5.607	20.55	5.97	105.4	23.5	0.24
	1143			20.66	5.599	20.80	5.97	105.3	24.1	0.23

Logged by: D. Garcia Date: 9/17/19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW40**

Sampler(s): LG

FIELD CONDITIONS

Cloudy

SAMPLING INFORMATION

Sample No: 16WW40-190917

DATE/TIME: 9/17/19 1409

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample: Clear

Assoc. QC Samples: LLHAAP-FB-190917

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LFPD

Casing ID (in.): 2

Purge Start Date/Time: 9/17/19 1334

Depth to Water - Initial (DTWi) (ft) 16.35

Purge End Date/Time: 9/17/19

Depth to Well Bottom (ft) ~~18.5~~ Not recorded

Discharge Tube Length: _____

PID Reading: 0.0

Screen Interval (ft): 10.8-20.8 FT BTOC

Discharge Tube Diameter: _____

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): -99

Pump Start Time: 1324

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW40 Sample No: 16WW40-190917

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1339	250		1149	6.091	24.46	5.62	136	62.7	1.53
	1344			1153	6.099	24.32	5.62	95.5	61.6	1.84
	1349			1159	6.113	24.27	5.65	79.8	57.9	1.95
	1354			1164	6.261	24.18	5.81	74.3	32.5	1.77
	1359			1166	6.300	24.17	5.84	21.9	23.4	2.00
	1404			1171	6.342	24.22	5.87	22.6	12.4	2.03
	1409			1173	6.295	24.23	5.88	25.6	7.8	2.09

Logged by: W Gam Date: 9/17/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW41**

Sampler(s): [signature]

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW41-190917

DATE/TIME: 9/17/19 / 1035

Sample Interval: ~~- -~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample Clear

Assoc. QC Samples 16LHAAP-TB2 190917

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LFPP

Casing ID (in.): 4

Purge Start Date/Time: 9/17/19 959

Depth to Water - Initial (DTWi) (ft) 25.43

Purge End Date/Time: 9/17/19 1035

Depth to Well Bottom (ft) ~~51~~ Not recorded

Discharge Tube Length: _____

PID Reading: 0.0

Screen Interval (ft): 42.6-52.6 FT BTOC

Discharge Tube Diameter: _____

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 45

Pump Start Time: 959

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW41 Sample No: 16WW41-190917

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1004	250		26.86	0.040	24.64	6.92	-5.5	41.8	0.00
	1014			28.27	14.17	22.55	6.68	298.7	91.0	0.37
	1019			28.84	14.18	22.79	6.17	275.7	95.7	0.34
	1024			28.97	14.20	23.10	6.16	258.2	100.2	0.30
	1029			28.03	14.20	23.48	6.14	257.3	104.5	0.29
	1034			28.96	14.22	23.51	6.18	106.8	109.5	0.27

Logged by: _____ Date: 9/17/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW42**

Project No: **501032** Sampler(s): LG

FIELD CONDITIONS Hot

SAMPLING INFORMATION

Sample No: 16WW42-1909 **DATE/TIME:** ~~1556~~ 9/16/19 1633

~~**Sample Interval:** __ - __~~ L George 05/21/2020

Sampling Method: LF **Sample Purpose:** ~~REG~~ **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures
Clear	16LHAAP-181-190916	

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Pump LT

Casing ID (in.): 4 Purge Start Date/Time: 9/16/19 1554

Depth to Water - Initial (DTWi) (ft) 11.39 Purge End Date/Time: 9/16/19 1636

Depth to Well Bottom (ft) ~~12~~ Not recorded Discharge Tube Length: _____ PID Reading: 0.3

Screen Interval (ft): 6.57-16.57 FT BTOC Discharge Tube Diameter: _____ Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 7 Pump Start Time: 1554

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW42				Sample No: 16WW42-190916						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/16/19	1602	200	—	1186	1.324	24.14	6.00	29.21	-20.7	0.90
	1612			1214	1.157	24.17	5.92	27.0	-48.4	1.02
	1617			1219	1.158	24.49	5.95	27.8	-50.7	1.70
	1622			1222	1.160	25.03	5.99	38.1	-45.9	1.78
	1627			1227	1.164	26.14	6.06	43.5	-34.1	1.86
	1632			1230	1.165	26.19	6.10	21.7	-31.4	1.89

Logged by: _____ Date: 9/16/19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16WW43**

Project No: **501032** Sampler(s): Kennie Moore

FIELD CONDITIONS Clear / Sunny

SAMPLING INFORMATION

Sample No: 16WW43-190917 **DATE/TIME:** 9/17/19 / 1235 ~~**Sample Interval:** 9.98 - 10.15~~

L George 05/21/2020

Sampling Method: **Sample Purpose: REG** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** LCHAAP-TB1-190916 **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: LF/BP

Casing ID (in.): 4 Purge Start Date/Time: 9/17/19/1210

Depth to Water - Initial (DTWi) (ft) 9.98Ft Purge End Date/Time: 9/17/19/1235

Depth to Well Bottom (ft) ~~15~~ 15.48ft Discharge Tube Length: _____ PID Reading: _____

Screen Interval (ft): ~~5ft - 15ft~~ 4.59-14.59 FT BTOC Discharge Tube Diameter: 1/4" Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): ~~1~~ 12.5ft Pump Start Time: _____

Ferrous Iron (Required Y or N) N mg/L

Second DTW 9.98ft

APTIM

Sample Collection Log

Location ID: 16WW43 Sample No: 16WW43-190917

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1210	100	.5	9.98	0.464	26.80	6.22	6.6	41	0.54
	1215	100	1.0	10.05	0.337	24.37	6.16	10.1	39	0.10
	1220	100	1.5	10.07	0.309	23.94	5.96	11.7	42	0.10
	1225	100	2.0	10.09	0.309	23.91	5.93	11.7	43	0.09
	1230	100	2.5	10.12	0.307	23.87	5.93	11.6	43	0.09
	1235	100	3.0	10.15	0.307	23.88	5.92	11.6	42	0.09

Logged by: _____ Date: 9/17/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW48**

Sampler(s): [illegible]

FIELD CONDITIONS Cloudy

SAMPLING INFORMATION

Sample No: 16WW48-1909 18

DATE/TIME: 9/18/19 / 1720

~~**Sample Interval:** __ - __~~
L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample Clear

Assoc. QC Samples 16LHAAP-TB3-[illegible]

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 1335

Depth to Well Bottom (ft) Not recorded

Screen Interval (ft): 12.95-22.95 FT BTOC
L George 05/21/2020

Approximate depth of pump inlet*(ft): 15

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: PPLT

Purge Start Date/Time: 9/18/19 1646

Purge End Date/Time: 9/18/19 1720

Discharge Tube Length: _____

PID Reading: 0.0

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 1646

APTIM

Sample Collection Log

Location ID: 16WW48 Sample No: 16WW48-190918

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	16.50	250		13.48	5.793	21.79	5.76	0.0	79.3	0.00
	16.55			13.50	5.791	21.49	5.78	2.88	89.1	0.87
	1700			13.51	5.770	21.33	5.80	4.6	105.6	0.48
	1705			13.53	5.760	21.30	5.80	7.1	107.5	0.40
	1710			13.54	5.765	21.36	5.80	6.5	113.2	0.36
	1715			13.55	5.793	21.38	5.80	11.9	120.9	0.27
	1720			13.56	5.769	21.39	5.80	8.3	124.7	0.25

Logged by: _____ Date: 9/18/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW49**

Sampler(s): [illegible]

FIELD CONDITIONS [illegible]

SAMPLING INFORMATION

Sample No: 16WW49-1909~~19~~

DATE/TIME: 9/19/19 ~~1435~~

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample: clear

Assoc. QC Samples: 16LHAP-TB6-190919

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by E300 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LFPP

Casing ID (in.): 4

Purge Start Date/Time: 9/19/19 1401

Depth to Water - Initial (DTWi) (ft) 19.21

Purge End Date/Time: 9/19/19 1439

Depth to Well Bottom (ft) 57?

Discharge Tube Length: _____

PID Reading: 0.1

Screen Interval (ft): 45.03-55.03 FT BTOC

Discharge Tube Diameter: _____

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): Screen Interval Not Defined

Pump Start Time: 1401

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW49		Sample No: 16WW49-1909[19]								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/19/19	805	250		21.54	2.515	20.47	6.10	0.0	-12.1	0.00
	810			21.71	2.484	20.29	6.16	20.7	-21.9	0.60
	815			21.76	2.485	20.24	6.16	27.0	-23.4	0.57
	820			21.81	2.484	20.24	6.16	23.4	-24.3	0.54
	825			21.85	2.486	20.24	6.17	33.6	-25.9	0.57
	830			21.88	2.477	20.26	6.17	38.5	-26.5	0.46
	835			21.91	2.474	20.30	6.16	26.8	-27.3	0.44

Logged by: _____ Date: 9/19/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW51**

Project No: **501032** Sampler(s): LF

FIELD CONDITIONS Cloudy

SAMPLING INFORMATION

Sample No: 16WW51-1909 (4) **DATE/TIME:** 9/18/19 1800 **~~Sample Interval:~~**

L George 05/21/2020

Sampling Method: LF **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures
Cloudy	16LHAAP-TB3-190918	

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: LFPP

Casing ID (in.): 2 Purge Start Date/Time: 9/18/19 1726

Depth to Water - Initial (DTWi) (ft) 13.61 Purge End Date/Time: 9/18/19

Depth to Well Bottom (ft) Not recorded Discharge Tube Length: _____ PID Reading: 0.2

Screen Interval (ft): 34.13-44.13 FT BTOC Discharge Tube Diameter: _____ Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): Screen Interval Not Defined Pump Start Time: _____

Ferrous Iron (Required Y or N) _____ mg/L

Date	Time	PR	TP	PTW	cond	temp	pH	Turb.	ORP	DO
9/18/19	1720	250	—	13.46	3.314	21.60	6.04	2.4	-69.6	1.30
	1735			14.04	3.270	21.12	6.05	8.2	-78.7	0.53
	1740			14.16	3.251	20.88	6.06	5.6	-82.0	0.38
	1745			14.24	3.232	20.79	6.06	0.7	-84.0	0.31
	1750			14.31	3.219	20.71	6.06	8.4	-85.1	0.21
	1755			14.35	3.226	20.72	6.04	0.0	-86.4	0.00
	1800			14.36	3.224	20.71	6.06	0.0	-90.8	0.00

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW55**

Sampler(s): VBC

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW55-190917

DATE/TIME: 9/17/19 1454

~~**Sample Interval:** __ __~~
L George 05/21/2020

Sampling Method: LFPP

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures
Clear	16LHAAP-TB2-190917	

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 4

Depth to Water - Initial (DTWi) (ft) 20.62

Depth to Well Bottom (ft) Not recorded

Screen Interval (ft): 19.92-29.92 FT BTOC
L George 05/21/2020

Approximate depth of pump inlet*(ft): 22

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: LFPP

Purge Start Date/Time: 9/17/19 1425

Purge End Date/Time: 9/17/19 1457

Discharge Tube Length: _____ PID Reading: 0.0

Discharge Tube Diameter: _____ Immersible Layer: Y / N

Pump Start Time: 1425

APTIM

Sample Collection Log

Location ID: 16WW55				Sample No: 16WW55-1909_17						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1429	250		20.95	4.952	22.54	6.17	8.9	77.5	0.00
	1434			20.96	4.849	22.33	6.18	7.4	79.9	0.36
	1439			20.87	4.932	22.03	6.17	2.7	84.0	0.08
	1444			20.90	4.819	21.91	6.17	1.0	87.1	0.23
	1449			20.74	4.817	21.90	6.16	0.6	88.3	0.21
	1454			20.94	4.821	21.85	6.17	0.0	90.7	0.20

Logged by: _____ Date: 9/17/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW56**

Sampler(s): L George

FIELD CONDITIONS hwy

SAMPLING INFORMATION

Sample No: 16WW56-190917

DATE/TIME: 9/17/19 1312

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample clear

Assoc. QC Samples 16-HAAP-TB2-190917

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Casing ID (in.): 2in PVC

Depth to Water - Initial (DTWi) (ft) 26.50

Depth to Well Bottom (ft) 42.79

Screen Interval (ft): 24.26-34.26 FT BTOC

L George 05/21/2020

Approximate depth of pump inlet*(ft): Screen Interval Not Defined

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: LFPP

Purge Start Date/Time: 9/17/19 0 1234

Purge End Date/Time: 9/17/19

Discharge Tube Length: _____

PID Reading: 0.0

Discharge Tube Diameter: _____

Immersible Layer: Y / N

Pump Start Time: 1234

APTIM

Sample Collection Log

Location ID: 16WW56 Sample No: 16WW56-190917

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/17/19	1242	250		26.66	3.743	23.74	5.86	86.1	124.4	0.00
	1247			26.69	3.697	23.61	5.98	30.4	22.3	0.00
	1252			26.69	3.684	23.56	5.99	4.3	27.4	0.00
	1257			26.69	3.663	23.42	6.01	-5.5	28.4	0.00
	1302			26.69	3.501	23.33	6.03	2.7	31.0	0.25
	1307			26.70	3.444	23.20	6.04	3.4	32.5	0.23
	1312			26.70	3.440	23.16	6.05	2.6	33.7	0.22

Logged by: _____ Date: 9/17/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW57**

Sampler(s): LF GM

FIELD CONDITIONS Rain

SAMPLING INFORMATION

Sample No: 16WW57-190918 **DATE/TIME:** 9/18/19 1530

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample: Clr

Assoc. QC Samples: 16LHAP-TBS-190918, 16WW57-190918 MS, 16WW57-190918 MSD

Decontamination Procedures:

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Anions (nitrate/sulfate/bromide) in Water by 9056, Alkalinity in Water by SM2320B	1 x 250 mL HDPE	Cool 4C
		ALSHT	Dissolved Gases in Water by RSK175	3 x 40 mL Glass	HCL<pH2
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2
		MI	DHC in Water by CENSUS-qPCR	1 x 1 L HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LF PP

Casing ID (in.): 2

Purge Start Date/Time: 9/18/19 1500

Depth to Water - Initial (DTWi) (ft) 5.86

Purge End Date/Time: 9/18/19 1600

Depth to Well Bottom (ft) Not recorded

Discharge Tube Length: _____

PID Reading: 0.0

Screen Interval (ft): 29.94-39.94 FT BTOC

Discharge Tube Diameter: _____

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): Screen Interval Not Defined

Pump Start Time: 1500

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW57 **Sample No: 16WW57-190914**

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	1505	240	—	6.00	1.372	22.27	6.61	3.0	-66.3	1.30
	1510			6.05	1.729	21.44	6.64	2.9	-61.1	0.50
	1515			6.08	2.580	20.92	6.23	0.4	-23.1	0.34
	1520			6.12	3.556	20.70	5.66	0.4	7.6	0.26
	1525			6.13	3.571	20.75	5.68	0.4	10.1	0.19
	1530			6.15	3.577	20.76	5.69	0.4	13.6	0.17

Logged by: [signature] Date: 9/18/19

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16WW58**

Project No: **501032** Sampler(s): JL/GM

FIELD CONDITIONS Sunny

SAMPLING INFORMATION

Sample No: 16WW58-1909 16 **DATE/TIME:** 9/18/19 1408

~~**Sample Interval:** ___ - ___~~

L George 05/21/2020

Sampling Method: LF **Sample Purpose: REG** **Sample Matrix: GW**

Appearance of Sample Clear **Assoc. QC Samples** 16LHAAP-TB6-190919 **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Anions (nitrate/sulfate/bromide) in Water by 9056, Alkalinity in Water by SM2320B	1 x 250 mL HDPE	Cool 4C
		ALSHT	Dissolved Gases in Water by RSK175	3 x 40 mL Glass	HCL<pH2
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2
		MI	DHC in Water by CENSUS-qPCR	1 x 1 L HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: ____

Casing ID (in.): 2 Purge Start Date/Time: 9/18/19 1334

Depth to Water - Initial (DTWi) (ft) ~~9.20~~ 8.20 Purge End Date/Time: 9/18/19 1415

Depth to Well Bottom (ft) Not recorded Discharge Tube Length: ____ PID Reading: 0.3

Screen Interval (ft): 31.92-41.92 FT BTOC Discharge Tube Diameter: ____ Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): Screen Interval Not Defined Pump Start Time: 1334

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW58		Sample No: 16WW58-190918								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
9/18/19	1338	2400		6.83	2.441	21.92	5.92	0.0	-34.9	0.87
	1343			6.86	2.430	21.67	6.00	2.6	-65.6	0.42
	1348			6.94	2.418	21.37	6.01	1.0	-68.6	0.31
	1353			9.03	2.414	21.05	6.03	0.3	-71.8	0.25
	1358			9.10	2.416	20.71	6.04	0.5	-74.3	0.20
	1403			9.14	2.751	20.77	6.00	0.6	-77.7	0.18
	1408			9.14	2.761	20.96	5.96	0.7	-78.1	0.16

Logged by: LJ Garcia Date: 9/18/19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW20**

Sampler(s): Scott Beasinger

FIELD CONDITIONS Cool / Sunny

SAMPLING INFORMATION

Sample No: 16IW20-191022 **DATE/TIME:** 10/22/19 1051 **Pump Inlet Depth:** 19.91

Sampling Method: **Sample Purpose: REG** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 2"

Purge Start Date/Time: 10/22/19 1100

Depth to Water - Initial (DTWi) (ft) 17.67

Purge End Date/Time: 10/22/19 1130

Depth to Well Bottom (ft) 25.48

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): 14.91 - 24.91 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 19.91

Pump Start Time: 1100

Ferrous Iron (Required Y or (N) _____ mg/L

2ND Depth to water- 17.67

APTIM

Sample Collection Log

Location ID: 16IW20				Sample No: 16IW20-191022						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	1105	100	.5	17.75	5.04	18.47	5.97	59.6	-103	0.90
↓	1110	100	1.0	17.81	5.39	19.20	6.06	53.0	-180	0.24
	1115	100	1.5	17.85	5.43	19.29	6.06	44.1	-179	0.05
	1120	100	2.0	17.88	5.43	19.39	6.07	43.5	-180	0.05
	1125	100	2.5	17.90	5.44	19.47	6.07	42.8	-181	0.04
↓	1130	100	3.0	17.91	5.44	19.54	6.07	42.0	-182	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW11**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Cool / sunny

SAMPLING INFORMATION

Sample No: 16RW11-1910 22 **DATE/TIME:** 10/22/19 0959 **Pump Inlet Depth:** 19.49

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Lowflow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 10/22/19 1020

Depth to Water - Initial (DTWi) (ft) 18.65

Purge End Date/Time: 10/22/19 1040

Depth to Well Bottom (ft) 25.62

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): 14.49 - 24.49 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 19.49

Pump Start Time: 1020

Ferrous Iron (Required Y or (N) _____ mg/L

2ND Depth to water - 18.65

APTIM

Sample Collection Log

Location ID: 16RW11				Sample No: 16RW11-191022						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	1015	100	.5	18.73	3.40	17.31	5.37	477	40	0.88
	1020	100	1.0	18.80	3.32	18.39	5.26	438	-16	0.32
	1025	100	1.5	18.85	3.34	18.77	5.26	418	-36	0.08
	1030	100	2.0	18.88	3.35	18.85	5.27	416	-37	0.08
	1035	100	2.5	18.90	3.35	18.92	5.27	415	-38	0.07
↓	1040	100	3.0	18.92	3.35	18.98	5.27	414	-39	0.07

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW12**

Project No: **501032**

Sampler(s): Scott Baesinger

FIELD CONDITIONS COLD / SUNNY

SAMPLING INFORMATION

Sample No: 16RW12-191022 **DATE/TIME:** 10/22/19 0821 **Pump Inlet Depth:** 26.49

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 10/22/19 0830

Depth to Water - Initial (DTWi) (ft) 24.38

Purge End Date/Time: 10/22/19 0900

Depth to Well Bottom (ft) 32.60

Discharge Tube Length: NA

PID Reading: NA

FT BTOC

Screen Interval (ft): 21.49 - 31.49

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 26.49

Pump Start Time: 0830

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 24.38

APTIM

Sample Collection Log

Location ID: 16RW12		Sample No: 16RW12-1910 22								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	0835	100	.5	24.45	4.39	16.05	6.33	0.5	119	1.48
	0840	100	1.0	24.51	4.41	16.98	6.14	0.0	148	1.11
	0845	100	1.5	24.55	4.43	17.22	6.13	0.0	156	0.91
	0850	100	2.0	24.58	4.44	17.28	6.13	0.0	157	0.90
	0855	100	2.5	24.60	4.44	17.35	6.12	0.0	158	0.89
↓	0900	100	3.0	24.61	4.44	17.41	6.12	0.0	159	0.88

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW12**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Cold/Sunny

SAMPLING INFORMATION

Sample No: 16RW12-191022-FD **DATE/TIME:** 10/22/19 0821 **Pump Inlet Depth:** 26.49

Sampling Method: **Sample Purpose: FD** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 10/22/19 0830

Depth to Water - Initial (DTWi) (ft) 24.38

Purge End Date/Time: 10/22/19 0900

Depth to Well Bottom (ft) 32.60

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): 21.49 - 31.49 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 26.49

Pump Start Time: 0830

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16RW12				Sample No: 16RW12-191022-FD						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	0835	100	.5	24.45	4.39	16.05	6.33	0.5	119	1.48
	0840	100	1.0	24.51	4.41	16.98	6.14	0.0	148	1.11
	0845	100	1.5	24.55	4.43	17.22	6.13	0.0	156	0.91
	0850	100	2.0	24.58	4.44	17.28	6.13	0.0	157	0.90
	0855	100	2.5	24.60	4.44	17.35	6.12	0.0	158	0.89
↓	0900	100	3.0	24.61	4.44	17.41	6.12	0.0	159	0.88

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW12**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

Clear / Sunny

SAMPLING INFORMATION

Sample No: 16WW12-191022 **DATE/TIME:** 10/22/19 1140 **Pump Inlet Depth:** 22.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 10/22/19 1150

Depth to Water - Initial (DTWi) (ft) 17.42

Purge End Date/Time: 10/22/19 1220

Depth to Well Bottom (ft) 27.03

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.00 - 27.00~~ 16.64-26.64 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.00

Pump Start Time: 1150

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 17.42

APTIM

Sample Collection Log

Location ID: 16WW12		Sample No: 16WW12-191022								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	1155	100	.5	17.50	6.10	19.00	6.08	29.5	-41	0.72
	1200	100	1.0	17.56	6.07	19.17	6.04	30.9	-37	0.25
	1205	100	1.5	17.60	6.02	19.19	6.03	31.3	-37	0.06
	1210	100	2.0	17.63	6.02	19.22	6.02	31.7	-37	0.05
	1215	100	2.5	17.66	6.01	19.24	6.02	32.4	-37	0.06
↓	1220	100	3.0	17.68	6.01	19.26	6.02	32.8	-37	0.05

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW22**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS COLD | SUNNY

SAMPLING INFORMATION

Sample No: 16WW22-191022 **DATE/TIME:** 10/22/19 0723 **Pump Inlet Depth:** 30.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 10/22/19 0735

Depth to Water - Initial (DTWi) (ft) 27.40

Purge End Date/Time: 10/22/19 0805

Depth to Well Bottom (ft) 35.30

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~25.00 - 35.00~~ 23.94-33.94 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 30.00

Pump Start Time: 0735

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 27.40

APTIM

Sample Collection Log

Location ID: 16WW22				Sample No: 16WW22-191022						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	0740	100	.5	27.49	4.04	16.48	6.58	77.3	25	1.03
	0745	100	1.0	27.55	4.03	17.32	6.32	55.4	26	0.79
	0750	100	1.5	27.59	4.03	17.57	6.31	41.9	27	0.55
	0755	100	2.0	27.62	4.04	17.65	6.30	41.5	28	0.54
	0800	100	2.5	27.64	4.04	17.69	6.30	40.8	29	0.53
	0805	100	3.0	27.65	4.04	17.73	6.30	40.5	29	0.52

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW22**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Cold / Sunny

SAMPLING INFORMATION

Sample No: 16WW22-191022-MS **DATE/TIME:** 10/22/19 0723 **Pump Inlet Depth:** 30.00

Sampling Method: **Sample Purpose: MS** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Casing ID (in.): 4"

Depth to Water - Initial (DTWi) (ft) 27.40

Depth to Well Bottom (ft) 35.30

Screen Interval (ft): ~~25.00 - 35.00~~ 23.94-33.94 FT BTOC

L George 05/20/2020

Approximate depth of pump inlet*(ft): 30.00

Ferrous Iron (Required Y or N) _____ mg/L

Purging Method/Equipment: Low flow / Bladder Pump

Purge Start Date/Time: 10/22/19 0735

Purge End Date/Time: 10/22/19 0805

Discharge Tube Length: NA PID Reading: NA

Discharge Tube Diameter: 1/4" Immersible Layer: Y / N

Pump Start Time: 0735

APTIM

Sample Collection Log

Location ID: 16WW22				Sample No: 16WW22-191022-MS						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	0740	100	.5	27.49	4.04	16.48	6.58	77.3	25	1.03
	0745	100	1.0	27.55	4.03	17.32	6.32	55.4	26	0.79
	0750	100	1.5	27.59	4.03	17.57	6.31	41.9	27	0.55
	0755	100	2.0	27.62	4.04	17.65	6.30	41.5	28	0.54
	0800	100	2.5	27.64	4.04	17.69	6.30	40.8	29	0.53
↓	0805	100	3.0	27.65	4.04	17.73	6.30	40.5	29	0.52

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW22**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS COLD / SUNNY

SAMPLING INFORMATION

Sample No: 16WW22-1910 22-MSD **DATE/TIME:** 10/22/19 0723 **Pump Inlet Depth:** 30.00

Sampling Method: **Sample Purpose: MSD** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 10/22/19 0735

Depth to Water - Initial (DTWi) (ft) 27.40

Purge End Date/Time: 10/22/19 0805

Depth to Well Bottom (ft) 35.30

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~25.00 - 35.00~~ 23.94-33.94 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 30.00

Pump Start Time: 0735

Ferrous Iron (Required Y or (N)) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW22 **Sample No: 16WW22-1910_22_-MSD**

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	0740	100	.5	27.49	4.04	16.48	6.58	77.3	25	1.03
	0745	100	1.0	27.55	4.03	17.32	6.32	55.4	26	0.79
	0750	100	1.5	27.59	4.03	17.57	6.31	41.9	27	0.55
	0755	100	2.0	27.62	4.04	17.65	6.30	41.5	28	0.54
	0800	100	2.5	27.64	4.04	17.69	6.30	40.8	29	0.53
↓	0805	100	3.0	27.65	4.04	17.73	6.30	40.5	29	0.52

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW39**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS COLD / SUNNY

SAMPLING INFORMATION

Sample No: 16WW39-191022 **DATE/TIME:** 10/22/19 0912 **Pump Inlet Depth:** 24.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 10/22/19 0920

Depth to Water - Initial (DTWi) (ft) 20.08

Purge End Date/Time: 10/22/19 0950

Depth to Well Bottom (ft) 29.40

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~19.00 - 24.00~~ 18-28 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 24.00

Pump Start Time: 0920

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER -

APTIM

Sample Collection Log

Location ID: 16WW39		Sample No: 16WW39-1910 22								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	0925	100	.5	20.16	5.76	15.74	6.30	25.2	84	0.93
	0930	100	1.0	20.21	5.78	16.75	6.15	14.9	54	0.31
	0935	100	1.5	20.25	5.77	16.80	6.15	9.8	55	0.22
	0940	100	2.0	20.28	5.77	16.87	6.14	8.7	56	0.21
	0945	100	2.5	20.30	5.77	16.93	6.14	7.8	56	0.21
↓	0950	100	3.0	20.32	5.77	16.99	6.14	7.1	57	0.20

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16WW40**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear / Sunny

SAMPLING INFORMATION

Sample No: 16WW40-191022 **DATE/TIME:** 10/22/19 **Pump Inlet Depth:** 16.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SW9060	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : TOC

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 2"

Purge Start Date/Time: 10/22/19 1240

Depth to Water - Initial (DTWi) (ft) 11.22

Purge End Date/Time: 10/22/19 1310

Depth to Well Bottom (ft) 17.50

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~13.8 - 23.8~~ 10.8-20.8 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 16.00

Pump Start Time: 1240

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 11.22

APTIM

Sample Collection Log

Location ID: 16WW40		Sample No: 16WW40-191022								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
10/22/19	1245	~~100~~	.5	11.30	6.73	20.06	5.95	66.3	-7	0.73
↓	1250	100	1.0	11.36	6.80	20.55	5.88	48.7	-35	0.24
	1255	100	1.5	11.40	6.81	20.63	5.93	43.0	-54	0.04
	1300	100	2.0	11.43	6.82	20.70	5.94	42.7	-55	0.04
	1305	100	2.5	11.45	6.83	20.78	5.95	41.9	-56	0.03
↓	1310	100	3.0	11.46	6.83	20.84	5.95	41.4	-56	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Location ID: 16EW01 Sample No: 16EW01-1911 11

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11-11-19	1212	150	1.0	24.75	0.124	19.16	6.46	6.8	-1.1	1.90
11-11-19	1217	150	1.75	24.75	0.439	19.18	6.11	4.8	-18.8	0.88
11-11-19	1222	150	2.50	24.75	0.849	19.17	6.14	3.8	-20.5	0.74
11-11-19	1227	150	3.25	24.75	0.511	19.19	6.14	3.0	-22.4	0.68
11-11-19	1232	150	4.00	24.75	0.517	19.18	6.12	2.0	-23.5	0.57
11-11-19	1237	150	4.75	24.75	0.521	19.18	6.12	1.7	-23.9	0.55
11-11-19	1242	150	5.5	24.75	0.525	19.19	6.12	1.3	-23.9	0.55
11-11-19	Sample									

Logged by: [signature] Date: 11-11-19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Location ID: 16EW02 Sample No: 16EW02-191111

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11-11-19	1435	200	1	22.50	5.671	19.08	6.35	0.0	29.9	2.93
11-11-19	1440	200	2	22.50	5.798	19.07	6.01	0.0	54.2	1.01
11-11-19	1445	200	3	22.50	5.880	19.07	5.97	0.0	60.1	0.98
11-11-19	1450	200	4	22.50	5.871	19.09	5.96	0.0	64.2	0.97
11-11-19	1455	200	5	22.50	5.865	19.10	5.95	0.0	70.9	0.95
11-11-19	Sample									

Logged by: _____ Date: 11-11-19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Location ID: 16EW03 Sample No: 16EW03-191111

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11-11-19	1358	180	1.0	12.30	7.906	19.60	6.13	22.0	-59.0	1.79
11-11-19	1403	180	1.9	12.30	8.014	19.68	6.18	7.1	-101.1	0.560
11-11-19	1408	180	2.8	12.30	8.024	19.73	6.20	0.0	-106.1	0.43
11-11-19	1413	180	3.7	12.30	8.025	19.75	6.20	0.0	-108.1	0.40
11-11-19	1418	180	4.6	12.30	8.031	19.74	6.21	0.0	-110.1	0.39
11-11-19	Sceen									

Logged by: _____ Date: 11-11-19

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Location ID: 16EW04 Sample No: 16EW04-1911_11

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11-11-19	1308	200	1.0	7.65	6.162	17.49	6.21	14.8	95.8	2.37
11-11-19	1313	200	2.0	7.65	6.300	18.91	5.48	9.7	119.1	0.71
11-11-19	1318	200	3.0	7.65	6.312	18.82	5.46	7.3	122.0	0.59
11-11-19	1323	200	4.0	7.65	6.325	18.47	5.46	7.2	126.2	0.58
11-11-19	1328	200	5.0	7.65	6.326	18.49	5.46	6.5	127.2	0.57
11-11-19	1333	200	6.0	7.65	6.323	18.50	5.46	5.8	128.3	0.57
11-11-19	Sample									

Logged by: _____ Date: 11-11-19

QC'd by: _____ Date: _____

+FD

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW09**

Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16IW09-1911_19 **DATE/TIME:** 11/19/19 1145 **Pump Inlet Depth:** 17.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow /BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 11/19/19 1155

Depth to Water - Initial (DTWi) (ft) 11.78

Purge End Date/Time: 11/19/19 1225

Depth to Well Bottom (ft) 22.25

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~12.00 - 22.00~~ 11.33-21.33 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 17.00

Pump Start Time: 1155

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 11.78

APTIM

Sample Collection Log

Location ID: 16IW09		Sample No: 16IW09-191119								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	1200	100	.5	11.85	1.38	20.52	5.57	0.0	-106	1.02
	1205	100	1.0	11.91	1.34	20.55	5.18	0.0	-100	0.27
	1210	100	1.5	11.95	1.23	20.60	4.98	0.0	-91	0.05
	1215	100	2.0	11.98	1.22	20.63	4.97	0.0	-90	0.05
	1220	100	2.5	12.00	1.21	20.68	4.96	0.0	-89	0.05
↓	1225	100	3.0	12.02	1.21	20.72	4.96	0.0	-88	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW10**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16IW10-191120 **DATE/TIME:** 11/20/19 1012 **Pump Inlet Depth:** 23.50

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 11/20/19 1025

Depth to Water - Initial (DTWi) (ft) 22.45

Purge End Date/Time: 11/20/19 1055

Depth to Well Bottom (ft) 28.50

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~18.00 - 28.00~~ 18.21-28.21 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): _____

Pump Start Time: 1025

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 22.45

APTIM

Sample Collection Log

Location ID: 16IW10				Sample No: 16IW10-1911 20						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	1030	100	.5	22.52	6.30	18.67	6.42	1000	-13	0.94
↓	1035	100	1.0	22.57	6.24	19.20	6.22	1000	-25	0.22
	1040	100	1.5	22.61	6.12	19.42	6.21	1000	-44	0.06
	1045	100	2.0	22.63	6.11	19.50	6.20	1000	-45	0.06
	1050	100	2.5	22.65	6.10	19.58	6.20	1000	-46	0.06
↓	1055	100	3.0	22.67	6.10	19.67	6.20	1000	-47	0.05

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW01**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear/ cold

SAMPLING INFORMATION

Sample No: 16RW01-191119 **DATE/TIME:** 11/19/19 0640 **Pump Inlet Depth:** 23.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 0655

Depth to Water - Initial (DTWi) (ft) 17.45

Purge End Date/Time: 11/19/19 0725

Depth to Well Bottom (ft) 28.28

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~18.00 - 28.00~~ 18.21-28.21 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 23.00

Pump Start Time: 0655

Ferrous Iron (Required Y or N) _____ mg/L

2ND DEPTH TO WATER - 17.45

APTIM

Sample Collection Log

Location ID: 16RW01				Sample No: 16RW01-191119						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	0700	100	1.5	17.52	2.42	13.09	4.82	17.3	298	0.93
	0705	100	1.0	17.58	2.24	16.75	4.90	7.4	301	0.40
	0710	100	1.5	17.62	2.23	16.97	4.91	2.9	302	0.20
	0715	100	2.0	17.65	2.22	17.08	4.92	1.0	302	0.20
	0720	100	2.5	17.67	2.22	17.16	4.93	0.5	303	0.19
↓	0725	100	3.0	17.68	2.22	17.21	4.93	0.0	303	0.19

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW02**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16RW02-191119 **DATE/TIME:** 11/19/19 1008 **Pump Inlet Depth:** 16.25

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 1015

Depth to Water - Initial (DTWi) (ft) 12.60

Purge End Date/Time: 11/19/19 1045

Depth to Well Bottom (ft) 21.50

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~11.25-21.25~~ 11.03-21.06 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 16.25

Pump Start Time: 1015

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 12.60

APTIM

Sample Collection Log

Location ID: 16RW02		Sample No: 16RW02-191119								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	1020	100	.5	12.68	0.294	17.93	6.31	12.2	-33	0.79
↓	1025	100	1.0	12.73	0.157	18.80	5.84	10.5	-18	0.21
	1030	100	1.5	12.77	0.147	18.97	5.75	9.7	-17	0.04
	1035	100	2.0	12.79	0.146	19.09	5.74	8.9	-16	0.04
	1040	100	2.5	12.81	0.146	19.18	5.74	8.0	-15	0.03
↓	1045	100	3.0	12.82	0.146	19.28	5.73	7.5	-15	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW03**

Sampler(s): Scott Bassinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16RW03-191119 **DATE/TIME:** 11/19/19 1053 **Pump Inlet Depth:** 17.90

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 1105

Depth to Water - Initial (DTWi) (ft) 12.20

Purge End Date/Time: 11/19/19 1135

Depth to Well Bottom (ft) 23.05

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~12.90 - 22.90~~ 13.34-23.34 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 17.90

Pump Start Time: 1105

Ferrous Iron (Required Y or (N) _____ mg/L

2ND Depth TO WATER - 12.20

APTIM

Sample Collection Log

Location ID: 16RW03		Sample No: 16RW03-191119								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	1110	100	.5	12.28	0.572	19.73	5.83	29.3	73	0.95
	1115	100	1.0	12.33	0.593	19.95	5.77	28.5	79	0.48
	1120	100	1.5	12.37	0.587	20.00	5.75	28.2	83	0.48
	1125	100	2.0	12.39	0.586	20.05	5.74	28.0	84	0.48
	1130	100	2.5	12.40	0.586	20.09	5.74	27.6	85	0.49
↓	1135	100	3.0	12.41	0.586	20.14	5.74	27.3	85	0.49

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW04**

Project No: **501032**

Sampler(s): Scott Bressinger

FIELD CONDITIONS Clear/cold

SAMPLING INFORMATION

Sample No: 16RW04-191119 **DATE/TIME:** 11/19/19 0735 **Pump Inlet Depth:** 19.45

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 0745

Depth to Water - Initial (DTWi) (ft) 18.93

Purge End Date/Time: 11/19/19 0815

Depth to Well Bottom (ft) 27.65

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~14.45 - 24.45~~ 16.9-26.9 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 19.45

Pump Start Time: 0745

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER- 18.93

APTIM

Sample Collection Log

Location ID: 16RW04		Sample No: 16RW04-191119								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	0750	100	.5	18.99	1.72	14.55	5.09	15.8	249	0.98
	0755	100	1.0	19.05	1.71	15.74	5.01	9.9	233	0.38
	0800	100	1.5	19.10	1.71	16.19	5.01	9.0	230	0.13
	0805	100	2.0	19.13	1.71	16.29	5.01	8.1	229	0.13
	0810	100	2.5	19.15	1.71	16.35	5.01	7.0	229	0.12
↓	0815	100	3.0	19.17	1.71	16.42	5.01	6.1	228	0.12

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW04**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

Clear / cold

SAMPLING INFORMATION

Sample No: 16RW04-191119-FD **DATE/TIME:** 11/19/19 0735 **Pump Inlet Depth:** 19.45

Sampling Method: **Sample Purpose: FD** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 0745

Depth to Water - Initial (DTWi) (ft) 18.93

Purge End Date/Time: 11/19/19 0815

Depth to Well Bottom (ft) 27.65

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~14.45 - 24.45~~ 16.9-26.9 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 19.45

Pump Start Time: 0745

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16RW04	Sample No: 16RW04-191119-FD									
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	0750	100	.5	18.49	1.72	14.55	5.09	15.8	249	0.98
	0755	100	1.0	19.05	1.71	15.74	5.01	9.9	233	0.38
	0800	100	1.5	19.10	1.71	16.19	5.01	9.0	230	0.13
	0805	100	2.0	19.13	1.71	16.29	5.01	8.1	229	0.13
	0810	100	2.5	19.15	1.71	16.35	5.01	7.0	229	0.12
↓	0815	100	3.0	19.17	1.71	16.42	5.01	6.1	228	0.12

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW05**

Project No: **501032**

Sampler(s): Scott Baesinger

FIELD CONDITIONS CLEAR / COOL

SAMPLING INFORMATION

Sample No: 16RW05-191119 **DATE/TIME:** 11/19/19 0920 **Pump Inlet Depth:** 18.20

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 0930

Depth to Water - Initial (DTWi) (ft) 12.78

Purge End Date/Time: 11/19/19 1000

Depth to Well Bottom (ft) 23.40

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~13.20 - 23.20~~ 13.09-23.09 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 18.20

Pump Start Time: 0930

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 12.78

APTIM

Sample Collection Log

Location ID: 16RW05					Sample No: 16RW05-191119					
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	0935	100	.5	12.85	3.14	17.30	5.96	0.0	-165	0.87
	0940	100	1.0	12.91	3.22	17.80	6.14	0.0	-186	0.24
	0945	100	1.5	12.95	3.27	18.07	6.15	0.0	-175	0.06
	0950	100	2.0	12.97	3.28	18.18	6.15	0.0	-176	0.05
	0955	100	2.5	12.99	3.28	18.27	6.16	0.0	-177	0.05
↓	1000	100	3.0	13.00	3.28	18.34	6.16	0.0	-178	0.05

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW06**

Project No: **501032**

Sampler(s): Scott Bussinger

FIELD CONDITIONS

Clear/ cold

SAMPLING INFORMATION

Sample No: 16RW06-191120 **DATE/TIME:** 11/20/19 0733 **Pump Inlet Depth:** 25.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/20/19 0750

Depth to Water - Initial (DTWi) (ft) 24.08

Purge End Date/Time: 11/20/19 0820

Depth to Well Bottom (ft) 29.25

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~18.52 - 28.52~~ 18.52-28.52 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 25.00

Pump Start Time: 0750

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND Depth to water- 24.08

APTIM

Sample Collection Log

Location ID: 16RW06				Sample No: 16RW06-1911 20						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	0755	100	.5	24.15	5.00	14.25	5.28	36.5	223	0.93
	0800	100	1.0	24.21	5.10	14.98	5.83	27.4	158	0.33
	0805	100	1.5	24.25	5.15	15.17	6.00	24.8	143	0.07
	0810	100	2.0	24.28	5.16	15.25	6.01	24.2	142	0.06
	0815	100	2.5	24.30	5.17	15.33	6.01	23.6	141	0.06
↓	0820	100	3.0	24.32	5.17	15.39	6.02	23.0	140	0.06

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16RW06**

Project No: **501032** Sampler(s): Scott Bressinger

FIELD CONDITIONS

CLEAR/COLD

SAMPLING INFORMATION

Sample No: 16RW06-1911 20 -FD **DATE/TIME:** 11/20/19 0733 **Pump Inlet Depth:** 25.00

Sampling Method: **Sample Purpose: FD** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4" Purge Start Date/Time: 11/20/19 0750

Depth to Water - Initial (DTWi) (ft) 24.08 Purge End Date/Time: 11/20/19 0820

Depth to Well Bottom (ft) 29.25 Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~18.75 - 28.75~~ 18.52-28.52 FT BTOC Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 25.00 Pump Start Time: 0750

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16RW06	Sample No: 16RW06-1911 20 -FD									
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	0755	100	.5	24.15	5.00	14.25	5.28	36.5	223	0.93
	0800	100	1.0	24.21	5.10	14.98	5.83	27.4	158	0.33
	0805	100	1.5	24.25	5.15	15.17	6.00	24.8	143	0.07
	0810	100	2.0	24.28	5.16	15.25	6.01	24.2	142	0.06
	0815	100	2.5	24.30	5.17	15.33	6.01	23.6	141	0.06
✓	0820	100	3.0	24.32	5.17	15.39	6.02	23.0	140	0.06

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW07**

Project No: **501032**

Sampler(s): Scott Dressinger

FIELD CONDITIONS CLEAR / COLD

SAMPLING INFORMATION

Sample No: 16RW07-191120 **DATE/TIME:** 11/20/19 0830 **Pump Inlet Depth:** 24.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/20/19 0845

Depth to Water - Initial (DTWi) (ft) 22.00

Purge End Date/Time: 11/20/19 0915

Depth to Well Bottom (ft) 29.45

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~19.00 - 29.00~~ 18.28-28.28 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 24.00

Pump Start Time: 0845

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - [redacted] 22.00

APTIM

Sample Collection Log

Location ID: 16RW07					Sample No: 16RW07-191120					
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	0850	100	.5	22.08	3.82	17.33	6.13	37.7	83	1.02
	0855	100	1.0	22.12	3.88	18.30	6.12	33.2	61	0.25
	0900	100	1.5	22.15	4.04	18.59	6.13	31.7	45	0.04
	0905	100	2.0	22.17	4.05	18.67	6.14	31.1	44	0.04
	0910	100	2.5	22.19	4.06	18.75	6.14	30.8	44	0.03
↓	0915	100	3.0	22.20	4.06	18.84	6.14	30.4	43	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW08**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear / cool

SAMPLING INFORMATION

Sample No: 16RW08-191120 **DATE/TIME:** 11/20/19 **Pump Inlet Depth:** 25.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/20/19 0935

Depth to Water - Initial (DTWi) (ft) 23.02

Purge End Date/Time: 11/20/19 1005

Depth to Well Bottom (ft) 30.52

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~20.00 - 30.00~~ 19.25-29.25 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 25.00

Pump Start Time: 0935

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER -23.02

APTIM

Sample Collection Log

Location ID: 16RW08		Sample No: 16RW08-191120								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	0940	100	.5	23.10	4.84	17.66	6.28	36.5	84	0.88
↓	0945	100	1.0	23.16	4.85	18.95	6.30	34.2	89	0.29
	0950	100	1.5	23.20	4.92	19.08	6.33	32.7	89	0.05
	0955	100	2.0	23.23	4.93	19.15	6.34	32.2	89	0.05
	1000	100	2.5	23.25	4.93	19.20	6.35	31.6	90	0.04
✓	1005	100	3.0	23.26	4.94	19.25	6.35	31.2	90	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW09**

Sampler(s): Scott Bessinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16RW09-1911 20 **DATE/TIME:** 11/20/19 1004 **Pump Inlet Depth:** 25.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/20/19 1115

Depth to Water - Initial (DTWi) (ft) 24.70

Purge End Date/Time: 11/20/19 1145

Depth to Well Bottom (ft) 30.63

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~20.00 - 30.00~~ 19.67-29.67 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 25.00

Pump Start Time: 1115

Ferrous Iron (Required Y or N) _____ mg/L

2ND Depth to water - 24.70

APTIM

Sample Collection Log

Location ID: 16RW09				Sample No: 16RW09-191120						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	1120	100	.5	24.77	4.34	20.37	6.28	22.3	67	0.97
↓	1125	100	1.0	24.82	4.28	20.60	6.16	19.7	102	0.43
	1130	100	1.5	24.86	4.28	20.82	6.16	18.5	122	0.23
	1135	100	2.0	24.89	4.27	20.90	6.17	18.1	123	0.22
	1140	100	2.5	24.91	4.27	20.96	6.17	17.6	123	0.21
↓	1145	100	3.0	24.93	4.27	21.01	6.17	17.3	124	0.21

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW10**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16RW10-191120 **DATE/TIME:** 11/20/19 1155 **Pump Inlet Depth:** 22.80

Sampling Method: **Sample Purpose: REG** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/20/19 1205

Depth to Water - Initial (DTWi) (ft) 22.02

Purge End Date/Time: 11/20/19 1240

Depth to Well Bottom (ft) 28.22

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.80-27.80~~ 17.98-27.98 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 22.80

Pump Start Time: 1205

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 22.02

APTIM

Sample Collection Log

Location ID: 16RW10					Sample No: 16RW10-191120					
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	1210	100	.5	22.10	5.19	20.81	6.24	31.3	126	1.06
	1215	100	1.0	22.15	5.29	20.18	6.25	22.2	93	0.48
	1220	100	1.5	22.19	5.35	20.05	6.25	17.5	80	0.21
	1225	100	2.0	22.22	5.38	19.97	6.25	15.0	82	0.04
	1230	100	2.5	22.24	5.38	19.91	6.26	14.6	83	0.03
	1235	100	3.0	22.25	5.39	19.85	6.26	14.2	84	0.03
↓	1240	100	3.5	22.25	5.39	19.80	6.26	13.9	85	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16RW10**

Project No: **501032**

Sampler(s): Scott Bressingar

FIELD CONDITIONS

CLEAR

SAMPLING INFORMATION

Sample No: 16RW10-1911 20 -MS **DATE/TIME:** 11/20/19 1155 **Pump Inlet Depth:** 22.80

Sampling Method: **Sample Purpose: MS** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/20/19 1205

Depth to Water - Initial (DTWi) (ft) 22.02

Purge End Date/Time: 11/20/19 1240

Depth to Well Bottom (ft) 28.22

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.90 - 27.80~~ 17.98-27.98 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/21/2020

Approximate depth of pump inlet*(ft): 22.80

Pump Start Time: 1205

Ferrous Iron (Required Y or N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16RW10 **Sample No: 16RW10-1911_20_-MS**

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	1210	100	.5	22.10	5.19	20.81	6.24	31.3	126	1.06
	1215	100	1.0	22.15	5.24	20.18	6.25	22.2	93	0.48
	1220	100	1.5	22.19	5.35	20.05	6.25	17.5	80	0.21
	1225	100	2.0	22.22	5.38	19.97	6.25	15.0	82	0.04
	1230	100	2.5	22.24	5.38	19.91	6.26	14.6	83	0.03
	1235	100	3.0	22.25	5.39	19.85	6.26	14.2	84	0.03
↓	1240	100	3.5	22.25	5.39	19.80	6.26	13.9	85	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16RW10**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16RW10-1911 20 -MSD **DATE/TIME:** 11/20/19 1155 **Pump Inlet Depth:** 22.80

Sampling Method: **Sample Purpose: MSD** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4" Purge Start Date/Time: 11/20/19 1205

Depth to Water - Initial (DTWi) (ft) 22.02 Purge End Date/Time: 11/20/19 1240

Depth to Well Bottom (ft) 28.22 Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~17.80 - 27.80~~ 17.98-27.98 FT BTOC Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 22.80 Pump Start Time: 1205

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16RW10 Sample No: 16RW10-191120-MSD

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/20/19	1210	100	.5	22.10	5.19	20.81	6.24	31.3	126	1.06
↑	1215	100	1.0	22.15	5.29	20.18	6.25	22.2	93	0.48
	1220	100	1.5	22.19	5.35	20.05	6.25	17.5	80	0.21
	1225	100	2.0	22.22	5.38	19.97	6.25	15.0	82	0.04
	1230	100	2.5	22.24	5.38	19.91	6.26	14.6	83	0.03
	1235	100	3.0	22.25	5.39	19.85	6.26	14.2	84	0.03
↓	1240	100	3.5	22.25	5.39	19.80	6.26	13.9	85	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16WW26**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR / COLD

SAMPLING INFORMATION

Sample No: 16WW26-1911 19 **DATE/TIME:** 11/19/19 0826 **Pump Inlet Depth:** 19.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 0840

Depth to Water - Initial (DTWi) (ft) 16.55

Purge End Date/Time: 11/19/19 0910

Depth to Well Bottom (ft) 21.80

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~16.50 - 21.50~~ 15.97-20.97 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 19.00

Pump Start Time: 0840

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 16.55

APTIM

Sample Collection Log

Location ID: 16WW26		Sample No: 16WW26-1911 19								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	0845	100	.5	16.62	1.25	16.18	5.22	30.1	115	1.01
	0850	100	1.0	16.67	1.11	17.60	5.26	30.6	96	0.31
	0855	100	1.5	16.70	1.10	17.79	5.28	10.3	96	0.19
	0900	100	2.0	16.72	1.09	17.88	5.29	9.5	95	0.19
	0905	100	2.5	16.74	1.09	17.95	5.29	8.9	95	0.18
↓	0910	100	3.0	16.75	1.09	18.04	5.29	8.3	95	0.18

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW42**

Sampler(s): Scott Bassinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16WW42-1911 19 **DATE/TIME:** 11/19/19 1236 **Pump Inlet Depth:** 9.90

Sampling Method: **Sample Purpose: REG** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 1245

Depth to Water - Initial (DTWi) (ft) 9.19

Purge End Date/Time: 11/19/19 1320

Depth to Well Bottom (ft) 15.20

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~4.90 - 14.90~~ 6.57-16.57 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 9.90

Pump Start Time: 1245

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND Depth to water - 9.19

APTIM

Sample Collection Log

Location ID: 16WW42				Sample No: 16WW42-191119						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	1250	100	.5	9.27	2.03	22.11	5.49	281	-27	0.99
	1255	100	1.0	9.33	1.92	22.25	5.62	250	-29	1.22
	1300	100	1.5	9.37	1.83	22.30	5.66	215	-12	1.29
	1305	100	2.0	9.39	0.607	22.37	5.60	209	45	1.33
	1310	100	2.5	9.40	0.607	22.43	5.59	208	46	1.35
	1315	100	3.0	9.41	0.606	22.48	5.58	207	47	1.36
↓	1320	100	3.5	9.41	0.606	22.53	5.58	206	48	1.37

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16WW42**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16WW42-1911**19**-MS **DATE/TIME:** 11/19/19 1236 **Pump Inlet Depth:** 9.90

Sampling Method: **Sample Purpose:** MS **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 1245

Depth to Water - Initial (DTWi) (ft) 9.19

Purge End Date/Time: 11/19/19 1320

Depth to Well Bottom (ft) 15.20

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~4.90 - 14.90~~ 6.57-16.57 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 9.90

Pump Start Time: 1245

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW42				Sample No: 16WW42-191119-MS						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	1250	100	.5	9.27	2.03	22.11	5.49	281	-27	0.99
	1255	100	1.0	9.33	1.972	22.25	5.62	250	-29	1.22
	1300	100	1.5	9.37	1.23	22.30	5.66	215	12	1.29
	1305	100	2.0	9.39	0.607	22.37	5.60	209	45	1.33
	1310	100	2.5	9.40	0.607	22.43	5.59	208	46	1.35
	1315	100	3.0	9.41	0.606	22.48	5.58	207	47	1.36
↓	1320	100	3.5	9.41	0.606	22.53	5.58	206	48	1.37

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW42**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

Clear

SAMPLING INFORMATION

Sample No: 16WW42-191119-MSD **DATE/TIME:** 11/19/19 1236 **Pump Inlet Depth:** 9.90

Sampling Method: **Sample Purpose: MSD** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 11/19/19 1245

Depth to Water - Initial (DTWi) (ft) 9.19

Purge End Date/Time: 11/19/19 1320

Depth to Well Bottom (ft) 15.20

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~4.90 - 14.90~~ 6.57-16.57 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/21/2020

Approximate depth of pump inlet*(ft): 9.90

Pump Start Time: 1245

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW42	Sample No: 16WW42-191119-MSD									
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
11/19/19	1250	100	.5	9.27	2.03	22.11	5.49	281	-27	0.99
↑	1255	100	1.0	9.33	1.92	22.25	5.62	250	-24	1.22
	1300	100	1.5	9.37	1.23	22.30	5.66	215	12	1.29
	1305	100	2.0	9.39	0.607	22.37	5.60	209	45	1.33
	1310	100	2.5	9.40	0.607	22.43	5.59	208	46	1.35
	1315	100	3.0	9.41	0.606	22.48	5.58	207	47	1.36
↓	1320	100	3.5	9.41	0.606	22.53	5.58	206	48	1.37

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16EW05**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR / COLD

SAMPLING INFORMATION

Sample No: 16EW05-E2-191223 **DATE/TIME:** 12/23/19 0743 **Pump Inlet Depth:** 49.50

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 6" Purge Start Date/Time: 12/23/19 0800

Depth to Water - Initial (DTWi) (ft) 6.10 Purge End Date/Time: 12/23/19 0830

Depth to Well Bottom (ft) 51.77 Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~47.00 - 52.00~~ 46.43-51.43 FT BTOC Discharge Tube Diameter: 1/4" Immersible Layer: Y /(N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 49.50 Pump Start Time: 0800

Ferrous Iron (Required Y or N) N/A mg/L

2ND DEPTH TO WATER - 6.10

APTIM

Sample Collection Log

Location ID: 16EW05		Sample No: 16EW05-E2-191223								
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	0805	100	.5	6.15	4.16 [illegible]	16.55	5.39	1000	-31	0.77
↓	0810	100	1.0	6.20	3.65	17.63	5.34	1000	-33	0.25
↓	0815	100	1.5	6.24	3.64	17.65	5.34	1000	-30	0.08
↓	0820	100	2.0	6.27	3.63	17.67	5.33	1000	-30	0.08
↓	0825	100	2.5	6.29	3.63	17.69	5.33	1000	-29	0.07
↓	0830	100	3.0	6.30	3.63	17.70	5.33	1000	-29	0.07

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16EW06**

Project No: **501032**

Sampler(s): Scott Baessinger

FIELD CONDITIONS

CLEAR / COLD

SAMPLING INFORMATION

Sample No: 16EW06-E2-191223 **DATE/TIME:** 12/23/19 0839 **Pump Inlet Depth:** 52.50

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 6"

Purge Start Date/Time: 12/23/19 0855

Depth to Water - Initial (DTWi) (ft) 21.12

Purge End Date/Time: 12/23/19 0925

Depth to Well Bottom (ft) 55.88

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~50.00 - 55.00~~ 49.72-54.72 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 52.50

Pump Start Time: 0925

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 21.12

APTIM

Sample Collection Log

Location ID: 16EW06				Sample No: 16EW06-E2-191223						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	0900	100	.5	21.19	3.34	11.27	5.26	1000	-19	0.73
	0905	100	1.0	21.25	3.52	11.83	5.26	1000	-30	0.22
	0910	100	1.5	21.29	3.51	12.05	5.26	1000	-31	0.05
	0915	100	2.0	21.32	3.50	12.12	5.25	1000	-32	0.05
	0920	100	2.5	21.34	3.50	12.20	5.25	1000	-33	0.04
	0925	100	3.0	21.36	3.50	12.27	5.25	1000	-33	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW06**

Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR / COLD

SAMPLING INFORMATION

Sample No: 16EW06-E2-19~~1223~~-FD **DATE/TIME:** 12/23/19 0839 **Pump Inlet Depth:** 52.50

Sampling Method: **Sample Purpose:** FD **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 6"

Purge Start Date/Time: 12/23/19 0855

Depth to Water - Initial (DTWi) (ft) 21.12

Purge End Date/Time: 12/23/19 0925

Depth to Well Bottom (ft) 55.88

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~50.00 - 55.00~~ 49.72-54.72 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 52.50

Pump Start Time: 0855

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16EW06				Sample No: 16EW06-E2-191223FD						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	0900	100	.5	21.29	3.34	11.27	5.26	1000	-19	0.73
	0905	100	1.0	21.25	3.52	11.83	5.26	1000	-30	0.22
	0910	100	1.5	21.29	3.51	12.05	5.26	1000	-31	0.05
	0915	100	2.0	21.32	3.50	12.12	5.25	1000	-32	0.05
	0920	100	2.5	21.34	3.50	12.20	5.25	1000	-33	0.04
	0925	100	3.0	21.36	3.50	12.27	5.25	1000	-33	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16EW07**

Project No: **501032**

Sampler(s): Scott Bassinger

FIELD CONDITIONS CLEAR/COOL

SAMPLING INFORMATION

Sample No: 16EW07-E2-191223 **DATE/TIME:** 12/23/19 0937 **Pump Inlet Depth:** 43.50

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 6"

Purge Start Date/Time: 12/23/19 0950

Depth to Water - Initial (DTWi) (ft) 12.27

Purge End Date/Time: 12/23/19 1020

Depth to Well Bottom (ft) 46.70

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): 41.00-46.00 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 43.50

Pump Start Time: 0950

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 12.27

APTIM

Sample Collection Log

Location ID: 16EW07				Sample No: 16EW07-E2-191223						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	0955	100	.5	12.35	3.59	11.59	5.23	1000	-2	0.68
	1000	100	1.0	12.40	3.43	12.08	5.17	1000	-13	0.19
	1005	100	1.5	12.44	3.40	12.48	5.18	1000	-16	0.03
	1010	100	2.0	12.47	3.40	12.55	5.19	1000	-17	0.03
	1015	100	2.5	12.49	3.39	12.61	5.19	1000	-17	0.02
	1020	100	3.0	12.51	3.39	12.66	5.19	1000	-18	0.02

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16EW07**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear/cool

SAMPLING INFORMATION

Sample No: 16EW07-E2-191223-MS **DATE/TIME:** 12/23/19 0937 **Pump Inlet Depth:** 43.50

Sampling Method: **Sample Purpose: MS** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Low flow Bladder Pump

Casing ID (in.): 6" Purge Start Date/Time: 12/23/19 0950

Depth to Water - Initial (DTWi) (ft) 12.27 Purge End Date/Time: 12/23/19 1020

Depth to Well Bottom (ft) 46.70 Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): 41.00 - 46.00 FT BTOC Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 43.50 Pump Start Time: 0950

Ferrous Iron (Required Y or (N)) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16EW07	Sample No: 16EW07-E2-191223-MS									
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	0955	100	.5	12.35	3.59	11.59	5.23	1000	-2	0.68
↓	1000	100	1.0	12.40	3.43	12.08	5.17	1000	-13	0.19
	1005	100	1.5	12.44	3.40	12.48	5.18	1000	-16	0.03
	1010	100	2.0	12.47	3.40	12.55	5.19	1000	-17	0.03
	1015	100	2.5	12.49	3.39	12.61	5.19	1000	-17	0.02
↓	1020	100	3.0	12.51	3.39	12.66	5.19	1000	-18	0.02

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP** Location ID: **16EW07**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear / cool

SAMPLING INFORMATION

Sample No: 16EW07-E2-19 1223MSD **DATE/TIME:** 12/23/19 0937 **Pump Inlet Depth:** 43.50

Sampling Method: **Sample Purpose: MSD** **Sample Matrix: GW**

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310C	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 6" Purge Start Date/Time: 12/23/19 0950

Depth to Water - Initial (DTWi) (ft) 12.27 Purge End Date/Time: 12/23/19 1020

Depth to Well Bottom (ft) 46.70 Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): 41.00 - 46.00 FT BTOC Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 43.50 Pump Start Time: 0950

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16EW07	Sample No: 16EW07-E2-19/22?-MSD									
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	0955	100	.5	12.35	3.59	11.59	5.23	1000	-2	0.68
	1000	100	1.0	12.40	3.43	12.08	5.17	1000	-13	0.19
	1005	100	1.5	12.44	3.40	12.48	5.18	1000	-16	0.03
	1010	100	2.0	12.47	3.40	12.55	5.19	1000	-17	0.03
	1015	100	2.5	12.49	3.39	12.61	5.19	1000	-17	0.02
	1020	100	3.0	12.51	3.39	12.66	5.19	1000	-18	0.02

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW08**

Sampler(s): Scott Bassinger

FIELD CONDITIONS Clear/ cool

SAMPLING INFORMATION

Sample No: 16EW08-E2-191223 **DATE/TIME:** 12/23/19 1030 **Pump Inlet Depth:** 36.50

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 6"

Purge Start Date/Time: 12/23/19 1100

Depth to Water - Initial (DTWi) (ft) 7.00

Purge End Date/Time: 12/23/19 1130

Depth to Well Bottom (ft) 38.55

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~34.00 - 39.00~~ 33.76-38.76 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 36.50

Pump Start Time: 1100

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER- 7.00

APTIM

Sample Collection Log

Location ID: 16EW08		Sample No: 16EW08-E2-19/1223								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
12/23/19	1105	100	.5	7.07	0.622	13.04	5.30	1000	-10	0.73
	1110	100	1.0	7.12	1.39	13.60	5.23	1000	-6	0.27
	1115	100	1.5	7.16	1.39	13.67	5.22	1000	-6	0.10
	1120	100	2.0	7.19	1.40	13.75	5.21	1000	-7	0.10
	1125	100	2.5	7.21	1.40	13.82	5.20	1000	-7	0.10
	1130	100	3.0	7.23	1.40	13.88	5.20	1000	-7	0.09

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW03**

Sampler(s): SCOTT BEESINGER

FIELD CONDITIONS OVERCAST

SAMPLING INFORMATION

Sample No: 16IW03-20012323 **DATE/TIME:** 1/23/20 1302 **Pump Inlet Depth:** 20.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1315

Depth to Water - Initial (DTWi) (ft) 14.80

Purge End Date/Time: 1/23/20 1345

Depth to Well Bottom (ft) 25.00

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~15.00 - 25.00~~

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 20.00

Pump Start Time: 1315

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER- 14.80

APTIM

Sample Collection Log

Location ID: 16IW03 Sample No: 16IW03-200123

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1320	100	.5	14.88	1.00	15.68	7.48	90.1	-36	0.84
↓	1325	100	1.0	14.94	1.01	16.02	7.28	80.5	-58	0.26
	1330	100	1.5	14.98	1.00	16.29	7.26	79.0	-75	0.05
	1335	100	2.0	15.01	0.999	16.33	7.26	78.6	-76	0.05
	1340	100	2.5	15.03	0.999	16.40	7.25	77.9	-77	0.05
↓	1345	100	3.0	15.05	0.999	16.47	7.25	77.3	-78	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW04**

Sampler(s): Scott Beesinger

FIELD CONDITIONS OVERCAST

SAMPLING INFORMATION

Sample No: 16IW04-200123 **DATE/TIME:** 1/23/20 1213 **Pump Inlet Depth:** 22.75

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1225

Depth to Water - Initial (DTWi) (ft) 16.47

Purge End Date/Time: 1/23/20 1255

Depth to Well Bottom (ft) 28.35

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.75 - 27.75~~

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.75

Pump Start Time: 1225

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 16.47

APTIM

Sample Collection Log

Location ID: 16IW04				Sample No: 16IW04-200123						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1230	100	.5	16.55	4.82	13.56	6.87	60.1	-12	0.81
	1235	100	1.0	16.61	4.90	14.01	6.97	53.2	-31	0.29
	1240	100	1.5	16.64	4.91	14.03	6.99	49.9	-36	0.07
	1245	100	2.0	16.66	4.92	14.06	7.00	49.4	-36	0.07
	1250	100	2.5	16.67	4.92	14.08	7.00	48.7	-37	0.06
	1255	100	3.0	16.68	4.92	14.10	7.00	48.2	-37	0.06

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16PM02**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Over Cast

SAMPLING INFORMATION

Sample No: 16PM02-200123 **DATE/TIME:** 1/23/20 1446 **Pump Inlet Depth:** _____

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow/Bladder Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1500

Depth to Water - Initial (DTWi) (ft) 17.11

Purge End Date/Time: 1/23/20 1530

Depth to Well Bottom (ft) 28.40

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~18.10 - 27.80~~ 18.1-28.1 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.95

Pump Start Time: 1500

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 17.11

APTIM

Sample Collection Log

Location ID: 16PM02				Sample No: 16PM02-200123						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1505	100	.5	17.18	1.35	15.29	7.60	151	24	0.82
↓	1510	100	1.0	17.24	1.35	16.67	7.31	144	44	0.25
	1515	100	1.5	17.28	1.36	16.74	7.17	140	50	0.09
	1520	100	2.0	17.31	1.36	16.79	7.16	139	51	0.09
	1525	100	2.5	17.33	1.37	16.83	7.16	138	52	0.08
↓	1530	100	3.0	17.34	1.37	16.89	7.15	137	53	0.08

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16PM03**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS OVERCAST

SAMPLING INFORMATION

Sample No: 16PM03-20012323 **DATE/TIME:** 1/23/20 1536 **Pump Inlet Depth:** 23.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1545

Depth to Water - Initial (DTWi) (ft) 16.65

Purge End Date/Time: 1/23/20 1615

Depth to Well Bottom (ft) 28.50

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~18.00 - 28.00~~ 17.9-27.4 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 23.00

Pump Start Time: 1545

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 16.65

APTIM

Sample Collection Log

Location ID: 16PM03				Sample No: 16PM03-200123						
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1550	100	.5	16.72	3.37	15.39	7.02	77.3	41	0.63
	1555	100	1.0	16.77	4.21	15.77	7.04	71.2	23	0.18
	1600	100	1.5	16.81	4.34	15.88	7.05	67.9	19	0.03
	1605	100	2.0	16.83	4.34	15.95	7.06	67.4	19	0.03
	1610	100	2.5	16.85	4.35	15.99	7.06	66.8	18	0.03
	1615	100	3.0	16.86	4.35	16.03	7.06	66.5	18	0.02

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16PM06**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS OVERCAST

SAMPLING INFORMATION

Sample No: 16PM06-200123 **DATE/TIME:** 1/23/20 1122 **Pump Inlet Depth:** 22.65

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Lowflow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1135

Depth to Water - Initial (DTWi) (ft) 16.15

Purge End Date/Time: 1/23/20 1205

Depth to Well Bottom (ft) 27.40

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.80 - 27.50~~ 18.2-28.2 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.65

Pump Start Time: 1135

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 16.15

APTIM

Sample Collection Log

Location ID: 16PM06 Sample No: 16PM06-200123

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1140	100	.5	16.22	4.50	15.23	6.81	56.3	26	0.78
↓	1145	100	1.0	16.27	4.55	15.89	6.78	48.8	-8	0.29
	1150	100	1.5	16.31	4.54	16.38	6.83	44.0	-19	0.09
	1155	100	2.0	16.33	4.53	16.45	6.84	43.7	-20	0.09
	1200	100	2.5	16.35	4.53	16.51	6.84	43.3	-21	0.08
↓	1205	100	3.0	16.36	4.53	16.57	6.85	42.9	-21	0.08

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16PM06**

Sampler(s): Scott Bressinger

FIELD CONDITIONS OVERCAST

SAMPLING INFORMATION

Sample No: 16PM06-2001~~23~~-FD **DATE/TIME:** 1/23/20 1122 **Pump Inlet Depth:** 22.65

Sampling Method: **Sample Purpose:** FD **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow/Bladder Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1135

Depth to Water - Initial (DTWi) (ft) 16.15

Purge End Date/Time: 1/23/20 1205

Depth to Well Bottom (ft) 27.40

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.80 - 27.80~~ 18.2-28.2 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.65

Pump Start Time: 1135

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16PM06		Sample No: 16PM06-2001 23 -FD								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1140	100	.5	16.22	4.50	15.23	6.81	56.3	26	0.78
	1145	100	1.0	16.27	4.55	15.89	6.78	48.8	-8	0.29
	1150	100	1.5	16.31	4.54	16.38	6.83	44.0	-19	0.09
	1155	100	2.0	16.33	4.53	16.45	6.84	43.7	-20	0.09
	1200	100	2.5	16.35	4.53	16.51	6.84	43.3	-21	0.08
	1205	100	3.0	16.36	4.53	16.57	6.85	42.9	-21	0.08

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16PM09**

Sampler(s): Scott Bressinger

FIELD CONDITIONS Overcast / Light Rain

SAMPLING INFORMATION

Sample No: 16PM09-20012323 **DATE/TIME:** 1/23/20 1036 **Pump Inlet Depth:** 22.95

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1045

Depth to Water - Initial (DTWi) (ft) 14.43

Purge End Date/Time: 1/23/20 1115

Depth to Well Bottom (ft) 27.15

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~17.10 - 26.80~~ 16.8-26.8 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.95

Pump Start Time: 1045

Ferrous Iron (Required Y or (N) _____ mg/L

2ND Depth to water - 14.43

APTIM

Sample Collection Log

Location ID: 16PM09 Sample No: 16PM09-200123

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1050	100	.5	14.50	1.10	15.33	8.06	433	127	0.69
↓	1055	100	1.0	14.56	1.66	16.18	7.18	415	170	0.20
	1100	100	1.5	14.60	1.84	16.45	6.85	410	173	0.04
	1105	100	2.0	14.63	1.85	16.54	6.74	409	174	0.04
	1110	100	2.5	14.65	1.86	16.62	6.73	409	175	0.03
↓	1115	100	3.0	14.66	1.86	16.69	6.73	408	176	0.03

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16PM14**

Project No: **501032**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

OVERCAST

SAMPLING INFORMATION

Sample No: 16PM14-20012**3**

DATE/TIME: 1/23/20 1400

Pump Inlet Depth: 20.00

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 1/23/20 1410

Depth to Water - Initial (DTWi) (ft) 17.60

Purge End Date/Time: 1/23/20 1440

Depth to Well Bottom (ft) 28.22

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~15.20 - 25.80~~ 18-28 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): _____

Pump Start Time: 1410

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 17.60

APTIM

Sample Collection Log

Location ID: 16PM14		Sample No: 16PM14-2001 23								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1415	100	.5	17.67	5.36	15.85	6.56	37.3	2	0.71
↓	1420	100	1.0	17.73	6.10	16.74	6.75	30.1	3	0.20
	1425	100	1.5	17.77	6.14	16.75	6.80	24.7	5	0.05
	1430	100	2.0	17.79	6.15	16.77	6.80	24.2	5	0.05
	1435	100	2.5	17.81	6.16	16.79	6.81	23.6	6	0.04
↓	1440	100	3.0	17.83	6.14	16.80	6.81	23.1	6	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW36**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Overcast/ Light Rain

SAMPLING INFORMATION

Sample No: 16WW36-200123 **DATE/TIME:** 1/23/20 0928 **Pump Inlet Depth:** 22.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 1/23/20 0955

Depth to Water - Initial (DTWi) (ft) 17.12

Purge End Date/Time: 1/23/20 1025

Depth to Well Bottom (ft) 24.90

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~19.50 - 24.50~~ 19.49-24.49 FT BTOC

L George 05/20/2020

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

Approximate depth of pump inlet*(ft): 22.00

Pump Start Time: 0955

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 17.12

APTIM

Sample Collection Log

Location ID: 16WW36 Sample No: 16WW36-2001 23

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1000	100	.5	17.20	8.50	14.89	7.20	29.1	150	0.73
	1005	100	1.0	17.24	7.97	15.83	7.15	19.7	153	0.23
	1010	100	1.5	17.31	7.71	16.19	7.15	16.8	153	0.08
	1015	100	2.0	17.34	7.70	16.28	7.14	16.3	152	0.08
	1020	100	2.5	17.36	7.69	16.35	7.15	15.7	152	0.08
	1025	100	3.0	17.38	7.69	16.42	7.14	15.2	152	0.07

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Location ID: **16WW36**

Project No: **501032**

Sampler(s): Scott Bressinger

FIELD CONDITIONS Overcast / Light Rain

SAMPLING INFORMATION

Sample No: 16WW36-200123-MS **DATE/TIME:** 1/23/20 0928 **Pump Inlet Depth:** 22.00

Sampling Method: **Sample Purpose:** MS **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 4 "

Purge Start Date/Time: 1/23/20 0955

Depth to Water - Initial (DTWi) (ft) 17.12

Purge End Date/Time: 1/23/20 1025

Depth to Well Bottom (ft) 24.90

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~19.50 - 24.50~~ 19.49-24.49 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.00

Pump Start Time: 0955

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW36	Sample No: 16WW36-200123-MS									
Date of Reading	**Time of Reading**	**Purge Rate**	**Total Purge**	**DTW**	**Cond.**	**Temp.**	**pH**	**Turbidity**	**ORP**	**DO**
		(ml/min)	**(L)**	**(ft)**	**(mS/cm)**	**(°C)**		**(NTU)**	**(mV)**	**(mg/L)**
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1000	100	.5	17.20	8.50	14.84	7.20	29.1	150	0.73
↓	1005	100	1.0	17.26	7.97	15.83	7.15	19.7	153	0.23
	1010	100	1.5	17.31	7.71	16.19	7.15	16.8	153	0.08
	1015	100	2.0	17.34	7.70	16.28	7.14	16.3	152	0.08
	1020	100	2.5	17.36	7.69	16.35	7.15	15.7	152	0.08
↓	1025	100	3.0	17.38	7.69	16.42	7.14	15.2	152	0.07

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP** Location ID: **16WW36**

Project No: **501032** Sampler(s): Scott Beesinger

FIELD CONDITIONS Overcast / Light Rain

SAMPLING INFORMATION

Sample No: 16WW36-20012323-MSD **DATE/TIME:** 1/23/20 0428 **Pump Inlet Depth:** 22.00

Sampling Method: **Sample Purpose: MSD** **Sample Matrix: GW**

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing Purging Method/Equipment: Low Flow / Bladder Pump

Casing ID (in.): 4" Purge Start Date/Time: 1/23/20 0955

Depth to Water - Initial (DTWi) (ft) 17.12 Purge End Date/Time: 1/23/20 1025

Depth to Well Bottom (ft) 24.90 Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~19.50 - 24.50~~ 19.49-24.49 FT BTOC Discharge Tube Diameter: ~~NA~~ 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.00 Pump Start Time: 0955

Ferrous Iron (Required Y or (N) _____ mg/L

APTIM

Sample Collection Log

Location ID: 16WW36	Sample No: 16WW36-2001 23 -MSD									
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
1/23/20	1000	100	.5	17.20	8.50	14.89	7.20	29.1	150	0.73
↓	1005	100	1.0	17.26	7.47	15.83	7.15	19.7	153	0.23
	1010	100	1.5	17.31	7.71	16.19	7.15	16.8	153	0.08
	1015	100	2.0	17.34	7.70	16.28	7.14	16.3	152	0.08
	1020	100	2.5	17.36	7.69	16.35	7.15	15.7	152	0.08
↓	1025	100	3.0	17.38	7.69	16.42	7.14	15.2	152	0.07

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW01**

Sampler(s): ~~Scott Beesinger~~

FIELD CONDITIONS Cloudy

SAMPLING INFORMATION

Sample No: 16EW01-2003~~09~~ **DATE/TIME:** 3/9/20 0834 **Pump Inlet Depth:** 33.70

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Alkalinity by SM2320B	1 x 250 mL HPDE	Cool 4C
		ALSHT	Anions-Nitrate,Sulfate,Bromide by 9056	1 x 250 mL HPDE	Cool 4C
		ALSHT	Dissolved Gases in Water by RSK175	3 x 40 mL Glass	HCL<pH2
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2
		MI	DHC IN WATER CENSUS	1 x 1 L HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Lowflow/Bladder Pump

Casing ID (in.): 6"

Purge Start Date/Time: 3/9/20 0845

Depth to Water - Initial (DTWi) (ft) 25.15

Purge End Date/Time: 3/9/20 0915

Depth to Well Bottom (ft) 39.20

Discharge Tube Length: NA

PID Reading: NA

30.89-35.89 FT BTOC

Screen Interval (ft): ~~31.20-36.20~~

Discharge Tube Diameter: 1/4"

Immersible Layer: Y (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 33.70

Pump Start Time: 0845

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 25.15

APTIM

Sample Collection Log

Location ID: 16EW01				Sample No: 16EW01-200309						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	0850	100	1.5	25.22	6.75	16.92	6.81	18.6	-69	5.05
	0855	100	1.0	25.27	7.34	17.31	6.47	17.6	-77	4.85
	0900	100	1.5	25.31	7.39	17.34	6.38	17.0	-78	4.73
	0905	100	2.0	25.33	7.40	17.37	6.37	16.8	-78	4.71
	0910	100	2.5	25.35	7.41	17.40	6.36	16.0	-79	4.69
↓	0915	100	3.0	25.36	7.41	17.42	6.36	15.2	-79	4.68

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW02**

Sampler(s): Scott Blessinger

FIELD CONDITIONS

Cloudy / LIGHT RAIN

SAMPLING INFORMATION

Sample No: 16EW02-200309 **DATE/TIME:** 3/9/20 0931 **Pump Inlet Depth:** 24.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Alkalinity by SM2320B	1 x 250 mL HPDE	Cool 4C
		ALSHT	Anions-Nitrate,Sulfate,Bromide by 9056	1 x 250 mL HPDE	Cool 4C
		ALSHT	Dissolved Gases in Water by RSK175	3 x 40 mL Glass	HCL<pH2
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2
		MI	DHC IN WATER CENSUS	1 x 1 L HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: LowFlow / BLADDER Pump

Casing ID (in.): 6"

Purge Start Date/Time: 3/9/20 0945

Depth to Water - Initial (DTWi) (ft) 21.65

Purge End Date/Time: 3/9/20 1015

Depth to Well Bottom (ft) 29.70

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~21.50 - 26.50~~ 21.75-26.75 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/28/2020

Approximate depth of pump inlet*(ft): 24.00

Pump Start Time: 0945

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 21.65

APTIM

Sample Collection Log

Location ID: 16EW02 Sample No: 16EW02-2003 09

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	0950	100	1.5	21.72	4.40	17.69	7.14	1.3	-12 [redacted]	4.21
	0955	100	2.0	21.77	4.13	17.89	6.95	0.0	38	3.97
	1000	100	1.5	21.81	4.16	17.93	6.87	0.0	53	3.81
	1005	100	2.0	21.84	4.16	17.98	6.87	0.0	54	3.80
	1010	100	2.5	21.86	4.17	18.03	6.86	0.0	54	3.78
	1015	100	3.0	21.88	4.17	18.08	6.86	0.0	55	3.77

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16EW04**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Cloudy / Light Rain

SAMPLING INFORMATION

Sample No: 16EW04-200309 **DATE/TIME:** 3/9/20 1031 **Pump Inlet Depth:** 16.50

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / Bladder Pump

Casing ID (in.): 6"

Purge Start Date/Time: 3/9/20 1045

Depth to Water - Initial (DTWi) (ft) 6.00

Purge End Date/Time: 3/9/20 1115

Depth to Well Bottom (ft) 19.70

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~14.00-19.00~~ 13.95-18.95 FT BTOC

L George 05/20/2020

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

Approximate depth of pump inlet*(ft): 16.50

Pump Start Time: 1045

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER 6.00

APTIM

Sample Collection Log

Location ID: 16EW04 Sample No: 16EW04-2003D9

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	1050	100	.5	6.08	2.02	17.15	7.61	3.9	48	3.45
	1055	100	1.0	6.13	1.94	16.91	7.30	3.5	63	3.02
	1100	100	1.5	6.15	1.94	16.91	7.27	3.2	64	2.83
	1105	100	2.0	6.17	1.93	16.90	7.26	3.0	65	2.81
	1110	100	2.5	6.19	1.93	16.91	7.26	2.8	65	2.79
	1115	100	3.0	6.20	1.93	16.90	7.26	2.5	65	2.78

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW04**

Sampler(s): Scott Baesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16IW04-2003 10 **DATE/TIME:** 3/10/20 0738 **Pump Inlet Depth:** 22.75

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 3/10/20 0850

Depth to Water - Initial (DTWi) (ft) 16.05

Purge End Date/Time: 3/10/20 0920

Depth to Well Bottom (ft) 28.35

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): 17.75 - 27.75

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.75

Pump Start Time: 0850

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 16.05

APTIM

Sample Collection Log

Location ID: 16IW04 Sample No: 16IW04-2003 10

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	0855	100	.5	16.12	5.64	17.97	6.90	57.7	-67	0.77
	0900	100	1.0	16.18	5.57	17.95	6.58	52.1	-75	0.29
	0905	100	1.5	16.22	5.57	17.96	6.57	50.7	-78	0.07
	0910	100	2.0	16.25	5.56	17.97	6.56	50.3	-78	0.07
	0915	100	2.5	16.27	5.56	17.98	6.56	48.8	-79	0.06
	0920	100	3.0	16.28	5.56	17.99	6.56	48.5	-79	0.06

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16IW20**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

Cloudy

SAMPLING INFORMATION

Sample No: 16IW20-20030 9 **DATE/TIME:** 3/9/20 0735 **Pump Inlet Depth:** 19.41

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Alkalinity by SM2320B	1 x 250 mL HPDE	Cool 4C
		ALSHT	Anions-Nitrate,Sulfate,Bromide by 9056	1 x 250 mL HPDE	Cool 4C
		ALSHT	Dissolved Gases in Water by RSK175	3 x 40 mL Glass	HCL<pH2
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2
		MI	DHC IN WATER CENSUS	1 x 1 L HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 3/9/20 0745

Depth to Water - Initial (DTWi) (ft): 16.07

Purge End Date/Time: 3/9/20 0815

Depth to Well Bottom (ft) 25.48

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): 14.91-24.91

FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 19.41

Pump Start Time: 0745

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER 16.07

APTIM

Sample Collection Log

Location ID: 16IW20 Sample No: 16IW20-200309

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	0750	100	.5	16.14	4.87	17.36	7.98	26.8	-158	3.08
	0755	100	1.0	16.20	5.01	17.02	6.57	21.7	-189	2.83
	0800	100	1.5	16.24	5.13	16.99	6.50	21.2	-226	2.65
	0805	100	2.0	16.26	5.14	16.96	6.50	21.6	-228	2.63
	0810	100	2.5	16.27	5.15	16.93	6.49	21.3	-229	2.61
↓	0815	100	3.0	16.28	5.15	16.90	6.49	21.5	-230	2.60

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16PM06**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

CLEAR

SAMPLING INFORMATION

Sample No: 16PM06-200310 **DATE/TIME:** 3/10/20 0930 **Pump Inlet Depth:** 22.65

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low Flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 3/10/20 0940

Depth to Water - Initial (DTWi) (ft) 15.73

Purge End Date/Time: 3/10/20 1010

Depth to Well Bottom (ft) 27.50

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.80 - 27.50~~ 18.2-28.2 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.65

Pump Start Time: 0940

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER- 15.73

APTIM

Sample Collection Log

Location ID: 16PM06 Sample No: 16PM06-2003_10

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	0945	100	.5	15.80	5.23	18.10	6.48	77.6	-37	0.85
	0950	100	1.0	15.86	5.22	18.20	6.23	68.3	-52	0.32
	0955	100	1.5	15.90	5.21	18.28	6.22	66.0	-52	0.10
	1000	100	2.0	15.93	5.20	18.34	6.21	65.7	-53	0.10
	1005	100	2.5	15.95	5.20	18.38	6.21	65.1	-53	0.09
↓	1010	100	3.0	15.97	5.20	18.42	6.21	64.5	-53	0.09

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16PM09**

Sampler(s): Scott Bessinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16PM09-2003_16 **DATE/TIME:** 3/10/20 1020 **Pump Inlet Depth:** 21.95

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER PUMP

Casing ID (in.): 2"

Purge Start Date/Time: 3/10/20 1030

Depth to Water - Initial (DTWi) (ft) 13.92

Purge End Date/Time: 3/10/20 1100

Depth to Well Bottom (ft) 27.18

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~17.10 - 26.80~~ 16.8-26.8 FT BTOC

L George 05/20/2020

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

Approximate depth of pump inlet*(ft): 21.95

Pump Start Time: 1030

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER- 13.92

APTIM

Sample Collection Log

Location ID: 16PM09		Sample No: 16PM09-2003 10								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	1035	100	.5	13.99	1.42	19.24	6.85	1000	[illegible] 14	1.28
	1040	100	1.0	14.05	0.945	19.35	6.31	1000	58	0.81
	1045	100	1.5	14.08	0.875	19.37	6.35	1000	72	0.66
	1050	100	2.0	14.10	0.874	19.39	6.35	1000	73	0.65
	1055	100	2.5	14.12	0.873	19.41	6.36	1000	74	0.64
	1100	100	3.0	14.13	0.873	19.43	6.36	1000	75	0.64

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16PM14**

Sampler(s): Scott Buss, NCUR

FIELD CONDITIONS

Clear

SAMPLING INFORMATION

Sample No: 16PM14-20031D **DATE/TIME:** 3/10/20 0745 **Pump Inlet Depth:** 28.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 3/10/20 0800

Depth to Water - Initial (DTWi) (ft) 17.20

Purge End Date/Time: 3/10/20 0830

Depth to Well Bottom (ft) 28.20

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~18.20 - 28.80~~ 18-28 FT BTOC

Discharge Tube Diameter: ~~NA~~ 1/4" Immersible Layer: Y (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 28.00

Pump Start Time: 0800

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER — 17.20

APTIM

Sample Collection Log

Location ID: 16PM14		Sample No: 16PM14-2003 10								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	0800	100	.5	17.28	6.26	17.85	5.76	31.3	171	0.83
	0805	100	1.0	17.33	6.72	17.93	6.32	24.2	95	0.32
	0810	100	1.5	17.37	6.76	17.94	6.34	22.9	91	0.09
	0815	100	2.0	17.40	6.77	17.96	6.35	22.6	90	0.09
	0820	100	2.5	17.42	6.78	17.97	6.35	22.1	89	0.08
	0825	100	3.0	17.44	6.78	17.98	6.36	21.8	88	0.08

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW03**

Sampler(s): Scott Baesinger

FIELD CONDITIONS

Cloudy / LIGHT RAIN

SAMPLING INFORMATION

Sample No: 16RW03-200309 **DATE/TIME:** 3/9/20 1125 **Pump Inlet Depth:** 17.90

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/9/20 @ 1135

Depth to Water - Initial (DTWi) (ft) 4.77

Purge End Date/Time: 3/9/20 1205

Depth to Well Bottom (ft) 23.08

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~12.90 - 22.90~~ 13.34-23.34 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/28/2020

Approximate depth of pump inlet*(ft): 17.90

Pump Start Time: 1135

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 4.77

APTIM

Sample Collection Log

Location ID: 16RW03				Sample No: 16RW03-200309						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	1140	100	.5	4.85	0.765	16.86	6.75	1.2	160	1.03
	1145	100	1.0	4.90	0.734	16.80	5.88	0.0	184	0.61
	1150	100	1.5	4.93	0.734	16.80	5.65	0.0	196	0.35
	1155	100	2.0	4.95	0.734	16.80	5.64	0.0	197	0.34
	1200	100	2.5	4.97	0.735	16.80	5.63	0.0	198	0.33
↓	1205	100	3.0	4.99	0.735	16.80	5.62	0.0	199	0.32

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW04**

Sampler(s): Scott Bressinger

FIELD CONDITIONS Cloudy / LIGHT RAIN

SAMPLING INFORMATION

Sample No: 16RW04-200309 DATE/TIME: 3/9/20 1213 Pump Inlet Depth: ~~[illegible]~~ 21.45

Sampling Method: Sample Purpose: REG Sample Matrix: GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/9/20 1225

Depth to Water - Initial (DTWi) (ft) 17.50

Purge End Date/Time: 3/9/20 1255

Depth to Well Bottom (ft) 27.65

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~16.45 - 26.45~~ 16.9-26.9 FT BTOC 21.45

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): ~~[illegible]~~

Pump Start Time: 1225

Ferrous Iron (Required Y or N) _____ mg/L

2ND DEPTH TO WATER - 17.50

APTIM

Sample Collection Log

Location ID: 16RW04				Sample No: 16RW04-200309						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	1230	100	.5	17.57	1.88	17.55	5.56	17.1	212	0.98
	1235	100	1.0	17.62	2.04	17.60	5.21	13.6	240	0.45
	1240	100	1.5	17.65	2.06	17.60	5.10	13.5	248	0.22
	1245	100	2.0	17.67	2.06	17.60	5.09	13.3	249	0.21
	1250	100	2.5	17.69	2.06	17.61	5.08	13.2	250	0.21
	1255	100	3.0	17.70	2.06	17.61	5.07	13.1	250	0.20

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW08**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

CLEAR

SAMPLING INFORMATION

Sample No: 16RW08-20031 1

DATE/TIME: 3/11/201020

Pump Inlet Depth: 25.00

Sampling Method:

Sample Purpose: REG

Sample Matrix: GW

Appearance of Sample

Assoc. QC Samples

Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER PUMP

Casing ID (in.): 4"

Purge Start Date/Time: 3/11/20 1025

Depth to Water - Initial (DTWi) (ft) 22.22

Purge End Date/Time: 3/11/20 1055

Depth to Well Bottom (ft) 30.45

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~20.00-30.00~~ 19.25-29.25 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 25.00

Pump Start Time: 1025

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER- 22.22

APTIM

Sample Collection Log

Location ID: 16RW08					Sample No: 16RW08-200311					
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/31/20	1030	100	.5	22.30	4.67	20.75	7.16	4.6	39	1.05
	1035	100	1.0	22.36	4.67	21.83	6.75	1.2	25	0.88
	1040	100	1.5	22.40	4.67	22.19	6.75	0.0	26	0.64
	1045	100	2.0	22.42	4.68	22.30	6.76	0.0	27	0.65
	1050	100	2.5	22.44	4.68	22.40	6.76	0.0	27	0.66
	1055	100	3.0	22.46	4.68	22.46	6.76	0.0	28	0.67

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW09**

Sampler(s): Scott Bessinger

FIELD CONDITIONS

Clear

SAMPLING INFORMATION

Sample No: 16RW09-200311 **DATE/TIME:** 3/11/20 0915 **Pump Inlet Depth:** ~~25.00~~ 26.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/11/20 0930

Depth to Water - Initial (DTWi) (ft) 24.93

Purge End Date/Time: 3/11/20 1000

Depth to Well Bottom (ft) 30.65

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~20.00-30.00~~ 19.67-29.67 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): ~~25.00~~ 26.00

Pump Start Time: 0930

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 24.93

APTIM

Sample Collection Log

Location ID: 16RW09				Sample No: 16RW09-200311						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/11/20	0935	100	.5	25.00	4.71	19.12	6.96	0.3	49	0.77
	0940	100	1.0	25.06	4.60	19.38	6.71	0.0	54	0.25
	0945	100	1.5	25.10	4.61	19.46	6.70	0.0	54	0.05
	0950	100	2.0	25.13	4.62	19.53	6.70	0.0	54	0.05
	0955	100	2.5	25.15	4.62	19.59	6.69	0.0	53	0.04
↓	1000	100	3.0	25.17	4.62	19.63	6.69	0.0	53	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW09**

Sampler(s): Scott Beesinger

FIELD CONDITIONS

Clear

SAMPLING INFORMATION

Sample No: 16RW09-20031111-MS **DATE/TIME:** 3/11/20 0915 **Pump Inlet Depth:** 26.00

Sampling Method: **Sample Purpose:** MS **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/11/20 0930

Depth to Water - Initial (DTWi) (ft) 24.93

Purge End Date/Time: 3/11/20 1000

Depth to Well Bottom (ft) 30.65

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~20.00 - 30.00~~ 19.67-29.67 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 26.00

Pump Start Time: 0930

Ferrous Iron (Required Y or (N) _____ mg/L

2ND Depth to water - 24.93

APTIM

Sample Collection Log

Location ID: 16RW09				Sample No: 16RW09-2003 11-MS						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/11/20	0935	100	.5	25.00	4.71	19.12	6.96	0.3	49	0.77
	0940	100	1.0	25.06	4.60	19.38	6.71	0.0	54	0.25
	0945	100	1.5	25.10	4.61	19.46	6.70	0.0	54	0.05
	0950	100	2.0	25.13	4.62	19.53	6.70	0.0	54	0.05
	0955	100	2.5	25.15	4.62	19.59	6.69	0.0	53	0.04
	1000	100	3.0	25.17	4.62	19.63	6.69	0.0	53	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW09**

Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16RW09-200311-MSD **DATE/TIME:** 3/11/20 0915 **Pump Inlet Depth:** 26.00

Sampling Method: **Sample Purpose:** MSD **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/11/20 0930

Depth to Water - Initial (DTWi) (ft) 24.93

Purge End Date/Time: 3/11/20 1000

Depth to Well Bottom (ft) 30.65

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~20.00-30.00~~ 19.67-29.67 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 26.00

Pump Start Time: 0930

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 24.93

APTIM

Sample Collection Log

Location ID: 16RW09 Sample No: 16RW09-200311-MSD

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/11/20	0935	100	.5	25.00	4.71	19.12	6.96	0.3	49	0.77
	0940	100	1.0	25.06	4.60	19.38	6.71	0.0	54	0.25
	0945	100	1.5	25.10	4.61	19.46	6.70	0.0	54	0.05
	0950	100	2.0	25.13	4.62	19.53	6.70	0.0	54	0.05
	0955	100	2.5	25.15	4.62	19.59	6.69	0.0	53	0.04
	1000	100	3.0	25.17	4.62	19.63	6.69	0.0	53	0.04

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW10**

Sampler(s): Scott Bressinger

FIELD CONDITIONS

Clear

SAMPLING INFORMATION

Sample No: 16RW10-2003 11 **DATE/TIME:** 3/4/20 0825 **Pump Inlet Depth:** 22.80

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/11/20 0835

Depth to Water - Initial (DTWi) (ft) 14.83

Purge End Date/Time: 3/11/20 0905

Depth to Well Bottom (ft) 28.22

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~17.80 - 27.80~~ 17.98-27.98 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.80

Pump Start Time: 0835

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 14.83

APTIM

Sample Collection Log

Location ID: 16RW10		Sample No: 16RW10-2003[1]								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/11/20	0840	100	.5	14.90	1.53	18.22	6.94	17.3	121	1.33
	0845	100	1.0	14.96	2.15	18.28	6.85	7.1	85	1.01
	0850	100	1.5	15.00	1.93	18.30	6.65	3.0	52	0.90
	0855	100	2.0	15.03	1.92	18.33	6.65	2.6	51	0.89
	0900	100	2.5	15.05	1.91	18.36	6.64	2.1	50	0.87
↓	0905	100	3.0	15.07	1.91	18.39	6.64	1.9	50	0.86

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16RW12**

Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16RW12-2003 10 **DATE/TIME:** 3/10/20 1215 **Pump Inlet Depth:** 25.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow / BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/10/20 1225

Depth to Water - Initial (DTWi) (ft) 23.20

Purge End Date/Time: 3/10/20 1255

Depth to Well Bottom (ft) ~~32.20~~

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~20.00 - 30.00~~ 21.49-31.49 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/20/2020

Approximate depth of pump inlet*(ft): 25.00

Pump Start Time: 1225

Ferrous Iron (Required Y or N) _____ mg/L

2ND DEPTH TO WATER - 23.20

APTIM

Sample Collection Log

Location ID: 16RW12				Sample No: 16RW12-2003 10						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	1230	100	.5	23.27	4.11	19.83	5.87	8.3	25	1.88
	1235	100	1.0	23.33	4.33	19.83	6.29	4.2	14	1.54
	1240	100	1.5	23.37	4.40	19.98	6.63	1.8	8	1.37
	1245	100	2.0	23.40	4.40	20.06	6.64	1.2	8	1.36
	1250	100	2.5	23.42	4.40	20.11	6.64	0.7	7	1.35
	1255	100	3.0	23.44	4.40	20.16	6.65	0.2	7	1.34

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW12**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16WW12-2003 11 **DATE/TIME:** 3/11/20 0733 **Pump Inlet Depth:** 22.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/11/20 0745

Depth to Water - Initial (DTWi) (ft) 15.78

Purge End Date/Time: 3/11/20 0815

Depth to Well Bottom (ft) 27.00

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~17.00 - 27.00~~ 16.64-26.64 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 22.00

Pump Start Time: 0745

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER- 15.78

APTIM

Sample Collection Log

Location ID: 16WW12 Sample No: 16WW12-2003 11

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	+10% 5.25		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/11/20	0750	100	.5	15.85	[redacted]	19.62	6.75	37.2	144	1.07
	0755	100	1.0	15.91	5.43	18.10	6.55	29.5	153	0.81
	0800	100	1.5	15.95	5.71	17.70	6.43	28.0	155	0.63
	0805	100	2.0	15.98	5.72	17.61	6.42	27.7	156	0.62
	0810	100	2.5	16.00	5.73	17.53	6.41	27.2	157	0.62
	0815	100	3.0	16.02	5.73	17.46	6.41	26.8	158	0.61

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW26**

Sampler(s): Scott Baesinger

FIELD CONDITIONS

Cloudy / Light Rain

SAMPLING INFORMATION

Sample No: 16WW26-200309 **DATE/TIME:** 3/9/20 1304 **Pump Inlet Depth:** 19.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Alkalinity by SM2320B	1 x 250 mL HPDE	Cool 4C
		ALSHT	Anions-Nitrate,Sulfate,Bromide by 9056	1 x 250 mL HPDE	Cool 4C
		ALSHT	Dissolved Gases in Water by RSK175	3 x 40 mL Glass	HCL<pH2
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2
		MI	DHC IN WATER CENSUS	1 x 1 L HDPE	Cool 4C

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Lowflow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/9/20 1320

Depth to Water - Initial (DTWi) (ft) 14.84

Purge End Date/Time: 3/9/20 1350

Depth to Well Bottom (ft) 21.85

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~16.50 - 21.50~~ 15.97-20.97 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 19.00

Pump Start Time: 1320

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER- 14.84

APTIM

Sample Collection Log

Location ID: 16WW26				Sample No: 16WW26-2003 09						
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/9/20	1325	100	.5	14.90	1.15	17.81	5.40	127	226	0.83
	1330	100	1.0	14.95	1.09	17.60	5.09	111	247	0.31
	1335	100	1.5	14.99	1.09	17.56	4.75	110	263	0.08
	1340	100	2.0	15.02	1.09	17.52	4.74	~~101~~ 109	264	0.08
	1345	100	2.5	15.04	1.09	17.47	4.73	108	265	0.07
↓	1350	100	3.0	15.05	1.09	17.45	4.72	108	266	0.07

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Sample Collection Log

APTIM

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW40**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16WW40-200310 **DATE/TIME:** 3/10/20 1302 **Pump Inlet Depth:** 12.00

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 2"

Purge Start Date/Time: 3/10/20 1315

Depth to Water - Initial (DTWi) (ft) 9.80

Purge End Date/Time: 3/10/20 1345

Depth to Well Bottom (ft) 17.50

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~7.00 – 17.00~~ 10.8-20.8 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 12.00

Pump Start Time: 1315

Ferrous Iron (Required Y or (N)) _____ mg/L

2ND DEPTH TO WATER - 9.80

APTIM

Sample Collection Log

Location ID: 16WW40 Sample No: 16WW40-200310

Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	1320	100	.5	9.88	6.71	20.12	6.44	162	70	0.81
	1325	100	1.0	9.93	6.77	20.07	6.31	147	79	0.35
	1330	100	1.5	9.96	6.76	20.06	6.31	144	79	0.07
	1335	100	2.0	9.98	6.75	20.04	6.30	143	79	0.07
	1340	100	2.5	10.00	6.75	20.02	6.30	142	78	0.07
	1345	100	3.0	10.02	6.75	20.00	6.30	141	78	0.06

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW42**

Sampler(s): Scott Beesinger

FIELD CONDITIONS CLEAR

SAMPLING INFORMATION

Sample No: 16WW42-20031610 **DATE/TIME:** 3/10/20 1110 **Pump Inlet Depth:** 9.90

Sampling Method: **Sample Purpose:** REG **Sample Matrix:** GW

Appearance of Sample **Assoc. QC Samples** **Decontamination Procedures**

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/BLADDER Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/10/20 1125

Depth to Water - Initial (DTWi) (ft) 4.02

Purge End Date/Time: 3/10/20 1200

Depth to Well Bottom (ft) 15.45

Discharge Tube Length: NA PID Reading: NA

Screen Interval (ft): ~~4.90 - 14.90~~ 6.57-16.57 FT BTOC

Discharge Tube Diameter: 1/4" Immersible Layer: Y (N)

L George 05/20/2020

Approximate depth of pump inlet*(ft): 9.90

Pump Start Time: 1125

Ferrous Iron (Required Y or (N) _____ mg/L

2ND DEPTH TO WATER - 4.02

APTIM

Sample Collection Log

Location ID: 16WW42		Sample No: 16WW42-2003 10								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	1130	100	.5	4.10	0.209	18.24	6.17	10.3	142	2.41
	1135	100	1.0	4.16	0.178	18.10	5.12	3.0	212	2.12
	1140	100	1.5	4.20	0.162	17.89	5.09	1.8	240	1.83
	1145	100	2.0	4.23	0.159	17.69	5.13	1.5	240	1.57
	1150	100	2.5	4.24	0.158	17.65	5.14	1.9	240	1.55
	1155	100	3.0	4.25	0.158	17.59	5.15	2.0	241	1.53
	1200	100	3.5	4.25	0.158	17.54	5.15	2.2	241	1.52

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

APTIM

Sample Collection Log

Project Name: **Longhorn AAP**

Project No: **501032**

Location ID: **16WW42**

Sampler(s): Scott Beesinger

FIELD CONDITIONS Clear

SAMPLING INFORMATION

Sample No: 16WW42-200310-FD **DATE/TIME:** 3/10/20 1110 **Pump Inlet Depth:** 9.90

Sampling Method: **Sample Purpose:** FD **Sample Matrix:** GW

Appearance of Sample	Assoc. QC Samples	Decontamination Procedures

Chain of Custody	COC Notes	Lab	Analyses	Container	Preserv
		ALSHT	Bromide by SW9056 (Water)	1 x 250 mL HDPE	Cool 4C
		ALSHT	Perchlorate in Water by 6850	1 x 125 mL HDPE	Cool 4C
		ALSHT	TOC in Water by SM5310	2 x 40 mL Amber	H2SO4
		ALSHT	VOCs in Water by 8260B	3 x 40 mL Glass	HCL<pH2

WELL AND PURGING INFORMATION

Measuring Point : Top of Casing

Purging Method/Equipment: Low flow/Bladder Pump

Casing ID (in.): 4"

Purge Start Date/Time: 3/10/20 1125

Depth to Water - Initial (DTWi) (ft) 4.02

Purge End Date/Time: 3/10/20 1200

Depth to Well Bottom (ft) 15.45

Discharge Tube Length: NA

PID Reading: NA

Screen Interval (ft): ~~4.90 - 14.90~~ 6.57-16.57 FT BTOC

Discharge Tube Diameter: 1/4"

Immersible Layer: Y / N

L George 05/20/2020

Approximate depth of pump inlet*(ft): 9.90

Pump Start Time: 1125

Ferrous Iron (Required Y or N) _____ mg/L

2nd Depth to water - 4.02

APTIM

Sample Collection Log

Location ID: 16WW42		Sample No: 16WW42-2003 10-FD								
Date of Reading	Time of Reading	Purge Rate	Total Purge	DTW	Cond.	Temp.	pH	Turbidity	ORP	DO
		(ml/min)	(L)	(ft)	(mS/cm)	(°C)		(NTU)	(mV)	(mg/L)
	Purge Stabilization Criteria	-	-	Drawdown limit 0.3 ft	±10%		±0.1 units	No criteria		± 10% or 0.2 mg/L
3/10/20	1130	100	.5	4.10	0.209	18.24	6.17	10.3	142	2.41
	1135	100	1.0	4.16	0.178	18.10	5.12	3.0	212	2.12
	1140	100	1.5	4.20	0.162	17.89	5.09	1.8	240	1.83
	1145	100	2.0	4.23	0.159	17.69	5.13	1.5	240	1.57
	1150	100	2.5	4.24	0.158	17.65	5.14	1.9	240	1.55
	1155	100	3.0	4.25	0.158	17.59	5.15	2.0	241	1.53
↓	1200	100	3.5	4.25	0.158	17.54	5.15	2.2	241	1.52

Logged by: _____ Date: _____

QC'd by: _____ Date: _____

Appendix D

Analytical Results

(Provided electronically in separate PDF on CD and Portal)

Appendix E

Quality Control Summary Report

APPENDIX E

QUALITY CONTROL SUMMARY REPORT

ACRONYMS AND ABBREVIATIONS

%	percent
%D	percent difference
ALS	ALS Environmental Laboratories
CCB	continuing calibration blank
DHC	Dehalococcoides
DoD	U.S. Department of Defense
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ICP	interference check sample
ISB	*in-situ* bioremediation
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LHAAP	Longhorn Army Ammunition Plant
LOQ	limit of quantitation
MS	matrix spike
MSD	matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
QAPP	Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant, Karnack Texas: Appendix A: Standard Operating Procedures and Appendix B: Basewide Uniform Federal Policy-Quality Assurance Project Plan
QC	quality control
QCSR	quality control summary report
QSM	Quality Systems Manual
RPD	relative percent difference
RRF	relative response factor
SDG	sample delivery group
SM	standard method
SOP	standard operating procedure
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1. QUALITY CONTROL SUMMARY REPORT

This Quality Control Summary Report (QCSR) describes the findings of the review of data for groundwater sampling activities conducted from October 9, 2018 through March 11, 2020, and is provided to document the quality of the analytical data used in the *Remedial Action Completion Report, LHAAP-16 Landfill, Longhorn Army Ammunition Plant, Karnack Texas*. Sampling procedures and overall quality control (QC) and quality assurance protocols for groundwater sampling are presented in the *Final Installation-Wide Work Plan for Longhorn Army Ammunition Plant, Karnack Texas (IWWP): Appendix A: Standard Operating Procedures and Appendix B: Basewide Uniform Federal Policy-Quality Assurance Project Plan (QAPP), U.S Army Corps of Engineer [USACE], May 8, 2018)*.

This QCSR focuses on the data quality and usability of the samples collected from the following sampling events:

- October 2018 Baseline Groundwater Sampling Event
- February and August 2019 Baseline Groundwater Sampling Events (new wells 16WW51, 16WW56, 16WW57, and 16WW58)
- September 2019 Baseline Groundwater Sampling Event
- October 2019 *in-situ* bioremediation (ISB) Performance Monitoring – Bayou Biobarrier
- November 2019 ISB Performance Monitoring – Mid Plume (Shallow Zone)
- November 2019 ISB Performance Monitoring – Landfill Biobarrier #1
- November 2019 ISB Performance Monitoring – Landfill Biobarrier #3
- December 2019 ISB Performance Monitoring – Mid Plume (Intermediate Zone)
- January 2020 ISB Performance Monitoring – Landfill Biobarrier #2
- October, November, and December 2019 bromide and total organic carbon (TOC) Sampling
- March 2020 Design Effectiveness

During the period from October 9, 2018, through March 11, 2020, groundwater samples were collected and submitted to the primary laboratory, ALS Environmental Laboratories (ALS) located in Houston, Texas. ALS in Houston performed all analyses in house with the exception of the following:

- TOC analysis was performed by ALS in Kelso, Washington, as well as Houston, Texas.
- Dissolved gases analysis was completed by ALS in Simi Valley, California, as wells as Houston, Texas.

- Perchlorate analysis was conducted by ALS in Salt Lake, Utah.
- Groundwater samples for Dehalococcoides (DHC) analysis were submitted to Microbial Insights Laboratory in Knoxville, Tennessee.

ALS Laboratories in all four locations are accredited by the U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) Version 5.1 and National Environmental Laboratory Accreditation Program (NELAP) in the State of Texas to perform the analyses throughout the project duration.

Groundwater and surface water samples from the 2018 and 2019 baseline sampling events were analyzed for one or more of the following lists of parameters:

- Volatile Organic Compounds (VOCs) – EPA Method 8260C
- Perchlorate – EPA Method 6850
- TOC – Standard Method (SM) 5310C
- Dissolved gases – RSK 175
- Anions – EPA Method 9056A
- Alkalinity – SM 2320B
- Metals – EPA Method 6020A
- DHC – Laboratory Standard Operating Procedure (SOP)

Groundwater samples from the remaining sampling events were analyzed for the following:

- TOC – SM 5310C
- Bromide – EPA Method 9056A

Specific analyses performed for each sample and for each sampling event are presented in **Appendix E Table 1**. All analytical results from October 2018 through March 2020 sampling activities were received in sample delivery groups (SDGs). **Appendix D** presents laboratory data packages. **Appendix E Table 1** (provided at the end of this report) summarizes SDG numbers, sample numbers, sample locations, sample collection dates, analysis methods, analysis dates, and laboratories. APTIM project chemists manually performed EPA Level III data review on 100% of the groundwater and surface water sample results. EPA Level III data review was performed in accordance with the guidelines and control criteria specified in the following documents:

- QAPP (USACE 2018)
- *DoD Quality Systems Manual for Environmental Laboratories, Version 5.1* (2017)

- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (2006), SW-846* (EPA, 1996 and updates)
- *Standard Methods for the Examination of Water and Wastewater (21st Edition)* (American Public Health Association et al., 2005)
- *USEPA Contract Laboratory Program, National Functional Guidelines for Organic Superfund Methods Data Review* (EPA, 2017)
- *USEPA Contract Laboratory Program*, *National Functional Guidelines for Inorganic Superfund Methods Data Review*, *Final* (EPA, 2017)

The following QC elements were included in the EPA Level III data review:

- Sample preservation and sample extraction and analysis holding times
- Laboratory method blanks
- Initial and continuing calibration blanks (metals, anions, TOC analyses only)
- Surrogate recoveries (organic analyses)
- Laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) recoveries
- Matrix spike (MS)/matrix spike duplicate (MSD) recoveries
- Relative percent differences (RPDs)
- Initial calibration and initial calibration verifications (ICVs)
- Continuing calibration verifications (CCVs)
- Inductively coupled plasma (ICP) interference check samples (ICS) (metal analysis only)
- ICP serial dilutions (metal analysis only)
- Field blanks

Analytical data were reviewed in terms of precision, bias, representativeness, comparability, and completeness as follows:

- *Bias* is demonstrated by recovery of target analytes from fortified blank and sample matrices, LCS/LCSD, and MS/MSD, respectively. For organic methods, bias is also demonstrated through recovery of surrogates from each field and QC sample. The recovery of target analytes from fortified samples is compared with the acceptance criteria defined in the QAPP (USACE, 2018) and DoD Quality Systems Manual (QSM). When the acceptance criteria are not available in the QAPP or DoD QSM, results are compared with the laboratory in-house control limits. When these criteria are not met, the data are qualified accordingly.

- *Precision* is expressed as the RPD between the results of replicate sample analyses: sample duplicates, LCSDs, and MSDs. When analyte RPDs exceed the acceptance criteria, the data are qualified accordingly.
- *Representativeness* of the samples submitted for analysis is ensured by adherence to standard sampling techniques and protocols.
- *Comparability* of sample results is ensured through the use of approved sampling and analysis methods.
- *Completeness* is expressed as a ratio of the number of usable data points to the total number of analytical data results.

The following sections present the EPA Level III data review findings. The discussion summarizes data quality exceedances and their potential impact on the quality and usability of analytical results. **Appendix E Table 2** presents definitions of data qualification. **Appendix E Table 3** summarizes the qualified data.

1.1 Data Quality Outliers

1.1.1 Sample Preservation and Sample Extraction and Analysis Holding Times (Reason Codes 02, 02A, and 02B)

The sample coolers and samples contained within were received intact at the laboratory and were held within the required 0 to 6 degrees Celsius, and when required, were chemically preserved in accordance with EPA and SM preservation requirements.

Sample holding times were evaluated by comparing the sample collection dates to the sample extraction and analysis dates. Extraction and analysis holding times were reviewed for all samples to determine the validity of the sample results. Analysis holding time requirements were achieved for all samples and for all analyses.

1.1.2 Laboratory Method Blanks (Reason Code 06A)

The field sample results were evaluated with respect to the laboratory method blank prepared and analyzed for each analytical batch and for each analytical method. Positive analyte detections in a laboratory method blank were observed. Specific contaminants, analytical method, the detected levels, and the limits of quantitation (LOQs) are summarized as follows:

SDG Number	Analytical Method	Laboratory QC Batch No.	Contaminant	Contaminant Level (mg/L)	LOQ (mg/L)
HS19111080/K1911032	SM5310C	K1911032MB2	TOC	0.14	0.5

Notes:

LOQ limit of quantitation
mg/L milligrams per liter
No. number
SDG sample delivery group
TOC total organic carbon

Based on the DoD QSM requirements (2017), laboratory method blank concentrations are considered acceptable when contaminant levels in the blank are less than one-half the LOQ for target analytes and less than the LOQ for common laboratory contaminants, such as acetone and methylene chloride. As indicated in the preceding table, the laboratory method blank level was below one-half the LOQ, and thus met the blank acceptance criteria.

The low level laboratory method blank detection did not affect the sample results as the concentrations of TOC in all samples associated with the blank far exceeded five times the blank level. No data qualification was applied to the results of any TOC samples. Except where noted, all laboratory method blanks were free of contaminants for VOCs, perchlorate, anions, dissolved gases, metals, alkalinity, and DHC analyses.

1.1.3 Initial and Continuing Calibration Blanks (Reason Code 06B)

In addition to the laboratory method blanks for anions, TOC and metals analyses, initial and continuing calibration blank (CCB) results were reviewed to ensure that the instrument was free of contamination prior to the analysis. All initial and continuing calibration blanks were free of contaminants with the exception of the following:

SDG Number	Analytical Method	Laboratory QC Batch No.	Contaminant	Contaminant Level (mg/L)	LOQ (mg/L)
HS19111065/K1911033	SM5310C	CCB3	TOC	0.23	0.5
HS19111080/K1911032	SM5310C	CCB3	TOC	0.23	0.5
HS19111080/K1911032	SM5310C	CCB5	TOC	0.23	0.5

Notes:

LOQ limit of quantitation
mg/L milligrams per liter
No. number

SDG *sample delivery group*
TOC *total organic carbon*

As presented above, the continuing calibration blank levels for TOC were reported slightly below one-half the LOQ and met the DoD QSM blank acceptance criteria. The concentrations of TOC in all samples associated with the calibration blanks were greater than five times the blank levels, and therefore were not affected by the blank detections. No data qualification was applied to any results due to the low level calibration blank detections. Except for TOC, all other calibration blanks were free of anions and metals.

1.1.4 Surrogate Recoveries (Reason Codes 07, 07A, and 07B)

Surrogate standards are organic compounds added to field and laboratory QC samples for organic analysis to evaluate the matrix effect and method performance on an individual sample basis. Prior to analysis, surrogates 1,2-dichloroethane-d4, 4-bromofluorobenzene, dibromofluoromethane, and toluene-d8 were spiked into all samples analyzed for VOCs. The surrogates in all samples were recovered within the accuracy specifications.

1.1.5 Laboratory Control Sample/Laboratory Control Sample Duplicate Recoveries and Precisions (Reason Codes 11, 11A, and 11B)

The LCS is an aliquot of analyte-free matrix spiked with target analytes that is prepared with each analytical batch for each analytical method. The recovery of target analytes from the LCS analysis is a measurement of method performance in an interference-free sample matrix. The review indicated that LCS recoveries and precisions met the established QC requirements for VOCs, perchlorate, metals, anions, TOC, dissolved gases, alkalinity, and DHC analyses.

In addition to the LCS analysis, the laboratory performed sample duplicate analysis on project-specific groundwater samples to assess precisions of sample results. The laboratory duplicate analysis was performed for LHAAP-16 samples submitted for alkalinity, anions, dissolved gases, and TOC analyses. Non-compliant laboratory duplicate precisions were noted for TOC analysis, as summarized below:

SDG Number	Analytical Method	Duplicate Sample ID	Laboratory RPD Outlier (%)	RPD Control Limit (%)	Data Qualification
HS19111065/K1911033	SM5310C	16RW02-191119	31	10	J
HS19111065/K1911033	SM5310C	16RW03-191119	11	10	J

As a result of the laboratory duplicate precision outliers, results of TOC in the affected samples were qualified as estimated (J). There is no impact on the data usability due to the minor precision outliers. Acceptable precision results were reported for alkalinity, anions, and dissolved gases analyses.

1.1.6 Matrix Spike/Matrix Spike Duplicate Recoveries and Precisions (Reason Codes 08, 08A, and 08B)

The MS and MSD samples are a portion of a field sample spiked with target analytes that are prepared with each analytical batch and with each method. The MS/MSD results are used to evaluate any bias introduced to the method due to matrix interference, and to measure bias and precision for each analytical batch.

In accordance with the QAPP requirements (USACE, 2018), the MS/MSD samples are to be collected at a rate of 1 per 20 samples or 5%. During each groundwater sampling event, 5% MS/MSD samples were collected achieving the MS/MSD sample frequency requirement. In addition, the laboratory performed MS/MSD analysis on LHAAP-16 samples to achieve laboratory internal QC requirements. The following site-specific groundwater samples were spiked for MS/MSD analysis:

SDG Number	Sample Number	Sample Date	MS/MSD Analysis
HS18100492	16WW24-181009	10/9/2018	VOCs, anions, perchlorate, TOC, and dissolved gases
HS18100548	16WW31-181010	10/10/2018	VOCs and perchlorate
HS18100548	16WW16-181010	10/10/2018	TOC
HS18100725	16WW32-181011	10/11/2018	Perchlorate
HS18100726	16SW01-181011	10/11/2018	VOCs and metals
HS18100726	16SW02-181011	10/11/2018	Perchlorate
HS18100726	16SW03-181011	10/11/2018	Perchlorate
HS18100727	16WW40-181012	10/12/2018	VOCs, Bromide
HS18100823	16WW29-181015	10/15/2018	TOC
HS19020335	16WW56-190206	2/6/2019	TOC
HS19080827	16WW57-190815	8/15/2019	VOC
HS19090860	16WW14-190916	9/16/2019	VOC
HS19090962	16WW57-190918	9/18/2019	VOC, dissolved gases, TOC, and anions
HS19090962	16WW29-190918	9/18/2019	VOC, perchlorate
HS19090964	16WW49-190918	9/18/2019	VOC
HS19090964	16WW58-190919	9/19/2019	Perchlorate and TOC

HS19101353	16WW22-191022	10/22/2019	Bromide and TOC
HS19101488	16WW40-191022	10/22/2019	Bromide and TOC
HS19110026	16EW06-Event2-191031	10/31/2019	Bromide
HS19110484	16WW06-191108	11/8/2019	Bromide and TOC
HS19111065	16WW42-191109	11/9/2019	Bromide and TOC
HS19111080	16RW-191120	11/20/2019	Bromide
HS19120309	16WW11-191205	12/5/2019	Bromide and TOC
HS19120336	16WW12B-191206	12/6/2019	Bromide
HS19120208	16WW11-191208	12/8/2019	TOC
HS19120673	16EW11-191212	12/12/2029	Bromide and TOC
HS19121313	16EW07-191213	12/13/2019	Bromide and TOC
HS19121088	16EW11-191218	12/18/2019	Bromide and TOC
HS20011144	16WW36-200123	1/23/2020	Bromide and TOC
HS20030390	16RW04-200309	3/9/2020	Bromide
HS20030472	16PM06-200310	3/10/2020	TOC
HS20030502	16RW09-200311	3/11/2020	Bromide and TOC

The majority of the MS results met the established bias and precision requirements; however, MS recovery biases were observed for dissolved gases and TOC analyses, which are summarized as follows:

SDG Number	Analytical Method	Spiked Sample	MS Recovery Outlier (%)	MS Recovery Control Limit (%)	Data Qualification
HS18100492	RSK 175	16WW24-181009	Ethene: 158/151	72-133	J
HS20011144 / K2000749	SM5310C	16WW36-200123	TOC: -78	83-117	J

As presented above, the reported MS and MSD recoveries for ethene exceeded the upper control limit; however, the precision between the MS and MSD recoveries met the acceptance criteria. The high biased MS and MSD recoveries led to qualification of the detected results for ethene as estimated (J). Due to suspected matrix interference, no recoveries were reported for TOC in the spiked sample 16WW36. TOC in the spiked sample was detected and the detected result was consequently qualified as estimated (J). This data qualification was applied to the results of the listed analytes in the spiked samples only. It should be noted that the LCS results associated with the non-compliant batches met the bias and precision

control criteria, which demonstrated that acceptable batch bias and precision were achieved for dissolved gases and TOC analyses.

In addition to above, the parent concentrations of VOCs and anions in a few spiked samples exceeded four times their respective spiked levels. The elevated sample concentrations produced matrix interference, which affected the accuracy of the MS analysis. Because the parent concentrations were greater than four times the spiked levels, no data qualification was applied to the results of VOCs and anions.

Except as noted, the MS precision and bias results were acceptable for all other analyses.

1.1.7 Initial Calibration (Reason Codes 04, 04A, and 04B)

Instrument calibration is performed for VOCs, dissolved gases, perchlorate, metals, anions, and TOC analyses according to the EPA method requirements (EPA, 1996). The linear analytical range is established for each method by analysis of calibration standards prepared at increasing concentrations that cover the expected sample concentrations. The acceptability of the initial calibration is determined by calculation of a percent relative standard deviation or coefficient. The initial calibration results were acceptable for all the listed analyses.

Immediately after the initial calibration for each analysis, initial calibration verification was conducted at the mid-point of instrument calibration range by using a second-source calibration standard to verify the accuracy of the initial calibration. The review indicated acceptable initial calibration verification results for all analyses.

1.1.8 Continuing Calibration Verification (Reason Codes 05, 05A, and 05B)

Routinely during sample analysis, the stability of the analytical system is monitored by analysis of continuing calibration standards at concentrations near the mid-point of the instrument calibration range. The percent difference (%D) values between the relative response factor (RRF) in the initial calibration and the RRF in the continuing calibration met the calibration requirements for all analyses.

1.1.9 Interference Check Samples (Reason Code 12)

The ICS verifies the inter-element and background correction factors. An ICS was analyzed at the required frequencies, and all ICS results were within the established control limit for metals analysis for the October 2018 baseline sampling event.

1.1.10 ICP Serial Dilutions (Reason Code 13)

The ICP serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. When the concentration of an analyte exceeds 50 times the method detection limit (MDL), an ICP serial dilution is performed at a five-fold dilution and the results between the original analysis and the diluted analysis are compared. The results of the ICP serial dilution are deemed acceptable when a percent difference between the original analysis and the diluted analysis is less than or equal to 10%. The ICP serial dilution results met the accuracy goal for all samples and for all metals.

1.1.11 Trip Blanks (Reason Code 06D)

Trip blanks were prepared by the laboratory and stored with the groundwater and surface water samples collected for VOCs analysis. One trip blank was submitted per cooler containing VOCs samples. No VOCs were detected in any of trip blanks. Therefore, the trip blank results were acceptable and demonstrated that valid sample storage and shipping procedures were implemented.

1.1.12 Field Duplicates

In accordance with the QAPP requirements (USACE, 2018), field duplicate samples are to be collected at a minimum rate of 10% of the total number of groundwater samples. Field duplicate samples are evaluated by calculating the RPD between the parent sample and its duplicate. The RPD is calculated using the following equation:

$$RPD = |(S-D)/[(S+D)/2]| x\ 100$$

Where:

S = sample result

D = duplicate result

Acceptable precision control criteria are established at less than or equal to 30% for water samples. The RPD is calculated between pairs of field duplicate samples when both results are reported at or above the LOQ.

A total of 15 field duplicates were collected from the period of October 9, 2018, through March 11, 2020. Field duplicates were collected using the same sampling technique and analyzed for the same analytical parameters as their associated parent samples, **Appendix E Table 4** presents the field duplicate results. With the exception of the RPD result for methane for a field duplicate pair (16WW24-181009) from the October 2018 baseline sampling event, the field RPDs for all detected pairs ranged from 0 to 18.77% achieving the 30% precision goal for all analyses. The field RPD for methane was calculated at 65.85%

for the field duplicate pair (16WW24-181009) and was outside the field precision requirement. The field RPD outlier does not affect the data usability of the methane results as other QC elements, such as laboratory method blanks, holding time, LCS accuracy and precision and calibrations for the affected duplicate pair, were within the acceptance criteria. Overall, the field duplicate results demonstrated acceptable field sampling and analytical precision for all methods.

1.2 Completeness

The following sections present a discussion of technical completeness for the LHAAP-16 groundwater and surface water sampling events. Completeness results are calculated for groundwater, surface water and field duplicate samples that are used for project decisions. Completeness results are not calculated for trip blanks. Completeness results are presented in **Appendix E Table 5**.

1.2.1 Technical Completeness

Technical completeness is a quantitative measure of the data usability based on the number of rejected data compared to the total number of sample results. The technical completeness goal for each method is equal to or greater than 95%. The technical completeness calculation considers all data that are not rejected to be usable. The technical completeness is calculated as follows:

$$\% \text{ Technical Completeness} = \frac{\text{Number of Usable Results}}{\text{Total Number of Results}} \times 100$$

As discussed in the previous sections, results of TOC and dissolved gases were qualified as estimated (J) due to non-compliant sample duplicate precisions or MS and MSD recoveries; however, these data quality exceedances did not affect the data usability. The technical completeness was 100% for all methods for the LHAAP-16 groundwater and surface sampling activities, exceeding the 95% technical completeness objective. Therefore, the project data quality objectives were achieved for all methods for the LHAAP-16 groundwater and surface water sampling events.

1.3 Representativeness and Comparability

During sampling, samplers followed the approved QAPP requirements (USACE, 2018) and established sampling SOPs to collect, preserve, document, and ship samples to off-site laboratories, thus ensuring the representativeness of the groundwater and surface water samples collected for the sampling events.

Upon sample receipt, the laboratory reviewed sample conditions to ensure that sample containers, preservatives (when applicable), and requested analyses matched the chain-of-custody requirements.

Discrepancies between the chain-of-custody forms and sample containers were brought to the attention of the APTIM project chemist and resolved prior to sample analysis.

ALS Laboratories are DoD and NELAP certified and adhered to the most current EPA Methods, QAPP (USACE, 2018), and DoD QSM (2017) requirements to prepare, analyze, and report the data. This ensures the comparability of the analytical results between different samples and different sampling events. APTIM project chemists performed EPA Level III data validation on 100% of the analytical data obtained from the October 2018 through March 2020 sampling events to verify that the laboratories complied with the DoD QSM, QAPP, and method requirements. Analytical results that were outside the established QC requirements were qualified and the data quality and usability were discussed in the previous sections. Based on a review of the chain-of-custody forms, sample receipt forms, and laboratory data packages, the analytical data reported for LHAAP-16 sampling events has met the comparability requirements.

1.4 Summary

The analytical data has been reviewed for precision, bias, representativeness, comparability, and completeness. Data quality exceedances consisted of non-compliant laboratory duplicate precisions, low-level laboratory method blank and calibration blank contamination, and MS and MSD recoveries. The affected results were qualified as estimated (J). In all cases, the degree of these data quality exceedances was considered minor and the data usability was not affected. The 95% technical completeness goal was exceeded for all methods for all the sampling events. All data are usable for their intended purposes.

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TABLES

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Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS18100492	16 BASELINE OCT 2018	16TB01-181009	FIELDQC	10/09/2018	TB	SW8260	10/16/2018	ALSHT
043PJ	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	SW8260	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16WW43-181009	16WW43	10/09/2018	REG	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	SW8260	10/18/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16WW26-181009	16WW26	10/09/2018	REG	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	SW8260	10/18/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16WW41-181009	16WW41	10/09/2018	REG	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	SW8260	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16WW25-181009	16WW25	10/09/2018	REG	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	SW8260	10/18/2018	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS18100492	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16EW02-181009	16EW02	10/09/2018	REG	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	SW6850	10/17/2018	ALSS
1828552	16 BASELINE OCT 2018	16WW24-181009-FD	16WW24	10/09/2018	FD	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	SW8260	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	SW9056	10/11/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009-FD	16WW24	10/09/2018	FD	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009-FD	16WW24	10/09/2018	FD	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009-FD	16WW24	10/09/2018	FD	SW8260	10/18/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW24-181009-FD	16WW24	10/09/2018	FD	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16WW24-181009	16WW24	10/09/2018	REG	SM5310	10/18/2018	ALS
K1809960	16 BASELINE OCT 2018	16WW24-181009-FD	16WW24	10/09/2018	FD	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	SW8260	10/19/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16WW36-181009	16WW36	10/09/2018	REG	SM5310	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	CENSUS	10/23/2018	MI
1828552	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	SW6850	10/17/2018	ALSS
HS18100492	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	RSK-175	10/16/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	SM2320B	10/12/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	SW8260	10/18/2018	ALSHT
HS18100492	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	SW9056	10/11/2018	ALSHT
K1809960	16 BASELINE OCT 2018	16EW06-181009	16EW06	10/09/2018	REG	SM5310	10/18/2018	ALS
HS18100548	16 BASELINE OCT 2018	16TB02-181010	FIELDQC	10/10/2018	TB	SW8260	10/18/2018	ALSHT
1828822	16 BASELINE OCT 2018	16WW38-181010	16WW38	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW38-181010	16WW38	10/10/2018	REG	SW8260	10/19/2018	ALSHT
1828822	16 BASELINE OCT 2018	16WW44-181010	16WW44	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW44-181010	16WW44	10/10/2018	REG	SW8260	10/18/2018	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
1828822	16 BASELINE OCT 2018	16WW33-181010	16WW33	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW33-181010	16WW33	10/10/2018	REG	SW8260	10/18/2018	ALSHT
1828822	16 BASELINE OCT 2018	16WW37-181010	16WW37	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW37-181010	16WW37	10/10/2018	REG	SW8260	10/18/2018	ALSHT
1828822	16 BASELINE OCT 2018	16WW45-181010	16WW45	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW45-181010	16WW45	10/10/2018	REG	SW8260	10/18/2018	ALSHT
1828822	16 BASELINE OCT 2018	16WW14-181010	16WW14	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW14-181010	16WW14	10/10/2018	REG	SW8260	10/18/2018	ALSHT
1828822	16 BASELINE OCT 2018	16WW34-181010	16WW34	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW34-181010	16WW34	10/10/2018	REG	SW8260	10/18/2018	ALSHT
043PJ	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	CENSUS	10/23/2018	MI
1828822	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	RSK-175	10/18/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	SM2320B	10/16/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	SW8260	10/19/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	SW9056	10/11/2018	ALSHT
K1810021	16 BASELINE OCT 2018	16WW35-181010	16WW35	10/10/2018	REG	SM5310C	10/18/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	CENSUS	10/23/2018	MI
1828822	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	RSK-175	10/18/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	SM2320B	10/16/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	SW8260	10/19/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	SW9056	10/11/2018	ALSHT
K1810021	16 BASELINE OCT 2018	16WW16-181010	16WW16	10/10/2018	REG	SM5310C	10/18/2018	ALS
1828822	16 BASELINE OCT 2018	16WW31-181010	16WW31	10/10/2018	REG	SW6850	10/19/2018	ALSS
1828822	16 BASELINE OCT 2018	16WW31-181010-FD	16WW31	10/10/2018	FD	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW31-181010	16WW31	10/10/2018	REG	SW8260	10/18/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW31-181010-FD	16WW31	10/10/2018	FD	SW8260	10/19/2018	ALSHT
043PJ	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	CENSUS	10/23/2018	MI
1828822	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	RSK-175	10/18/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	SM2320B	10/16/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	SW8260	10/19/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	SW9056	10/11/2018	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
K1810021	16 BASELINE OCT 2018	16WW22-181010	16WW22	10/10/2018	REG	SM5310C	10/18/2018	ALS
1828822	16 BASELINE OCT 2018	16WW39-181010	16WW39	10/10/2018	REG	SW6850	10/19/2018	ALSS
HS18100548	16 BASELINE OCT 2018	16WW39-181010	16WW39	10/10/2018	REG	SW8260	10/19/2018	ALSHT
HS18100548	16 BASELINE OCT 2018	16WW39-181010	16WW39	10/10/2018	REG	SW9056	10/11/2018	ALSHT
HS18100725	16 BASELINE OCT 2018	16TB03-181011	FIELDQC	10/11/2018	TB	SW8260	10/19/2018	ALSHT
1828987	16 BASELINE OCT 2018	16WW32-181011	16WW32	10/11/2018	REG	SW6850	10/24/2018	ALSS
HS18100725	16 BASELINE OCT 2018	16WW32-181011	16WW32	10/11/2018	REG	SW8260	10/19/2018	ALSHT
HS18100725	16 BASELINE OCT 2018	16EW05-181011	16EW05	10/11/2018	REG	SW9056	10/17/2018	ALSHT
HS18100726	16 BASELINE SW OCT 2018	16TB04-181011	FIELDQC	10/11/2018	TB	SW8260	10/19/2018	ALSHT
1828988	16 BASELINE SW OCT 2018	16SW01-181011-FD	16SW01	10/11/2018	FD	SW6850	10/24/2018	ALSS
HS18100726	16 BASELINE SW OCT 2018	16SW01-181011-FD	16SW01	10/11/2018	FD	SW6020	10/24/2018	ALSHT
HS18100726	16 BASELINE SW OCT 2018	16SW01-181011-FD	16SW01	10/11/2018	FD	SW8260	10/19/2018	ALSHT
1828988	16 BASELINE SW OCT 2018	16SW01-181011	16SW01	10/11/2018	REG	SW6850	10/24/2018	ALSS
HS18100726	16 BASELINE SW OCT 2018	16SW01-181011	16SW01	10/11/2018	REG	SW6020	10/24/2018	ALSHT
HS18100726	16 BASELINE SW OCT 2018	16SW01-181011	16SW01	10/11/2018	REG	SW8260	10/19/2018	ALSHT
1828988	16 BASELINE SW OCT 2018	16SW02-181011	16SW02	10/11/2018	REG	SW6850	10/24/2018	ALSS
HS18100726	16 BASELINE SW OCT 2018	16SW02-181011	16SW02	10/11/2018	REG	SW6020	10/24/2018	ALSHT
HS18100726	16 BASELINE SW OCT 2018	16SW02-181011	16SW02	10/11/2018	REG	SW8260	10/19/2018	ALSHT
1828988	16 BASELINE SW OCT 2018	16SW03-181011	16SW03	10/11/2018	REG	SW6850	10/24/2018	ALSS
HS18100726	16 BASELINE SW OCT 2018	16SW03-181011	16SW03	10/11/2018	REG	SW6020	10/24/2018	ALSHT
HS18100726	16 BASELINE SW OCT 2018	16SW03-181011	16SW03	10/11/2018	REG	SW8260	10/19/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16TB05-181012	FIELDQC	10/12/2018	TB	SW8260	10/19/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW30-181012	16WW30	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW30-181012	16WW30	10/12/2018	REG	SW8260	10/19/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW30-181012	16WW30	10/12/2018	REG	SW9056	10/17/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW46-181012	16WW46	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW46-181012	16WW46	10/12/2018	REG	SW8260	10/19/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW23-181012	16WW23	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW23-181012	16WW23	10/12/2018	REG	SW8260	10/19/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW40-181012	16WW40	10/12/2018	REG	SW6850	10/24/2018	ALSS
1828989	16 BASELINE OCT 2018	16WW40-181012-FD	16WW40	10/12/2018	FD	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW40-181012	16WW40	10/12/2018	REG	SW8260	10/19/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW40-181012	16WW40	10/12/2018	REG	SW9056	10/17/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW40-181012-FD	16WW40	10/12/2018	FD	SW8260	10/19/2018	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS18100727	16 BASELINE OCT 2018	16WW40-181012-FD	16WW40	10/12/2018	FD	SW9056	10/17/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW27-181012	16WW27	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW27-181012	16WW27	10/12/2018	REG	SW8260	10/20/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW12-181012	16WW12	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW12-181012	16WW12	10/12/2018	REG	SW8260	10/19/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW12-181012	16WW12	10/12/2018	REG	SW9056	10/17/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW42-181012	16WW42	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW42-181012	16WW42	10/12/2018	REG	SW8260	10/19/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW42-181012	16WW42	10/12/2018	REG	SW9056	10/17/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW13-181012	16WW13	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW13-181012	16WW13	10/12/2018	REG	SW8260	10/19/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW13-181012	16WW13	10/12/2018	REG	SW9056	10/17/2018	ALSHT
1828989	16 BASELINE OCT 2018	16WW21-181012	16WW21	10/12/2018	REG	SW6850	10/24/2018	ALSS
HS18100727	16 BASELINE OCT 2018	16WW21-181012	16WW21	10/12/2018	REG	SW8260	10/20/2018	ALSHT
HS18100727	16 BASELINE OCT 2018	16WW21-181012	16WW21	10/12/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW08-181013	16EW08	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW07-181013	16EW07	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW15-181013	16EW15	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW11-181013	16EW11	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW14B-181013	16EW14B	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW12B-181013	16EW12B	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16EW13-181013	16EW13	10/13/2018	REG	SW9056	10/17/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16TB06-181015	FIELDQC	10/15/2018	TB	SW8260	10/23/2018	ALSHT
043PJ	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	CENSUS	10/23/2018	MI
1829115	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	SW6850	10/24/2018	ALSS
HS18100823	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	RSK-175	10/18/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	SM2320B	10/18/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	SW8260	10/23/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	SW9056	10/17/2018	ALSHT
K1810155	16 BASELINE OCT 2018	16WW29-181015	16WW29	10/15/2018	REG	SM5310C	10/30/2018	ALS
043PJ	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	CENSUS	10/23/2018	MI
1829115	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	SW6850	10/24/2018	ALSS
HS18100823	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	RSK-175	10/18/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	SM2320B	10/18/2018	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS18100823	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	SW8260	10/23/2018	ALSHT
HS18100823	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	SW9056	10/17/2018	ALSHT
K1810155	16 BASELINE OCT 2018	16WW55-181015	16WW55	10/15/2018	REG	SM5310C	10/30/2018	ALS
HS18101079	16 BASELINE OCT 2018	16TB07-101018	FIELDQC	10/18/2018	TB	SW8260	10/23/2018	ALSHT
043PJ	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	CENSUS	10/23/2018	MI
1829552	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	SW6850	10/25/2018	ALSS
HS18101079	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	RSK-175	10/25/2018	ALSHT
HS18101079	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	SM2320B	10/20/2018	ALSHT
HS18101079	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	SW8260	10/24/2018	ALSHT
HS18101079	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	SW9056	10/19/2018	ALSHT
K1810282	16 BASELINE OCT 2018	16WW48-181018	16WW48	10/18/2018	REG	SM5310C	10/30/2018	ALS
1904012	16 BASELINE (NEW) FEB 2019	16WW51-190206	16WW51	02/06/2019	REG	SW6850	02/19/2019	ALSS
HS19020335	16 BASELINE (NEW) FEB 2019	16WW51-190206	16WW51	02/06/2019	REG	SW8260	02/12/2019	ALSHT
HS19020335	16 BASELINE (NEW) FEB 2019	16WW51-190206	16WW51	02/06/2019	REG	SW9056	02/21/2019	ALSHT
017QB	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	CENSUS	02/14/2019	MI
1904012	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	SW6850	02/19/2019	ALSS
HS19020335	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	RSK-175	02/15/2019	ALSHT
HS19020335	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	SM2320B	02/16/2019	ALSHT
HS19020335	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	SW8260	02/12/2019	ALSHT
HS19020335	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	SW9056	02/07/2019	ALSHT
K1901286	16 BASELINE (NEW) FEB 2019	16WW56-190206	16WW56	02/06/2019	REG	SM5310C	02/19/2019	ALS
HS19080827	16 BASELINE (NEW) AUG 2019	FIELDQC-190815-TB1	FIELDQC	08/15/2019	TB	SW8260	08/20/2019	ALSHT
1923490	16 BASELINE (NEW) AUG 2019	16WW57-190815	16WW57	08/15/2019	REG	SW6850	08/20/2019	ALSS
HS19080827	16 BASELINE (NEW) AUG 2019	16WW57-190815	16WW57	08/15/2019	REG	SW8260	08/20/2019	ALSHT
1923490	16 BASELINE (NEW) AUG 2019	16WW58-190815	16WW58	08/15/2019	REG	SW6850	08/20/2019	ALSS
1923490	16 BASELINE (NEW) AUG 2019	16WW58-190815-FD	16WW58	08/15/2019	FD	SW6850	08/20/2019	ALSS
HS19080827	16 BASELINE (NEW) AUG 2019	16WW58-190815	16WW58	08/15/2019	REG	SW8260	08/20/2019	ALSHT
HS19080827	16 BASELINE (NEW) AUG 2019	16WW58-190815-FD	16WW58	08/15/2019	FD	SW8260	08/20/2019	ALSHT
HS19090860	16 BASELINE SEP 2019	16LHAAP-TB1-190916	FIELDQC	09/16/2019	TB	SW8260	09/25/2019	ALSHT
HS19090860	16 BASELINE SEP 2019	16LHAAP-TB2-190916	FIELDQC	09/16/2019	TB	SW8260	09/25/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW14-190916	16WW14	09/16/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW14-190916	16WW14	09/16/2019	REG	SW8260	09/24/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW16-190916	16WW16	09/16/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW16-190916	16WW16	09/16/2019	REG	SW8260	09/24/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
1927207	16 BASELINE SEP 2019	16WW36-190916	16WW36	09/16/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW36-190916	16WW36	09/16/2019	REG	SW8260	09/25/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW42-190916	16WW42	09/16/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW42-190916	16WW42	09/16/2019	REG	SW8260	09/25/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW22-190917	16WW22	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW22-190917	16WW22	09/17/2019	REG	SW8260	09/24/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW27-190917	16WW27	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW27-190917	16WW27	09/17/2019	REG	SW8260	09/25/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW41-190917	16WW41	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW41-190917	16WW41	09/17/2019	REG	SW8260	09/25/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW39-190917	16WW39	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW39-190917	16WW39	09/17/2019	REG	SW8260	09/27/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW43-190917	16WW43	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW43-190917	16WW43	09/17/2019	REG	SW8260	09/24/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW56-190917	16WW56	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW56-190917	16WW56	09/17/2019	REG	SW8260	09/24/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW23-190917	16WW23	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW23-190917	16WW23	09/17/2019	REG	SW8260	09/24/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW40-190917	16WW40	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW40-190917	16WW40	09/17/2019	REG	SW8260	09/27/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW55-190917	16WW55	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW55-190917	16WW55	09/17/2019	REG	SW8260	09/25/2019	ALSHT
1927207	16 BASELINE SEP 2019	16WW24-190917	16WW24	09/17/2019	REG	SW6850	09/25/2019	ALSS
HS19090860	16 BASELINE SEP 2019	16WW24-190917	16WW24	09/17/2019	REG	SW8260	09/25/2019	ALSHT
1927216	16 BASELINE SEP 2019	16WW26-190917	16WW26	09/17/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW26-190917	16WW26	09/17/2019	REG	SW8260	09/27/2019	ALSHT
HS19090962	16 BASELINE SEP 2019	16LHAAP-TB-5-190918	FIELDQC	09/18/2019	TB	SW8260	09/26/2019	ALSHT
HS19090962	16 BASELINE SEP 2019	16LHAAP-TB3-190918	FIELDQC	09/18/2019	TB	SW8260	09/25/2019	ALSHT
1927216	16 BASELINE SEP 2019	16WW13-190918	16WW13	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW13-190918	16WW13	09/18/2019	REG	SW8260	09/27/2019	ALSHT
1927216	16 BASELINE SEP 2019	16WW12-190918	16WW12	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW12-190918	16WW12	09/18/2019	REG	SW8260	09/27/2019	ALSHT
1927216	16 BASELINE SEP 2019	16WW35-190918	16WW35	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW35-190918	16WW35	09/18/2019	REG	SW8260	09/26/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
1927216	16 BASELINE SEP 2019	16WW30-190918	16WW30	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW30-190918	16WW30	09/18/2019	REG	SW8260	09/27/2019	ALSHT
1927216	16 BASELINE SEP 2019	16WW29-190918	16WW29	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW29-190918	16WW29	09/18/2019	REG	SW8260	09/27/2019	ALSHT
1927216	16 BASELINE SEP 2019	16EW06-190918	16EW06	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16EW06-190918	16EW06	09/18/2019	REG	SW8260	09/26/2019	ALSHT
076QI	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	CENSUS	09/27/2019	MI
1927220	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	SW6850	10/01/2019	ALSS
1927220	16 BASELINE SEP 2019	16WW58-190918-FD	16WW58	09/18/2019	FD	SW6850	10/01/2019	ALSS
HS19090964	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	RSK-175	09/25/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	SM2320B	09/21/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	SW8260	09/29/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	SW9056	09/26/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918-FD	16WW58	09/18/2019	FD	RSK-175	09/25/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918-FD	16WW58	09/18/2019	FD	SM2320B	09/21/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918-FD	16WW58	09/18/2019	FD	SW8260	09/29/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW58-190918-FD	16WW58	09/18/2019	FD	SW9056	09/26/2019	ALSHT
K1908781	16 BASELINE SEP 2019	16WW58-190918	16WW58	09/18/2019	REG	SM5310C	09/26/2019	ALS
K1908781	16 BASELINE SEP 2019	16WW58-190918-FD	16WW58	09/18/2019	FD	SM5310C	09/26/2019	ALS
1927216	16 BASELINE SEP 2019	16EW02-190918	16EW02	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16EW02-190918	16EW02	09/18/2019	REG	SW8260	09/26/2019	ALSHT
076QI	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	CENSUS	09/27/2019	MI
1927216	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	RSK-175	09/25/2019	ALSHT
HS19090962	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	SM2320B	09/21/2019	ALSHT
HS19090962	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	SW8260	09/26/2019	ALSHT
HS19090962	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	SW9056	09/20/2019	ALSHT
K1908780	16 BASELINE SEP 2019	16WW57-190918	16WW57	09/18/2019	REG	SM5310C	09/26/2019	ALS
1927216	16 BASELINE SEP 2019	16WW26-190917-FD	16WW26	09/18/2019	FD	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW26-190917-FD	16WW26	09/18/2019	FD	SW8260	09/27/2019	ALSHT
1927216	16 BASELINE SEP 2019	16WW48-190918	16WW48	09/18/2019	REG	SW6850	09/30/2019	ALSS
HS19090962	16 BASELINE SEP 2019	16WW48-190918	16WW48	09/18/2019	REG	SW8260	09/27/2019	ALSHT
1927220	16 BASELINE SEP 2019	16WW51-190918	16WW51	09/18/2019	REG	SW6850	10/01/2019	ALSS
HS19090964	16 BASELINE SEP 2019	16WW51-190918	16WW51	09/18/2019	REG	SW8260	09/27/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS19090964	16 BASELINE SEP 2019	16LHAAP-TB6-190919	FIELDQC	09/19/2019	TB	SW8260	09/27/2019	ALSHT
1927220	16 BASELINE SEP 2019	16WW49-190919	16WW49	09/19/2019	REG	SW6850	10/01/2019	ALSS
HS19090964	16 BASELINE SEP 2019	16WW49-190919	16WW49	09/19/2019	REG	SW8260	09/29/2019	ALSHT
1927220	16 BASELINE SEP 2019	16WW25-190919	16WW25	09/19/2019	REG	SW6850	10/01/2019	ALSS
1927220	16 BASELINE SEP 2019	16WW25-190919-FD	16WW25	09/19/2019	FD	SW6850	10/01/2019	ALSS
HS19090964	16 BASELINE SEP 2019	16WW25-190919	16WW25	09/19/2019	REG	SW8260	09/27/2019	ALSHT
HS19090964	16 BASELINE SEP 2019	16WW25-190919-FD	16WW25	09/19/2019	FD	SW8260	09/27/2019	ALSHT
HS19101170	16 BROMIDE OCT 2019	16EW07-191018	16EW07	10/18/2019	REG	SW9056	10/21/2019	ALSHT
HS19101170	16 BROMIDE OCT 2019	16EW05-191018	16EW05	10/18/2019	REG	SW9056	10/21/2019	ALSHT
HS19101353	16 LF BB PM OCT 2019	16WW22-191022	16WW22	10/22/2019	REG	SW9056	11/04/2019	ALSHT
K1909995	16 LF BB PM OCT 2019	16WW22-191022	16WW22	10/22/2019	REG	SM5310C	10/31/2019	ALS
HS19101353	16 LF BB PM OCT 2019	16RW12-191022	16RW12	10/22/2019	REG	SW9056	11/04/2019	ALSHT
HS19101353	16 LF BB PM OCT 2019	16RW12-191022-FD	16RW12	10/22/2019	FD	SW9056	11/04/2019	ALSHT
K1909995	16 LF BB PM OCT 2019	16RW12-191022	16RW12	10/22/2019	REG	SM5310C	10/31/2019	ALS
K1909995	16 LF BB PM OCT 2019	16RW12-191022-FD	16RW12	10/22/2019	FD	SM5310C	10/31/2019	ALS
HS19101353	16 LF BB PM OCT 2019	16WW39-191022	16WW39	10/22/2019	REG	SW9056	11/04/2019	ALSHT
K1909995	16 LF BB PM OCT 2019	16WW39-191022	16WW39	10/22/2019	REG	SM5310C	10/31/2019	ALS
HS19101353	16 LF BB PM OCT 2019	16RW11-191022	16RW11	10/22/2019	REG	SW9056	11/04/2019	ALSHT
K1909995	16 LF BB PM OCT 2019	16RW11-191022	16RW11	10/22/2019	REG	SM5310C	11/07/2019	ALS
HS19101353	16 LF BB PM OCT 2019	16IW20-191022	16IW20	10/22/2019	REG	SW9056	11/04/2019	ALSHT
K1909995	16 LF BB PM OCT 2019	16IW20-191022	16IW20	10/22/2019	REG	SM5310C	11/07/2019	ALS
HS19101353	16 LF BB PM OCT 2019	16WW12-191022	16WW12	10/22/2019	REG	SW9056	11/04/2019	ALSHT
K1909995	16 LF BB PM OCT 2019	16WW12-191022	16WW12	10/22/2019	REG	SM5310C	11/06/2019	ALS
HS19101343	16 BROMIDE OCT 2019	16EW06-191022	16EW06	10/22/2019	REG	SW9056	10/24/2019	ALSHT
HS19101343	16 BROMIDE OCT 2019	16EW08-191022	16EW08	10/22/2019	REG	SW9056	10/24/2019	ALSHT
HS19101488	16 LF BB PM OCT 2019	16WW40-191022	16WW40	10/22/2019	REG	SW9056	11/04/2019	ALSHT
K1910079	16 LF BB PM OCT 2019	16WW40-191022	16WW40	10/22/2019	REG	SM5310C	10/30/2019	ALS
HS19101603	16 BROMIDE OCT 2019	16EW07-191025	16EW07	10/25/2019	REG	SW9056	10/28/2019	ALSHT
HS19101603	16 BROMIDE OCT 2019	16EW05-191025	16EW05	10/25/2019	REG	SW9056	10/29/2019	ALSHT
HS19110026	16 BROMIDE OCT 2019	16EW06-EVENT2-191031	16EW06	10/31/2019	REG	SM5310B	11/02/2019	ALSHT
HS19110026	16 BROMIDE OCT 2019	16EW06-EVENT2-191031	16EW06	10/31/2019	REG	SW9056	11/04/2019	ALSHT
HS19110026	16 BROMIDE OCT 2019	16EW05-EVENT2-191031	16EW05	10/31/2019	REG	SM5310B	11/02/2019	ALSHT
HS19110026	16 BROMIDE OCT 2019	16EW07-EVENT2-191031	16EW07	10/31/2019	REG	SM5310B	11/02/2019	ALSHT
HS19110217	16 BROMIDE NOV 2019	16EW07-191105	16EW07	11/05/2019	REG	SM5310B	11/06/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS19110217	16 BROMIDE NOV 2019	16EW07-191105	16EW07	11/05/2019	REG	SW9056	11/06/2019	ALSHT
HS19110217	16 BROMIDE NOV 2019	16EW05-191105	16EW05	11/05/2019	REG	SM5310B	11/06/2019	ALSHT
HS19110217	16 BROMIDE NOV 2019	16EW05-191105	16EW05	11/05/2019	REG	SW9056	11/06/2019	ALSHT
HS19110304	16 BROMIDE NOV 2019	16EW08-191106	16EW08	11/06/2019	REG	SM5310B	11/08/2019	ALSHT
HS19110304	16 BROMIDE NOV 2019	16EW08-191106	16EW08	11/06/2019	REG	SW9056	11/07/2019	ALSHT
HS19110484	16 BROMIDE NOV 2019	16EW06-191108	16EW06	11/08/2019	REG	SM5310B	11/12/2019	ALSHT
HS19110484	16 BROMIDE NOV 2019	16EW06-191108	16EW06	11/08/2019	REG	SW9056	11/12/2019	ALSHT
HS19110619	16 BROMIDE NOV 2019	16EW05-191111	16EW05	11/11/2019	REG	SM5310B	11/13/2019	ALSHT
HS19110619	16 BROMIDE NOV 2019	16EW05-191111	16EW05	11/11/2019	REG	SW9056	11/13/2019	ALSHT
HS19110634	16 MIDPLUME(S) PM NOV 2019	16EW01-191111	16EW01	11/11/2019	REG	SW9056	11/25/2019	ALSHT
K1910765	16 MIDPLUME(S) PM NOV 2019	16EW01-191111	16EW01	11/11/2019	REG	SM5310C	11/17/2019	ALS
HS19110634	16 MIDPLUME(S) PM NOV 2019	16EW04-191111	16EW04	11/11/2019	REG	SW9056	11/25/2019	ALSHT
HS19110634	16 MIDPLUME(S) PM NOV 2019	16EW04-191111-FD	16EW04	11/11/2019	FD	SW9056	11/26/2019	ALSHT
K1910765	16 MIDPLUME(S) PM NOV 2019	16EW04-191111	16EW04	11/11/2019	REG	SM5310C	11/17/2019	ALS
K1910765	16 MIDPLUME(S) PM NOV 2019	16EW04-191111-FD	16EW04	11/11/2019	FD	SM5310C	11/21/2019	ALS
HS19110634	16 MIDPLUME(S) PM NOV 2019	16EW03-191111	16EW03	11/11/2019	REG	SW9056	11/25/2019	ALSHT
K1910765	16 MIDPLUME(S) PM NOV 2019	16EW03-191111	16EW03	11/11/2019	REG	SM5310C	11/17/2019	ALS
HS19110634	16 MIDPLUME(S) PM NOV 2019	16EW02-191111	16EW02	11/11/2019	REG	SW9056	11/25/2019	ALSHT
K1910765	16 MIDPLUME(S) PM NOV 2019	16EW02-191111	16EW02	11/11/2019	REG	SM5310C	11/17/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16RW01-191119	16RW01	11/19/2019	REG	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16RW01-191119	16RW01	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16RW04-191119	16RW04	11/19/2019	REG	SW9056	12/04/2019	ALSHT
HS19111065	16 LF BIO#1 PM NOV 2019	16RW04-191119-FD	16RW04	11/19/2019	FD	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16RW04-191119	16RW04	11/19/2019	REG	SM5310C	11/24/2019	ALS
K1911033	16 LF BIO#1 PM NOV 2019	16RW04-191119-FD	16RW04	11/19/2019	FD	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16WW26-191119	16WW26	11/19/2019	REG	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16WW26-191119	16WW26	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16RW05-191119	16RW05	11/19/2019	REG	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16RW05-191119	16RW05	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16RW02-191119	16RW02	11/19/2019	REG	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16RW02-191119	16RW02	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16RW03-191119	16RW03	11/19/2019	REG	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16RW03-191119	16RW03	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16IW09-191119	16IW09	11/19/2019	REG	SW9056	12/04/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
K1911033	16 LF BIO#1 PM NOV 2019	16IW09-191119	16IW09	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111065	16 LF BIO#1 PM NOV 2019	16WW42-191119	16WW42	11/19/2019	REG	SW9056	12/04/2019	ALSHT
K1911033	16 LF BIO#1 PM NOV 2019	16WW42-191119	16WW42	11/19/2019	REG	SM5310C	11/24/2019	ALS
HS19111080	16 LF BIO#3 PM NOV 2019	16RW06-191120	16RW06	11/20/2019	REG	SW9056	11/26/2019	ALSHT
HS19111080	16 LF BIO#3 PM NOV 2019	16RW06-191120-FD	16RW06	11/20/2019	FD	SW9056	11/26/2019	ALSHT
K1911032	16 LF BIO#3 PM NOV 2019	16RW06-191120	16RW06	11/20/2019	REG	SM5310C	11/24/2019	ALS
K1911032	16 LF BIO#3 PM NOV 2019	16RW06-191120-FD	16RW06	11/20/2019	FD	SM5310C	11/24/2019	ALS
HS19111080	16 LF BIO#3 PM NOV 2019	16RW07-191120	16RW07	11/20/2019	REG	SW9056	11/26/2019	ALSHT
K1911032	16 LF BIO#3 PM NOV 2019	16RW07-191120	16RW07	11/20/2019	REG	SM5310C	11/24/2019	ALS
HS19111080	16 LF BIO#3 PM NOV 2019	16RW08-191120	16RW08	11/20/2019	REG	SW9056	11/26/2019	ALSHT
K1911032	16 LF BIO#3 PM NOV 2019	16RW08-191120	16RW08	11/20/2019	REG	SM5310C	11/24/2019	ALS
HS19111080	16 LF BIO#3 PM NOV 2019	16IW10-191120	16IW10	11/20/2019	REG	SW9056	11/26/2019	ALSHT
K1911032	16 LF BIO#3 PM NOV 2019	16IW10-191120	16IW10	11/20/2019	REG	SM5310C	11/24/2019	ALS
HS19111080	16 LF BIO#3 PM NOV 2019	16RW09-191120	16RW09	11/20/2019	REG	SW9056	11/26/2019	ALSHT
K1911032	16 LF BIO#3 PM NOV 2019	16RW09-191120	16RW09	11/20/2019	REG	SM5310C	11/24/2019	ALS
HS19111080	16 LF BIO#3 PM NOV 2019	16RW10-191120	16RW10	11/20/2019	REG	SW9056	11/26/2019	ALSHT
K1911032	16 LF BIO#3 PM NOV 2019	16RW10-191120	16RW10	11/20/2019	REG	SM5310C	11/24/2019	ALS
HS19120208	16 BROMIDE DEC 2019	16EW11-191203	16EW11	12/03/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120208	16 BROMIDE DEC 2019	16EW12B-191203	16EW12B	12/03/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120208	16 BROMIDE DEC 2019	16EW13-191203	16EW13	12/03/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120208	16 BROMIDE DEC 2019	16EW14B-191203	16EW14B	12/03/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120208	16 BROMIDE DEC 2019	16EW15-191203	16EW15	12/03/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW11-191204	16EW11	12/04/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW11-191204	16EW11	12/04/2019	REG	SW9056	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW12B-191204	16EW12B	12/04/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW12B-191204	16EW12B	12/04/2019	REG	SW9056	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW13-191204	16EW13	12/04/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW13-191204	16EW13	12/04/2019	REG	SW9056	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW14B-191204	16EW14B	12/04/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW14B-191204	16EW14B	12/04/2019	REG	SW9056	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW15-191204	16EW15	12/04/2019	REG	SM5310B	12/06/2019	ALSHT
HS19120210	16 BROMIDE DEC 2019	16EW15-191204	16EW15	12/04/2019	REG	SW9056	12/06/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW11-191205	16EW11	12/05/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW11-191205	16EW11	12/05/2019	REG	SW9056	12/07/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS19120309	16 BROMIDE DEC 2019	16EW12B-191205	16EW12B	12/05/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW12B-191205	16EW12B	12/05/2019	REG	SW9056	12/07/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW13-191205	16EW13	12/05/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW13-191205	16EW13	12/05/2019	REG	SW9056	12/07/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW14B-191205	16EW14B	12/05/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW14B-191205	16EW14B	12/05/2019	REG	SW9056	12/07/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW15-191205	16EW15	12/05/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120309	16 BROMIDE DEC 2019	16EW15-191205	16EW15	12/05/2019	REG	SW9056	12/07/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW11-191206	16EW11	12/06/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW11-191206	16EW11	12/06/2019	REG	SW9056	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW12B-191206	16EW12B	12/06/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW12B-191206	16EW12B	12/06/2019	REG	SW9056	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW13-191206	16EW13	12/06/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW13-191206	16EW13	12/06/2019	REG	SW9056	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW14B-191206	16EW14B	12/06/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW14B-191206	16EW14B	12/06/2019	REG	SW9056	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW15-191206	16EW15	12/06/2019	REG	SM5310B	12/09/2019	ALSHT
HS19120336	16 BROMIDE DEC 2019	16EW15-191206	16EW15	12/06/2019	REG	SW9056	12/09/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW11-191209	16EW11	12/09/2019	REG	SM5310B	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW11-191209	16EW11	12/09/2019	REG	SW9056	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW12B-191209	16EW12B	12/09/2019	REG	SM5310B	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW12B-191209	16EW12B	12/09/2019	REG	SW9056	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW13-191209	16EW13	12/09/2019	REG	SM5310B	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW13-191209	16EW13	12/09/2019	REG	SW9056	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW14B-191209	16EW14B	12/09/2019	REG	SM5310B	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW14B-191209	16EW14B	12/09/2019	REG	SW9056	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW15-191209	16EW15	12/09/2019	REG	SM5310B	12/10/2019	ALSHT
HS19120453	16 BROMIDE DEC 2019	16EW15-191209	16EW15	12/09/2019	REG	SW9056	12/10/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW11-191212	16EW11	12/12/2019	REG	SM5310B	12/16/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW11-191212	16EW11	12/12/2019	REG	SW9056	12/14/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW12B-191212	16EW12B	12/12/2019	REG	SM5310B	12/16/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW12B-191212	16EW12B	12/12/2019	REG	SW9056	12/14/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW13-191212	16EW13	12/12/2019	REG	SM5310B	12/16/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW13-191212	16EW13	12/12/2019	REG	SW9056	12/14/2019	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS19120673	16 BROMIDE DEC 2019	16EW14B-191212	16EW14B	12/12/2019	REG	SM5310B	12/16/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW14B-191212	16EW14B	12/12/2019	REG	SW9056	12/14/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW15-191212	16EW15	12/12/2019	REG	SM5310B	12/16/2019	ALSHT
HS19120673	16 BROMIDE DEC 2019	16EW15-191212	16EW15	12/12/2019	REG	SW9056	12/14/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW11-191218	16EW11	12/18/2019	REG	SM5310B	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW11-191218	16EW11	12/18/2019	REG	SW9056	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW12B-191218	16EW12B	12/18/2019	REG	SM5310B	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW12B-191218	16EW12B	12/18/2019	REG	SW9056	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW13-191218	16EW13	12/18/2019	REG	SM5310B	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW13-191218	16EW13	12/18/2019	REG	SW9056	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW14B-191218	16EW14B	12/18/2019	REG	SM5310B	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW14B-191218	16EW14B	12/18/2019	REG	SW9056	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW15-191218	16EW15	12/18/2019	REG	SM5310B	12/23/2019	ALSHT
HS19121088	16 BROMIDE DEC 2019	16EW15-191218	16EW15	12/18/2019	REG	SW9056	12/23/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW05-E2-191223	16EW05	12/23/2019	REG	SM5310B	12/28/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW05-E2-191223	16EW05	12/23/2019	REG	SW9056	12/26/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW06-E2-191223	16EW06	12/23/2019	REG	SM5310B	12/30/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW06-E2-191223	16EW06	12/23/2019	REG	SW9056	12/26/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW06-E2-191223-FD	16EW06	12/23/2019	FD	SM5310B	12/30/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW06-E2-191223-FD	16EW06	12/23/2019	FD	SW9056	12/26/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW07-E2-191223	16EW07	12/23/2019	REG	SM5310B	12/28/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW07-E2-191223	16EW07	12/23/2019	REG	SW9056	12/26/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW08-E2-191223	16EW08	12/23/2019	REG	SM5310B	12/28/2019	ALSHT
HS19121313	16 MIDPLUME(I) PM DEC 2019	16EW08-E2-191223	16EW08	12/23/2019	REG	SW9056	12/26/2019	ALSHT
HS20011144	16 LF BIO#2 PM JAN 2020	16WW36-200123	16WW36	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16WW36-200123	16WW36	01/23/2020	REG	SM5310C	01/31/2020	ALS
HS20011144	16 LF BIO#2 PM JAN 2020	16PM09-200123	16PM09	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16PM09-200123	16PM09	01/23/2020	REG	SM5310C	01/31/2020	ALS
HS20011144	16 LF BIO#2 PM JAN 2020	16PM06-200123	16PM06	01/23/2020	REG	SW9056	02/06/2020	ALSHT
HS20011144	16 LF BIO#2 PM JAN 2020	16PM06-200123-FD	16PM06	01/23/2020	FD	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16PM06-200123	16PM06	01/23/2020	REG	SM5310C	01/31/2020	ALS
K2000749	16 LF BIO#2 PM JAN 2020	16PM06-200123-FD	16PM06	01/23/2020	FD	SM5310C	01/31/2020	ALS
HS20011144	16 LF BIO#2 PM JAN 2020	16IW04-200123	16IW04	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16IW04-200123	16IW04	01/23/2020	REG	SM5310C	01/31/2020	ALS

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS20011144	16 LF BIO#2 PM JAN 2020	16IW03-200123	16IW03	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16IW03-200123	16IW03	01/23/2020	REG	SM5310C	02/13/2020	ALS
HS20011144	16 LF BIO#2 PM JAN 2020	16PM14-200123	16PM14	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16PM14-200123	16PM14	01/23/2020	REG	SM5310C	01/31/2020	ALS
HS20011144	16 LF BIO#2 PM JAN 2020	16PM02-200123	16PM02	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16PM02-200123	16PM02	01/23/2020	REG	SM5310C	01/31/2020	ALS
HS20011144	16 LF BIO#2 PM JAN 2020	16PM03-200123	16PM03	01/23/2020	REG	SW9056	02/06/2020	ALSHT
K2000749	16 LF BIO#2 PM JAN 2020	16PM03-200123	16PM03	01/23/2020	REG	SM5310C	01/31/2020	ALS
HS20030390	16 DES EFF MAR 2020	16IW20-200309	16IW20	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16IW20-200309	16IW20	03/09/2020	REG	SW9056	03/11/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16EW01-200309	16EW01	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16EW01-200309	16EW01	03/09/2020	REG	SW9056	03/17/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16EW02-200309	16EW02	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16EW02-200309	16EW02	03/09/2020	REG	SW9056	03/17/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16EW04-200309	16EW04	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16EW04-200309	16EW04	03/09/2020	REG	SW9056	03/10/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16RW03-200309	16RW03	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16RW03-200309	16RW03	03/09/2020	REG	SW9056	03/10/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16RW04-200309	16RW04	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16RW04-200309	16RW04	03/09/2020	REG	SW9056	03/10/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16WW26-200309	16WW26	03/09/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030390	16 DES EFF MAR 2020	16WW26-200309	16WW26	03/09/2020	REG	SW9056	03/10/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16PM14-200310	16PM14	03/10/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16PM14-200310	16PM14	03/10/2020	REG	SW9056	03/18/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16IW04-200310	16IW04	03/10/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16IW04-200310	16IW04	03/10/2020	REG	SW9056	03/18/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16PM06-200310	16PM06	03/10/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16PM06-200310	16PM06	03/10/2020	REG	SW9056	03/18/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16PM09-200310	16PM09	03/10/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16PM09-200310	16PM09	03/10/2020	REG	SW9056	03/18/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16WW42-200310	16WW42	03/10/2020	REG	SM5310B	03/12/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16WW42-200310	16WW42	03/10/2020	REG	SW9056	03/18/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16WW42-200310-FD	16WW42	03/10/2020	FD	SM5310B	03/13/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16WW42-200310-FD	16WW42	03/10/2020	FD	SW9056	03/18/2020	ALSHT

Appendix E Table 1: Summary of Samples Collected, Sample Date, Sample Location, and Analysis Method

SDG	Task Code	Sample ID	Location ID	Sample Date	Sample Purpose	Analytical Method	Analysis Date	Laboratory
HS20030472	16 DES EFF MAR 2020	16RW12-200310	16RW12	03/10/2020	REG	SM5310B	03/13/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16RW12-200310	16RW12	03/10/2020	REG	SW9056	03/19/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16WW40-200310	16WW40	03/10/2020	REG	SM5310B	03/13/2020	ALSHT
HS20030472	16 DES EFF MAR 2020	16WW40-200310	16WW40	03/10/2020	REG	SW9056	03/19/2020	ALSHT
HS20030502	16 DES EFF MAR 2020	16RW10-200311	16RW10	03/11/2020	REG	SM5310B	03/18/2020	ALSHT
HS20030502	16 DES EFF MAR 2020	16RW10-200311	16RW10	03/11/2020	REG	SW9056	03/19/2020	ALSHT
HS20030502	16 DES EFF MAR 2020	16RW09-200311	16RW09	03/11/2020	REG	SM5310B	03/18/2020	ALSHT
HS20030502	16 DES EFF MAR 2020	16RW09-200311	16RW09	03/11/2020	REG	SW9056	03/19/2020	ALSHT
HS20030502	16 DES EFF MAR 2020	16RW08-200311	16RW08	03/11/2020	REG	SM5310B	03/18/2020	ALSHT
HS20030502	16 DES EFF MAR 2020	16RW08-200311	16RW08	03/11/2020	REG	SW9056	03/19/2020	ALSHT

Notes:

ALS / ALSHT / ALSS - ALS Laboratories in Houston, Salt Lake City, Kelso, and Simi Valley.

FD - field duplicate

MI - Microbial Insights

REG - regular sample

SDG - sample delivery group

TB - trip blank

Appendix E Table 2: Data Qualification Flags

Data Qualifier Definitions for Organic and Inorganic Data Review

Qualifier	Definition
	No Qualifier indicates that the data are acceptable both qualitatively and quantitatively.
U	The analyte was analyzed for but was not detected above the reported limit of detection.
J	The analyte was analyzed for and was positively identified, but the reported numerical value may not be consistent with the amount actually present in the environmental sample. Results are estimated, although the data are considered usable and may be used as appropriate to meet project objectives. Results are qualitatively acceptable and quantitatively uncertain.
J-	The analyte was positively identified; the associated numerical value is its approximate concentration with a low bias in the sample.
J+	The analyte was positively identified; the associated numerical value is its approximate concentration with a high bias in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified," and the associated value represents its approximate concentration.
UJ	The analyte was not detected above the reported limit of detection. However, the reported limit of detection is approximate and may or may not represent the actual limit of detection necessary to accurately and precisely measure the analyte in the sample.
X	The analyte was analyzed for, but the presence or absence of the analyte has not been verified. Re-sampling and re-analysis may be necessary to confirm or deny the presence of the analyte. Results are rejected, and data are unusable for any purposes.

Appendix E: Table 3 Qualified Data Summary

Sample	Sample Type	Sample Date	Analyte	SDG	Result	LOQ	Units	Qualifier
Reason Code 08A		**Method RSK-175**						
16WW24-181009	REG	10/09/2018	Ethylene	HS18100492	0.00139	0.00100	mg/L	J
Reason Code 08A		**Method SM5310C**						
16WW36-200123	REG	01/23/2020	Total organic carbon	K2000749	21	0.50	mg/L	J
Reason Code 11B		**Method SM5310C**						
16RW02-191119	REG	11/19/2019	Total organic carbon	K1911033	4.37	0.50	mg/L	J
16RW03-191119	REG	11/19/2019	Total organic carbon	K1911033	2.51	0.50	mg/L	J

Notes:

See Appendix E Table 2 for definitions of qualifiers.
J - estimated value
mg/L - milligrams per liter
LOQ - limit of quantitation
REG - regular sample
SDG - sample delivery group

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code	16EW04				Relative Percent Difference
				Sample Number	16EW04-191111		16EW04-191111-FD		
				Sample Date	11/11/2019		11/11/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		2.48		2.54		2.39
	Total organic carbon	mg/L	N		13.6		15.3		11.76

				Location Code	16EW06				Relative Percent Difference
				Sample Number	16EW06-E2-191223		16EW06-E2-191223-FD		
				Sample Date	12/23/2019		12/23/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	52.5 - 52.5 ft		52.5 - 52.5 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		521		539		3.40
	Total organic carbon	mg/L	N		144,000		137,000		4.98

				Location Code	16PM06				Relative Percent Difference
				Sample Number	16PM06-200123		16PM06-200123-FD		
				Sample Date	01/23/2020		01/23/2020		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	22.65 - 22.65 ft		22.65 - 22.65 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		2.74		2.74		0.00
	Total organic carbon	mg/L	N		9.03		9.01		0.22

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code	16RW04				Relative Percent Difference
				Sample Number	16RW04-191119		16RW04-191119-FD		
				Sample Date	11/19/2019		11/19/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		0.66		0.656		0.61
	Total organic carbon	mg/L	N		2.81		2.8		0.36

				Location Code	16RW06				Relative Percent Difference
				Sample Number	16RW06-191120		16RW06-191120-FD		
				Sample Date	11/20/2019		11/20/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		5.03		5.05		0.40
	Total organic carbon	mg/L	N		1.54		1.55		0.65

				Location Code	16RW12				Relative Percent Difference
				Sample Number	16RW12-191022		16RW12-191022-FD		
				Sample Date	10/22/2019		10/22/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		3.85		3.9		1.29
	Total organic carbon	mg/L	N		1.78		1.91		7.05

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code	16SW01				Relative Percent Difference
				Sample Number	16SW01-181011		16SW01-181011-FD		
				Sample Date	10/11/2018		10/11/2018		
				Sample Purpose	REG		FD		
				Sample Type	SW		SW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
METALS	Arsenic	mg/L	T		0.00204		0.00212		3.85
	Chromium	mg/L	T		0.000499	J	0.000515	J	NC
	Manganese	mg/L	T		0.545		0.586		7.25
	Nickel	mg/L	T		0.00756		0.00786		3.89
	Thallium	mg/L	T		0.000418	J	0.001	U	NC
PERCHLORATE	Perchlorate	µg/L	N		2	U	2	U	NC
VOLATILES	1,1,2-Trichloroethane	µg/L	N		0.5	U	0.5	U	NC
	1,1-Dichloroethene	µg/L	N		0.5	U	0.5	U	NC
	1,2-Dichloroethane	µg/L	N		0.5	U	0.5	U	NC
	cis-1,2-Dichloroethene	µg/L	N		0.5	U	0.5	U	NC
	Methylene chloride	µg/L	N		1	U	1	U	NC
	Trichloroethene	µg/L	N		0.5	U	0.5	U	NC
	Vinyl chloride	µg/L	N		0.5	U	0.5	U	NC

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code		16WW24		Relative Percent Difference
				Sample Number		16WW24-181009	16WW24-181009-FD	
				Sample Date		10/09/2018	10/09/2018	
				Sample Purpose		REG	FD	
				Sample Type		GW	GW	
				Depth		10.17 - 11.1 ft	10.17 - 11.1 ft	
Test Group	Parameter	Units	Filtered	Result	VQ	Result	VQ	
DHC	Dehalococcoides	cells/mL	N	1.6		-NA-		0.00
	Ethane	mg/L	N	0.000256	J	0.000555	J	NC
	Ethylene	mg/L	N	0.00139	J	0.00124		11.41
	Methane	mg/L	N	0.00165		0.00327		65.85
	Alkalinity	mg/L	N	5	U	5	U	NC
	Bromide	mg/L	N	1.26		1.32		4.65
	Chloride	mg/L	N	287		284		1.05
	Fluoride	mg/L	N	0.326		0.33		1.22
	Nitrate	mg/L	N	0.1	U	0.1	U	NC
	Nitrite	mg/L	N	0.1	U	0.2	U	NC
	Sulfate	mg/L	N	905		898		0.78
	Total organic carbon	mg/L	N	2.76		2.65		4.07
PERCHLORATE	Perchlorate	µg/L	N	2	U	2	U	NC
	1,1,2-Trichloroethane	µg/L	N	0.5	U	0.5	U	NC
	1,1-Dichloroethene	µg/L	N	0.5	U	0.5	U	NC
	1,2-Dichloroethane	µg/L	N	0.5	U	0.5	U	NC
	cis-1,2-Dichloroethene	µg/L	N	0.5	U	0.5	U	NC
	Methylene chloride	µg/L	N	1	U	1	U	NC
	Trichloroethene	µg/L	N	0.5	U	0.5	U	NC
	Vinyl chloride	µg/L	N	0.5	U	0.5	U	NC

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code	16WW25				
				Sample Number	16WW25-190919		16WW25-190919-FD		Relative Percent Difference
				Sample Date	09/19/2019		09/19/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
PERCHLORATE	Perchlorate	µg/L	N		2	U	2	U	NC
	1,1,2-Trichloroethane	µg/L	N		0.5	U	0.5	U	NC
	1,1-Dichloroethene	µg/L	N		0.5	U	0.5	U	NC
	1,2-Dichloroethane	µg/L	N		0.5	U	0.5	U	NC
	cis-1,2-Dichloroethene	µg/L	N		0.5	U	0.5	U	NC
	Methylene chloride	µg/L	N		1	U	1	U	NC
	Trichloroethene	µg/L	N		0.5	U	0.5	U	NC
	Vinyl chloride	µg/L	N		0.5	U	0.5	U	NC

				Location Code	16WW26				
				Sample Number	16WW26-190917		16WW26-190917-FD		Relative Percent Difference
				Sample Date	09/17/2019		09/18/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
PERCHLORATE	Perchlorate	µg/L	N		2	U	2	U	NC
	1,1,2-Trichloroethane	µg/L	N		0.5	U	0.5	U	NC
	1,1-Dichloroethene	µg/L	N		1.4		1.6		13.33
	1,2-Dichloroethane	µg/L	N		0.5	U	0.5	U	NC
	cis-1,2-Dichloroethene	µg/L	N		35		36		2.82
	Methylene chloride	µg/L	N		1	U	1	U	NC
	Trichloroethene	µg/L	N		380		440		14.63
	Vinyl chloride	µg/L	N		0.5	U	0.5	U	NC

Appendix E Table 4: Summary of Field Duplicate Results

			Location Code	16WW31				Relative Percent Difference
			Sample Number	16WW31-181010		16WW31-181010-FD		
			Sample Date	10/10/2018		10/10/2018		
			Sample Purpose	REG		FD		
			Sample Type	GW		GW		
			Depth	31.45 - 31.55 ft		31.45 - 31.55 ft		
Test Group	Parameter	Units	Filtered	Result	VQ	Result	VQ	
PERCHLORATE	Perchlorate	µg/L	N	2	U	2	U	NC
	1,1,2-Trichloroethane	µg/L	N	0.5	U	0.5	U	NC
	1,1-Dichloroethene	µg/L	N	0.5	U	0.5	U	NC
	1,2-Dichloroethane	µg/L	N	0.5	U	0.5	U	NC
	cis-1,2-Dichloroethene	µg/L	N	0.5	U	0.5	U	NC
	Methylene chloride	µg/L	N	1	U	1	U	NC
	Trichloroethene	µg/L	N	0.5	U	0.5	U	NC
	Vinyl chloride	µg/L	N	0.5	U	0.5	U	NC

			Location Code	16WW40				Relative Percent Difference
			Sample Number	16WW40-181012		16WW40-181012-FD		
			Sample Date	10/12/2018		10/12/2018		
			Sample Purpose	REG		FD		
			Sample Type	GW		GW		
			Depth	12.31 - 12.56 ft		12.31 - 12.56 ft		
Test Group	Parameter	Units	Filtered	Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N	5.57		5.72		2.66
	Perchlorate	µg/L	N	2	U	2	U	NC
VOLATILES	1,1,2-Trichloroethane	µg/L	N	0.5	U	0.5	U	NC
	1,1-Dichloroethene	µg/L	N	3.5		3.5		0.00
	1,2-Dichloroethane	µg/L	N	3.8		3.8		0.00
	cis-1,2-Dichloroethene	µg/L	N	220		240		8.70
	Methylene chloride	µg/L	N	1	U	1	U	NC
	Trichloroethene	µg/L	N	660		640		3.08
	Vinyl chloride	µg/L	N	4.5		4.2		6.90

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code	16WW42				Relative Percent Difference
				Sample Number	16WW42-200310		16WW42-200310-FD		
				Sample Date	03/10/2020		03/10/2020		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
GEN CHEMISTRY	Bromide	mg/L	N		1.36		1.35		0.74
	Total organic carbon	mg/L	N		1.73		1.68		2.93

				Location Code	16WW58				Relative Percent Difference
				Sample Number	16WW58-190815		16WW58-190815-FD		
				Sample Date	08/15/2019		08/15/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
PERCHLORATE	Perchlorate	µg/L	N		2	U	2	U	NC
VOLATILES	1,1,2-Trichloroethane	µg/L	N		5	U	5	U	NC
	1,1-Dichloroethene	µg/L	N		5	U	5	U	NC
	1,2-Dichloroethane	µg/L	N		5	U	5	U	NC
	cis-1,2-Dichloroethene	µg/L	N		78		76		2.60
	Methylene chloride	µg/L	N		10	U	10	U	NC
	Trichloroethene	µg/L	N		2,700		2,700		0.00
	Vinyl chloride	µg/L	N		5	U	5	U	NC

Appendix E Table 4: Summary of Field Duplicate Results

				Location Code	16WW58				Relative Percent Difference
				Sample Number	16WW58-190918		16WW58-190918-FD		
				Sample Date	09/18/2019		09/18/2019		
				Sample Purpose	REG		FD		
				Sample Type	GW		GW		
				Depth	0 - 0 ft		0 - 0 ft		
Test Group	Parameter	Units	Filtered		Result	VQ	Result	VQ	
DHC	Dehalococcoides	cells/mL	N		17.8		-NA-		0.00
GASES	Ethane	mg/L	N		0.000332	J	0.000318	J	NC
	Ethylene	mg/L	N		0.00151		0.00143		5.44
	Methane	mg/L	N		0.00362		0.00437		18.77
GEN CHEMISTRY	Alkalinity	mg/L	N		94		107		12.94
	Bromide	mg/L	N		3.52		3.48		1.14
	Nitrate	mg/L	N		0.1	U	0.1	U	NC
	Sulfate	mg/L	N		394		396		0.51
	Total organic carbon	mg/L	N		4.21		4.27		1.42
PERCHLORATE	Perchlorate	µg/L	N		2	U	2	U	NC
VOLATILES	1,1,2-Trichloroethane	µg/L	N		2.5	U	2.5	U	NC
	1,1-Dichloroethene	µg/L	N		3.9	J	3.9	J	NC
	1,2-Dichloroethane	µg/L	N		2.5	U	2.5	U	NC
	cis-1,2-Dichloroethene	µg/L	N		170		180		5.71
	Methylene chloride	µg/L	N		5	U	5	U	NC
	Trichloroethene	µg/L	N		4,300		4,100		4.76
	Vinyl chloride	µg/L	N		2.5	U	2.5	U	NC

Notes:
See Appendix E Table 2 for definitions of qualifiers.
µg/L - micrograms per liter
J - Estimated value.
U - Not detected; The analyte was analyzed for but not detected above the associated method detection limit.
mL - milliliter
FD - field duplicate
ft - feet
GW - groundwater
mg/L - milligrams per liter
NA - not applicable
NC - not calculated. Field precision results are calculated when target compounds are detected above the limit of quantitation in both primary and duplicate samples.
REG - regular sample
VQ - validation qualifiers

Appendix E Table 5: Technical Completeness

Analytical Method	Number of Analytes	Number of Samples	Number of Results	Number of Rejected Results	Number of Useable Results	Technical Completeness [Goal = 95 %] (percent)
Groundwater Environmental Samples						
CENSUS	1	21	21	0	21	100.%
SW6850	1	76	76	0	76	100.%
RSK-175	3	23	69	0	69	100.%
SM2320B	1	23	23	0	23	100.%
SM5310	1	124	124	0	124	100.%
SW8260	7	78	546	0	546	100.%
SW9056	6	140	223 [a]	0	223	100.%
Surface Water Environmental Samples						
SW6850	1	4	4	0	4	100.%
SW6020	5	4	20	0	20	100.%
SW8260	7	4	28	0	28	100.%

Notes:

[a] Total number of anion results are listed. Note that not every sample was analyzed for the full list of anions.

Appendix F

Potentiometric Surface Maps

Shallow Monitoring Well

Groundwater Flow Direction

Groundwater Contour

Stream

Road

LHAAP-16 Landfill Fence

Note:
1. Groundwater elevations are feet above mean sea level.

N

0 50 100 Feet

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TULSA, OKLAHOMA

bhate APTIM

Figure F-1
Shallow Groundwater
Potentiometric Surface
October 2018
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\FigF-1 LHAAP16_PotentiometricSurface_Shallow_Oct2018.mxd

Shallow Monitoring Well
Groundwater Flow Direction
Groundwater Contour
Stream
Road
LHAAP-16 Landfill Fence

Note:
1. Groundwater elevations are feet above mean sea level.

N

0 50 100
Feet

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Figure F-2
Shallow Groundwater
Potentiometric Surface
June 2019
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

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Shallow Monitoring Well
Groundwater Flow Direction
Groundwater Contour
Stream
Road
LHAAP-16 Landfill Fence

Note:
1. Groundwater elevations are feet above mean sea level.

N

0 50 100
Feet

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Figure F-3
Shallow Groundwater
Potentiometric Surface
September 2019
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

Document Path: G:\Longhorn\LHAAP\Documents\Mxd\LHAAP16\RACR\FigF-3 LHAAP16_PotentiometricSurface_Shallow_Sept2019.mxd

Intermediate Monitoring Well
Groundwater Flow Direction
Groundwater Contour
Depression
Stream
Road
LHAAP-16 Landfill Fence

Note:
1. Groundwater elevations are feet above mean sea level.

N

0 50 100
Feet

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TULSA, OKLAHOMA

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Figure F-4
Intermediate Groundwater
Potentiometric Surface
October 2018
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

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Intermediate Monitoring Well

Groundwater Flow Direction

Groundwater Contour

Stream

Road

LHAAP-16 Landfill Fence

Note:
1. Groundwater elevations are feet above mean sea level.

N

0 50 100 Feet

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TULSA, OKLAHOMA

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Figure F-5
Intermediate Groundwater
Potentiometric Surface
June 2019
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

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Intermediate Monitoring Well

Groundwater Flow Direction

Groundwater Contour

Stream

Road

LHAAP-16 Landfill Fence

Note:
1. Groundwater elevations are feet above mean sea level.

N

0 50 100 Feet

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TULSA, OKLAHOMA

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Figure F-6
Intermediate Groundwater
Potentiometric Surface
September 2019
LHAAP-16 RACR

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Date: 5/28/2020

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Appendix G

Photographs

PHOTO LOG

Photo No.	Date	Task and Description
1	4-30-2018	Installation of Well 16IW30
2	8-2-2019	Looking west at drill rig set up on location of well 16WW57
3	8-2-2019	Looking southwest at well 16WW57 during drilling
4	9-24-2019	Injection trailer and mobile tank at Bayou Biobarrier
5	9-24-2019	Preparing to add zero valent iron to amendment at Bayou Biobarrier
6	9-27-2019	Grout failure at 16IW27
7	9-27-2019	Grout failure at 16IW28
8	10-2-2019	Fractionation tanks for storage of amendment water
9	10-2-2019	Staging area for intermediate bulk containers
10	10-5-2019	Injection rig at mid-plume area
11	10-5-2019	Mobile tank at mid-plume area
12	10-9-2019	Direct-push technology drill rig and intermediate bulk containers at Mid-Plume Shallow Biogrid
13	10-11-2019	Slabs and protective casings from 16IW27 and 16IW28 during their abandonment at mid-plume area.
14	10-18-2019	Recirculation storage tank for Mid-Plume Intermediate Biobarrier
15	10-18-2019	Mid-plume recirculation
16	10-19-2019	Direct-push technology drill rig at Landfill Biobarrier #3
17	11-21-2019	Injection at 16EW06 at Mid-Plume Intermediate Biobarrier
18	12-3-2019	Injection rig and horizontal tank at Landfill Biobarrier #2
19	12-3-2019	Extraction from 16EW14B for Landfill Biobarrier #2
20	12-20-2019	Injection at 16EW14B for Landfill Biobarrier #2

PHOTO 1: **Installation of Well 16IW30**
DATE: **April 30, 2018**

PHOTO 2: **Looking west at drill rig set up on location of well 16WW57**
DATE: **August 2, 2019**

PHOTO 3: Looking southwest at well 16WW57 during drilling
DATE: August 2, 2019

PHOTO 4: Injection trailer and mobile tank at Bayou Biobarrier
DATE: September 24, 2019

PHOTO 5: **Preparing to add zero valent iron to amendment at Bayou Biobarrier**
DATE: **September 24, 2019**

PHOTO 6: **Grout failure at 16IW27**
DATE: **September 27, 2019**

PHOTO 7: **Grout failure at 16IW28**
DATE: **September 27, 2019**

PHOTO 8: **Fractionation tanks for storage of amendment water**
DATE: **October 2, 2019**

PHOTO 9: Staging area for intermediate bulk containers
DATE: October 2, 2019 **VIEW**

PHOTO 10: Injection rig at mid-plume area
DATE: October 5, 2019

PHOTO 11: Mobile tank at mid-plume area
DATE: October 5, 2019

PHOTO 12: Direct-push technology drill rig and intermediate bulk containers at Mid-Plume Shallow Biogrid
DATE: October 9, 2019

PHOTO 13: Slabs and protective casings from 16IW27 and 16IW28 during their abandonment at mid-plume area.

DATE: October 11, 2019

PHOTO 14: Recirculation storage tank for Mid-Plume Intermediate Biobarrier

DATE: October 18, 2019

PHOTO 15: Mid-plume recirculation
DATE: October 18, 2019

PHOTO 16: Direct-push technology drill rig at Landfill Biobarrier #3
DATE: October 19, 2019

PHOTO 17: Injection at 16EW06 at Mid-Plume Intermediate Biobarrier
DATE: November 21, 2019

PHOTO 18: Injection rig and horizontal tank at Landfill Biobarrier #2
DATE: December 3, 2019

PHOTO 19: Extraction from 16EW14B for Landfill Biobarrier #2
DATE: December 3, 2019

PHOTO 20: Injection at 16EW14B for Landfill Biobarrier #2
DATE: December 20, 2019