
Subject: Final Minutes, Quarterly Restoration Advisory Board (RAB) Meeting, Longhorn Army Ammunition Plant (LHAAP)

Location of Meeting: Karnack Community Center, Karnack, Texas

Date of Meeting: October 20, 2016, 6:00 – 7:30 PM

Meeting Participants:

LHAAP/BRAC: Rose M. Zeiler

USACE: Aaron Williams

USAEC: Nicholas Smith

AECOM: Debra Richmann, Marwan Salameh, Elspeth Sharp

USEPA Region 6: Janetta Coats, Kent Becher (USGS Liaison)

TCEQ: April Palmie

USFWS: Paul Bruckwicki

RAB: **Present:** Paul Fortune, Terry Britt, Judy VanDeventer, Charles Dixon, Richard Le Tourneau, John Pollard, Jr.
Absent: Ken Burkhalter, Carol Fortune, Lee Guice, Ted Kurz, James Lambright, Nigel R. Shivers, Tom Walker

Public: Dan Murphy, Rick Lowerre, Carl Turner

An agenda for the RAB meeting, three handouts (Groundwater Treatment Plant [GWTP] – Processed Groundwater Volumes, Harrison Bayou and Goose Prairie Creek – Perchlorate Data, and LHAAP Perimeter Well Monitoring – Perchlorate Data), four Fact Sheets (selected remedies for LHAAP-001-R, LHAAP-003-R, LHAAP-16 and LHAAP-17), responsiveness summaries from each of the Final RODs for LHAAP-001-R, LHAAP-003-R, LHAAP-16, LHAAP-17, and a color copy of the AECOM slide presentation were provided for meeting attendees. In addition, RAB application forms were available at the sign-in table.

Welcome and Introduction

Mr. Paul Fortune, RAB Co-Chair, called the meeting to order.

Mr. Fortune introduced Mr. Dan Murphy and Dr. Carl Turner. Dr. Rose Zeiler said that if they wished to serve on the RAB, there were paper applications at the sign-in table.

Mr. Fortune stated that he noticed there was an announcement in the paper that was a long list of sites for the Army Ammunition Plant, but that he did not see the RAB October 2016 meeting announcement in the newspaper. Dr. Zeiler and Ms. Debra Richmann were surprised; they did

not know what the list of sites that Mr. Fortune referred to seeing in the newspaper was. Ms. Richmann explained that the RAB October 2016 meeting announcement and the Notice of Availability of Final RODs were published in the Marshall News Messenger on October 13, 2016. Additionally, the October 2016 RAB Meeting was publicized in numerous locations including PSAs at three radio stations and two TV events calendars. Also, churches in Karnack were mailed RAB announcements on October 7, 2016, and RAB Meeting fliers were posted at multiple locations in the community. RAB meeting notices and releases of Final RODs were also sent to State, Federal and local officials and local groups. Outreach is summarized on Slide 4 of the presentation materials. Dr. Zeiler considered that the announcement Mr. Fortune saw that included a long list of sites may have been associated with an Army Ammunition Plant in Louisiana.

Open Items - Dr. Rose M. Zeiler

RAB Administrative Issues

Membership Update

Dr. Zeiler discussed the July meeting decision that the RAB membership list be updated to remove those no longer interested in serving. On October 11, 2016, letters were sent to RAB members that have not attended a RAB meeting since 2014. The letters asked members who wished to remain on the Board to contact a RAB member or one of the Co-Chairs on or before the date of the next meeting to express continued interest. Copies of the letters were provided to the RAB members that were in attendance. Letters were sent to the following individuals: Mr. Ken Burkhalter, Mr. Robert Cargill, Mr. Walter Lee Guice, Mr. Ted Kurz, and Mr. Jim Lambright. Recipients of the letters did not express interest to remain on the Board. Mr. Fortune made a motion to remove the inactive members from the Board. Mr. John Pollard Jr. seconded the motion. The abovementioned inactive members will be removed from the Board.

Minutes

Dr. Zeiler asked the RAB members if anyone wanted to make a motion to approve the minutes from the July 2016 RAB meeting. Mr. Richard LeTourneau made a motion to accept the July 2016 minutes and Mr. Fortune seconded the motion. The approved July 2016 RAB minutes will be posted on the LHAAP website.

Meeting Schedule

Dr. Zeiler asked if the standard RAB meeting time (third Thursday of every month) should be changed since it conflicts with Water Board meetings. Two RAB members, Mr. Terry Britt and Ms. Judy VanDeventer are Water Board members. Mr. Fortune asked that the conversation be postponed until Ms. VanDeventer could participate in the discussion; Ms. VanDeventer arrived later to the RAB meeting because she had to attend the Water Board meeting. Later, after Ms. VanDeventer had arrived, discussion on this topic continued. Mr. Pollard stated that he had a conflict with moving the RAB meetings to Tuesdays. Moving the RAB meeting start time to later in the evening was discussed, but was not favorable. Several attendees indicated Mondays

were not suitable due to travel constraints. Ms. VanDeventer and Mr. Britt stated that they would change the regular meeting time of the Water Board meetings to not conflict with the RAB meetings. Ms. VanDeventer and Mr. Britt stated that keeping the RAB meetings the third Thursday of each month was their preference. The discussion concluded that there would be no change to the current RAB meeting schedule. Future meetings will remain on the third Thursday of each month starting at 6:00 p.m.

Website Update

Ms. Richmann said that the website was being updated for the third quarter of the year. Ms. Richmann also stated that in the future, the date for the next RAB meeting will be posted on the website farther in advance of the scheduled meeting.

Site-wide Environmental Restoration Issues – Dr. Zeiler and Ms. Richmann

Dispute Update

Dr. Zeiler discussed that the disputed RODs were finalized for LHAAP-16, LHAAP-17, LHAAP-001-R, and LHAAP-003-R. Copies of the responsiveness summaries from each of the Final RODs were available at the sign-in table, as well as a fact sheet on the ROD for each site. Complete copies of the Final RODs are available at the Marshall Public Library. In response to a question, Ms. Richmann clarified that compact disks with the RODs are at the library, not hard copies.

Ms. Richmann reviewed the remedy for LHAAP-16 (slides 11-13). The remedy includes maintenance of the existing landfill cap, land use controls, and in-situ enhanced bio-remediation, passive bio-barriers, and monitored natural attenuation for volatile organic compounds and perchlorate in groundwater. Mr. Fortune asked for clarification on why groundwater was to be returned to its potential beneficial uses as drinking water, “wherever practicable.” Dr. Zeiler responded that TCE can become trapped in the fine-grained soils and is not able to be treated in that situation, so remediation to drinking water standards might not be “practicable.”

Ms. Richmann reviewed the remedy for LHAAP-17 (slides 14-16). The remedy includes excavation and off-site disposal of soil contaminated with perchlorate and explosives; and extraction, land use controls, and monitored natural attenuation for groundwater contaminated with volatile organic compounds and perchlorate. The LUCs are to prevent human health and ecological exposure. Extracted groundwater goes to the groundwater treatment plant.

The remedial actions for the other two disputed ROD sites, LHAAP-001-R-01 (South Test Area/Bomb Test Area) and LHAAP-003-R-01 (Ground Signal Test Area) were also discussed by Dr. Zeiler and Ms. Richmann (slides 17 through 21). The main remedial technology for both sites is land use controls with limited groundwater sampling for perchlorate – three annual rounds at LHAAP-001-R-01 and a single round at LHAAP-003-R-01. Dr. Zeiler pointed out that signs are in place at the two MMRP sites that note the restrictions.

Post-ROD Schedule for Disputed ROD Sites

Dr. Zeiler discussed the post-ROD schedule for the four disputed ROD sites (slide 22). There is a big gap in the schedule where no draft reports will be submitted from December 2016 through February 2018 due to the follow-on contract award process. AECOM is working to complete reports by November 30, 2016, so that these reports will be available to contractors proposing on the follow-on contract as Government Furnished Information.

LHAAP-4 Draft Final Revised ROD

Ms. Richmann discussed that the Draft Final Revised ROD is undergoing review by EPA and TCEQ.

Updated Schedule

Dr. Zeiler discussed that AECOM is working to complete reports and plans by November 30, 2016, so that these documents may be available for contractors proposing on the follow-on contract. Reports will not be published after November 30, 2016, so that the current contractor does not have an unfair advantage during the upcoming procurement process. The Army plans to issue the request for proposals for the follow-on contract December 1, 2016. The contracting process has to follow federal acquisition regulation (FAR) requirements.

1,4-Dioxane Confirmation Sampling at LHAAP-18/24

Mr. Charles Dixon had previously asked about 1,4-dioxane results at LHAAP-18/24. Ms. Richmann provided a brief recap of the initial round of 1,4-dioxane sampling at LHAAP-18/24, which was performed in October/November 2015. She said the purpose of the second round of sampling performed in June 2016 was to confirm the first round results and determine if a contingency remedy for 1,4-dioxane in groundwater will be needed. In June, a total of 52 monitoring wells at the site were sampled. Detected concentrations exceed the TRRP Tier 1 groundwater residential PCL in samples from six wells during the 2015 event and from four of the wells that were resampled in June 2016. The extent of 1,4-dioxane is limited (slide 28).

Mr. Britt asked if 1,4-dioxane will be treated by the current groundwater treatment plant at the site. Dr. Zeiler said a big driver of revising the FS for this site is to recognize 1,4-dioxane as a contaminant of concern at the site and to identify a contingency remedy. The contingency remedy will be put in place if 1,4-dioxane is not addressed by the remedy implemented to address the other contaminants of concern at the site. Ms. April Palmie added that the groundwater treatment plant is running, which also keeps the groundwater plume controlled and prevents migration.

Defense Environmental Restoration Program (DERP) Update – AECOM (Debra Richmann)

MNA Site Updates (LHAAP-37, 46, 50, 58, 67)

Ms. Richmann provided an overview of the current status of the MNA sites at LHAAP (Slide 29). Dr. Zeiler and Ms. Palmie explained that sampling at LHAAP-37 is discontinued. The Army is waiting for the site to return to baseline conditions, following the Bio-Plug testing, before beginning the quarterly MNA monitoring.

LHAAP-29 Update

Ms. Richmann updated the current status of LHAAP-29, indicating that the Draft RI Addendum has now been reviewed by TCEQ and EPA, and responses to the agency comments were submitted. The RI Addendum was approved by EPA with TCEQ concurrence in August 2016. The FS addendum is in preparation.

LHAAP-18/24 Update

Ms. Richmann updated the current status of LHAAP-18/24 (slide 31). A Draft Revised FS was submitted to EPA and TCEQ for review on October 13, 2016. Submittal of the revised FS was originally scheduled for the spring of 2017, but it was expedited due to the follow-on contract procurement schedule.

LHAAP-47 Plant Area 3 Update

Dr. Zeiler explained that Army coordinated its plan to reassess groundwater conditions to get a good understanding of current site contamination. The additional data will be collected to inform the existing Draft Final ROD before it is finalized. The Post-Screening Investigation Work Plan was approved by EPA with TCEQ concurrence on September 30, 2016. However, due to time constraints, the actual investigation will be completed under the next PBR contract.

Groundwater Treatment Plant (GWTP) Update

Dr. Salameh provided an update on the LHAAP GWTP operations. Dr. Salameh was asked by Mr. Lowerre of Caddo Lake Institute what caused occasional perchlorate excursions observed during 2016. Dr. Salameh responded that the excursions were caused by varying factors including low nutrient concentrations and low temperature in the winter that affects biomass viability. Mr. Lowerre then asked what other factors there might be and Dr. Salameh indicated that perchlorate feed concentrations, rainfall and quantity of flow and levels of dissolved oxygen and nitrate could affect performance as well. Mr. Lowerre asked how we use this information to avoid future excursions. Dr. Salameh explained that future excursions are prevented by understanding what has caused issues in the past and making adjustments to prevent future excursions. Ms. Palmie further explained that the reactor beds, which are part of the remedy at the groundwater treatment plant, have their own contained ecosystem that is treating the perchlorate. AECOM samples the nutrients, dissolved oxygen, oxidation-reduction potential,

and pH, and also knows the nutrients that are being added into the system on a regularly scheduled basis. Dr. Salameh stated 800,000 to 1.2 million gallons are treated per month.

Surface Water and Perimeter Well Sampling Update

Ms. Richmann showed the slides with the surface water and perimeter well sampling locations (slide 35). Perchlorate was not detected in any of the samples collected in August 2016 from Harrison Bayou or GPW-1. A trace amount was detected in the sample from GPW-3 (0.141 µg/L), which is below the screening criteria (TRRP Tier 1 groundwater residential PCL of 17 µg/L). Mr. Britt noticed a spike on the graph (slide 36). Ms. Palmie clarified that the spike occurred in August 2009, before the source of the perchlorate was removed.

Groundwater samples were collected in June from the six perimeter wells. Perchlorate was not detected in four of the wells, 108, 110, 111, and 112. Perchlorate was detected below screening criteria (TRRP Tier 1 groundwater residential PCL of 17 µg/L) at wells 133 and 134.

Dr. Zeiler noted that surface water sampling will no longer be necessary when the site remedies are implemented.

Vintage World War II Era and Post-World War II Era Photos

Old photos of the LHAAP were provided in the RAB presentation (slides 39 through 48). The first photo is of LHAAP-49.

Next RAB Meeting Schedule and Closing Remarks

The next RAB meeting will be held on **January 19, 2017**, at the same time (**6:00 – 7:30 p.m.**) at the Karnack Community Center.

Adjourn

Motion to adjourn was made by Mr. Fortune and seconded by Ms. VanDeventer.

October 2016 Meeting Attachments and Handouts:

- Meeting Agenda
- PowerPoint Presentation Slides
- Groundwater Treatment Plant [GWTP] – Processed Groundwater Volumes Handout
- Harrison Bayou and Goose Prairie Creek – Perchlorate Data Handout
- LHAAP Perimeter Well Monitoring – Perchlorate Data Handout
- LHAAP-16, Landfill 16 Selected Remedy Fact Sheet
- LHAAP-17, Burning Ground No. 2/Flashing Area Selected Remedy Fact Sheet
- LHAAP-001-R, South Test Area/Bomb Test Area Selected Remedy Fact Sheet
- LHAAP-003-R, Ground Signal Test Area Selected Remedy Fact Sheet
- LHAAP-16 ROD Responsiveness Summary
- LHAAP-17 ROD Responsiveness Summary
- LHAAP-001-R-01 and LHAAP-003R-01 ROD Responsiveness Summary

Acronyms

µg/L	micrograms per liter
AECOM	AECOM Technical Services, Inc.
BRAC	Base Realignment and Closure
DERP	Defense Environmental Response Program
FAR	Federal Acquisition Regulation
FS	Feasibility Study
GWTP	Groundwater Treatment Plant
LHAAP	Longhorn Army Ammunition Plant
LUCs	Land Use Controls
MMRP	Military Munitions Response Program
MNA	Monitored Natural Attenuation
PBR	Performance-Based Remediation
PCL	Protective Concentration Level
PSA	Public Service Announcement
RAB	Restoration Advisory Board
RI	Remedial Investigation
ROD	Record of Decision
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
TRRP	Texas Risk Reduction Program
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Center
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey



LONGHORN ARMY AMMUNITION PLANT
RESTORATION ADVISORY BOARD
Karnack, Texas
(479) 635-0110

AGENDA

DATE: Thursday, October 20, 2016
TIME: 6:00 – 7:30 PM
PLACE: Karnack Community Center, Karnack, Texas

- 06:00** Welcome and Introduction
- 06:05** Open Items {RMZ}
- RAB Administrative Issues
 - Minutes (July 2016 RAB Meeting)
 - Website
- 06:15** Sitewide Environmental Restoration Issues {RMZ}
- Dispute Sites Update
 - Final RODs for LHAAP-16, LHAAP-17, and LHAAP-001-R and LHAAP-003-R
 - Revised Draft Final LHAAP-004 ROD
 - Updated Schedule, Environmental Contract Ending
 - Ongoing Outreach – Public Notification Efforts for the October 2016 RAB
 - Results of 1,4-Dioxane Sampling at LHAAP-18/24
- 06:35** Defense Environmental Restoration Program (DERP) Update {AECOM}
- MNA Sites Update
 - LHAAP-29 Update
 - LHAAP-18/24 Update
 - LHAAP-47 PSI Update
 - Groundwater Treatment Plant (GWTP) Update
- 07:20** World War II era photos
- Next RAB Meeting Schedule and Closing Remarks
- Discuss changing the RAB meeting date to avoid a conflict with Caddo Lake Water Supply Corp. meetings, which meet on the 3rd Thursday of the month from 5:30 – 6:30 p.m.
- 07:30** Adjourn {RMZ}

Longhorn Army Ammunition Plant Restoration Advisory Board Meeting October 20, 2016

A faint, light green graphic of a leafy branch is positioned on the right side of the slide, overlapping the blue and green background areas.

AECOM Environment

Agenda

AGENDA

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- 07:30** Adjourn {RMZ}

Open Items

- RAB Administrative Issues
- Membership Update
- Outreach Efforts
- Minutes from July 2016 RAB Meeting
- Website Update

Ongoing Outreach - Notifications for October RAB Meeting

- Published RAB meeting announcement in Marshall News Messenger on October 13th
- Published Notice of Availability of Final RODs in Marshall News Messenger on October 13th
- Requested the following radio stations to air October RAB Meeting Public Service Announcement (PSA):
 - KMHT Radio 103.9 (Karnack)
 - 98 Rocks (Alpha Media, Shreveport) and
 - Kiss Country 93.7 (Town Square Media, Shreveport)
- Requested PSA to be placed on KTBS Channel 3 and KTAL Channel 6 TV Community/Local Events Calendar
- Sent RAB announcement/agenda by email or USPS to individual RAB members and other interested parties
- Mailed RAB announcement to churches in Karnack on October 7th
- Sent RAB notice and Final RODs news release to State, Federal and local officials and local groups
- Posted RAB Meeting Fliers at multiple locations in the community:
 - Shady Glade Café, Caddo Grocery, Fyffes Corner Store, Circle S Grocery, Run In Grocery, Family Dollar Store, Convenience Store at FM9 and FM199

The Army Wants You to be Informed!

- The Army is committed to protecting human health and the environment; key to that commitment is engaging the community and increasing public participation in environmental restoration at LHAAP.
- You are encouraged to:
 - Attend RAB meetings and/or become a member of the RAB
 - Visit the Longhorn environmental website at www.longhornaap.com
 - Make suggestions for improving communication – the Army welcomes and appreciates community feedback

Minutes from Past RAB Meetings

- Discussion of July 2016 RAB Meeting Minutes/Motion to accept

Website Update



Longhorn Army Ammunition Plant Environmental Restoration Program

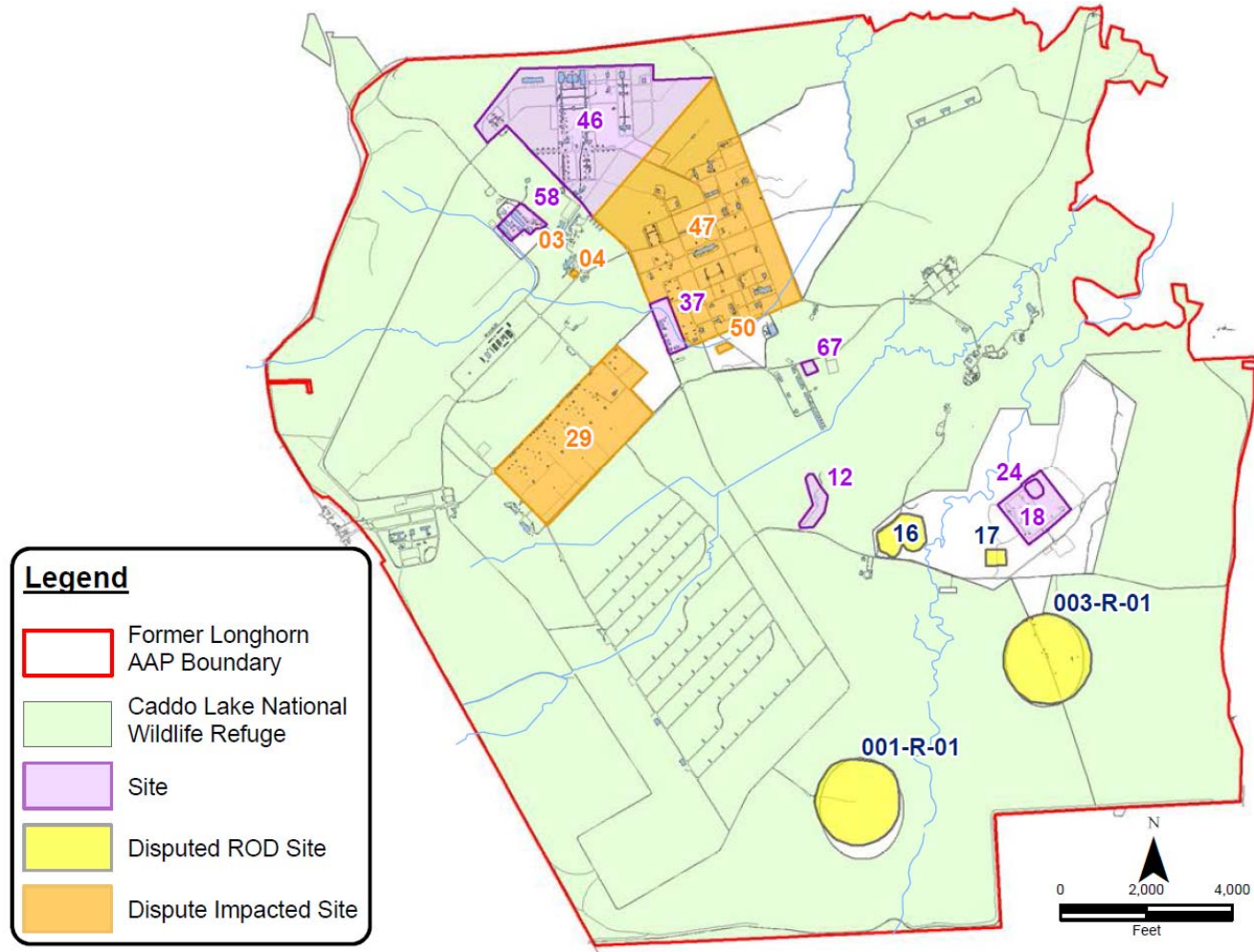
The next RAB meeting will be Thursday, October 20, 2016 from 6:00-7:30PM at the Karnack Community Center, Karnack, Texas [Click on Calendar for Meeting Agenda and Details.](#)

Site-wide Environmental Restoration Issues

Active LHAAP Performance-Based Remediation Sites (* Disputed ROD Site)

LHAAP-03	Building 722 Paint Shop
LHAAP-04	Pilot Wastewater Treatment Plant
LHAAP-12	Landfill 12
LHAAP-16	Landfill 16*
LHAAP-17	Burning Ground No.2/Flashing Area*
LHAAP-18	Burning Ground No.3
LHAAP-24	Unlined Evaporation Pond
LHAAP-29	Former TNT Production Area
LHAAP-37	Chemical Laboratory Waste Pad
LHAAP-46	Plant Area 2
LHAAP-47	Plant Area 3
LHAAP-50	Former Sump Water Tank
LHAAP-58	Maintenance Complex
LHAAP-67	Aboveground Storage Tank Farm
LHAAP-001-R	South Test Area/Bomb Test Area*
LHAAP-003-R	Ground Signal Test Area*

Longhorn Performance-Based Remediation Sites Map



Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R

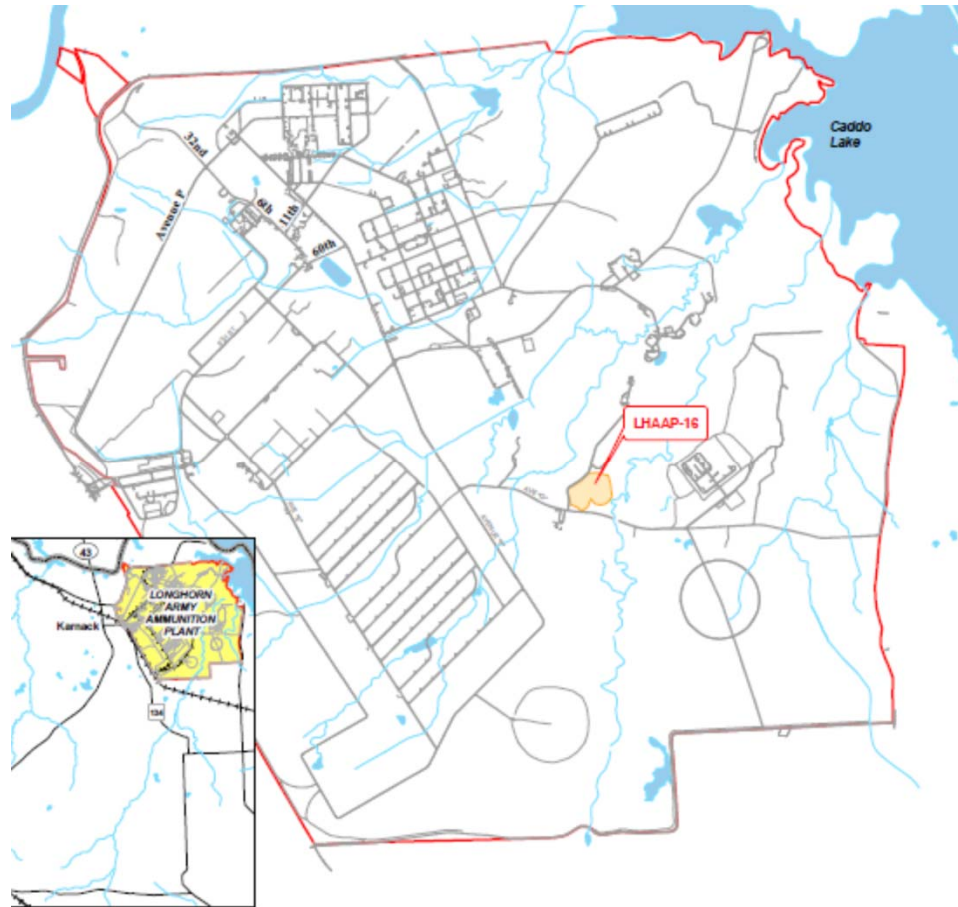
- Copies of the Responsiveness Summaries from each of the Final RODs are available at the sign in table
- Complete copies of the Final RODs are available to the public at the Marshall Public Library, 300 S. Alamo, Marshall, Texas, 75670
 - Library hours are 10:00 A.M. to 8:00 P.M. Monday through Thursday, and 10:00 A.M. to 5:30 P.M. Friday and Saturday.
- For more information, contact Dr. Rose M. Zeiler, Longhorn Army Ammunition Plant, P.O. Box 220, Ratcliff, Arkansas, 72951; phone number 479-635-0110; e-mail rose.m.zeiler.civ@mail.mil.

Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)

Final ROD for LHAAP-16

- The Selected Remedy is **Maintenance of Landfill Cap, Land Use Controls (LUCs), In-Situ Enhanced Bio-remediation, Bio-barriers, and Monitored Natural Attenuation (MNA)**
- The Selected Remedy will achieve the following Remedial Action Objectives (RAOs):
 - Protection of human health and the environment by preventing exposure to landfill wastes;
 - 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 to Harrison Bayou at levels that cause surface water in Harrison Bayou to exceed surface water criteria; and
 - Return of groundwater to its potential beneficial uses as drinking water, wherever practicable
- A **Fact Sheet** that provides additional information on the Final LHAAP-16 ROD is available at the check in table

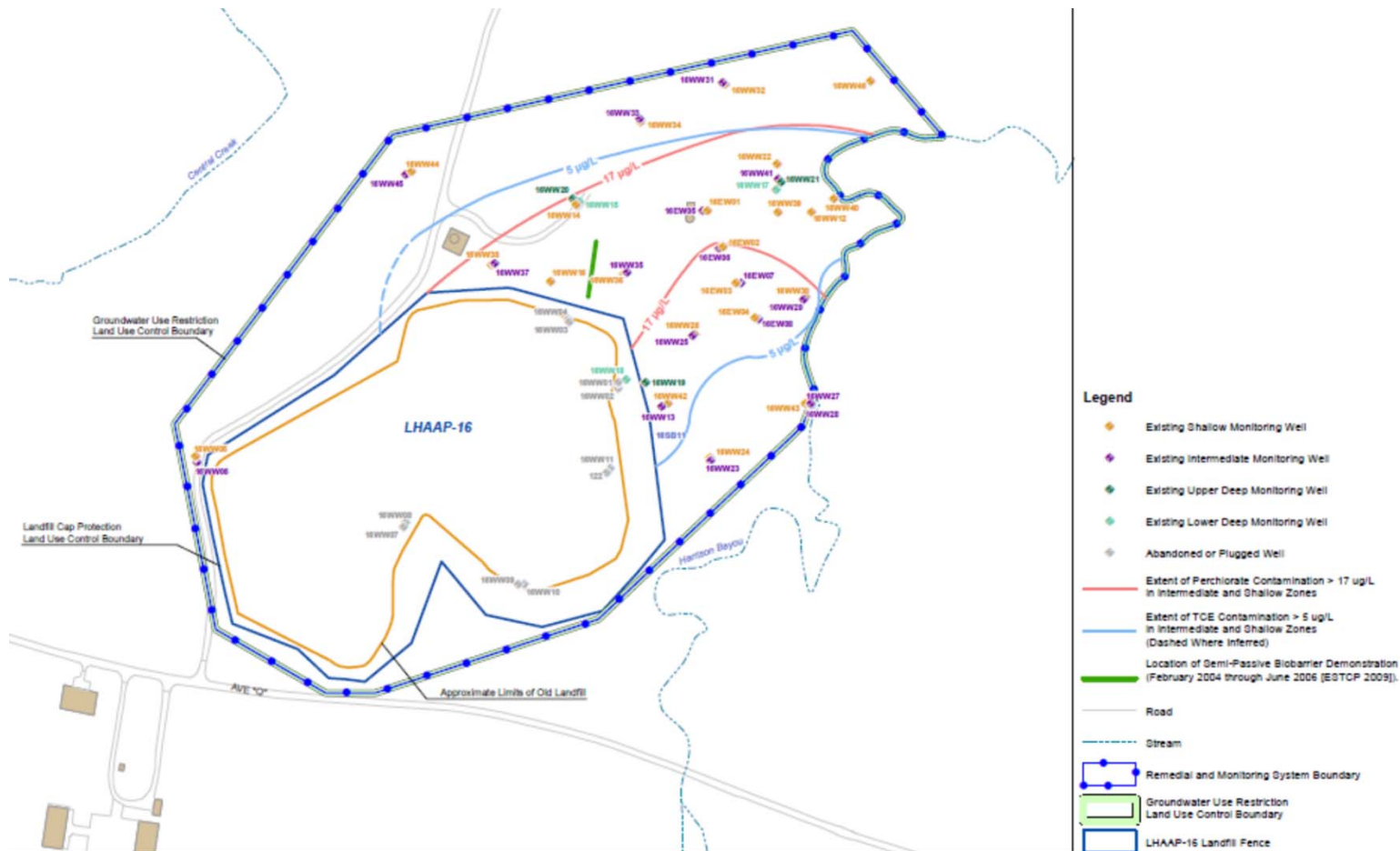
Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-16, Landfill

SELECTED REMEDY: Cap Maintenance, Land Use Controls, In Situ Enhanced Bioremediation, Biobarriers, and Monitored Natural Attenuation

Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-16, Landfill

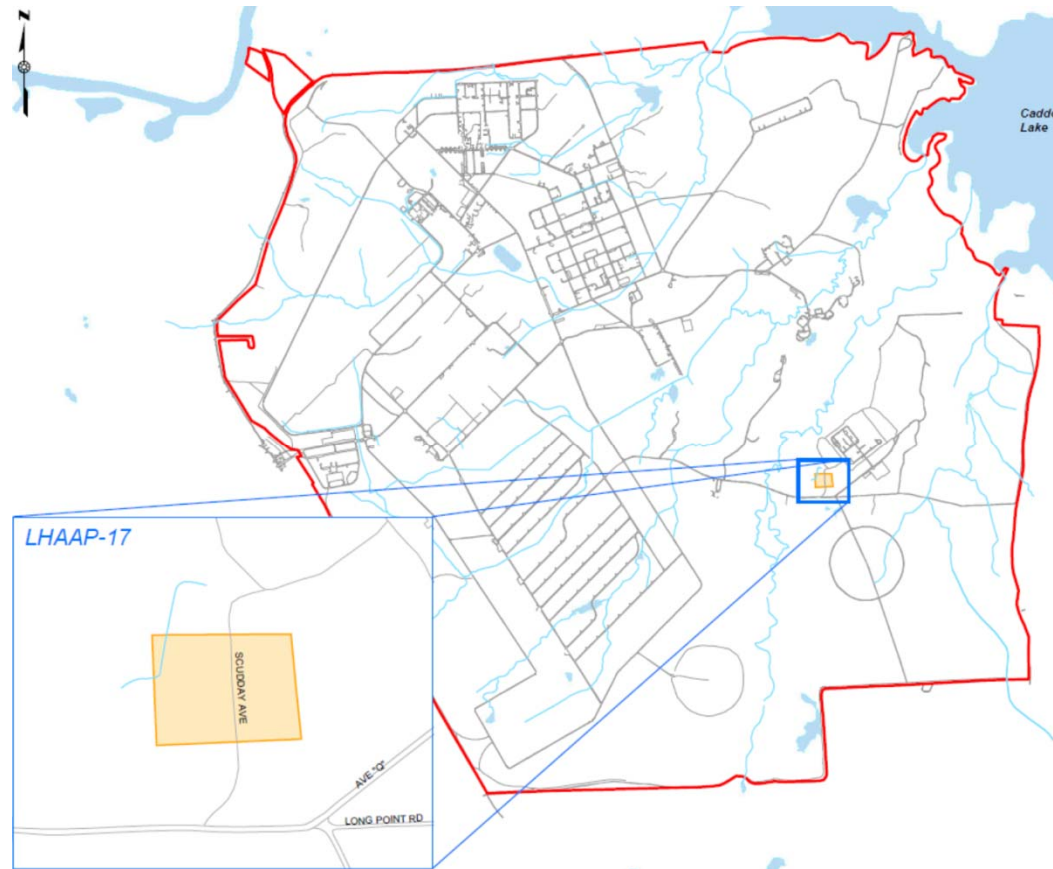
SELECTED REMEDY: Cap Maintenance, Land Use Controls, In Situ Enhanced Bioremediation, Biobarriers, and Monitored Natural Attenuation

Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)

Final LHAAP-17 ROD

- The Selected Remedy is **Contaminated Soil Removal, Extraction and Treatment of Groundwater, MNA and LUCs**
- The Selected Remedy will achieve the following RAOs:
 - Protection of human health by preventing human exposure to contaminated groundwater and contaminated soil;
 - Protection of human health by preventing further potential degradation of groundwater from contaminated soil;
 - Protection of ecological receptors by preventing exposure to contaminated soil;
 - Protection of human health and the environment by preventing contaminated groundwater from migrating into nearby surface water; and
 - Return of groundwater to its potential beneficial uses as drinking water, wherever practicable
- A **Fact Sheet** that provides additional information on the Final LHAAP-17 ROD is available at the check in table

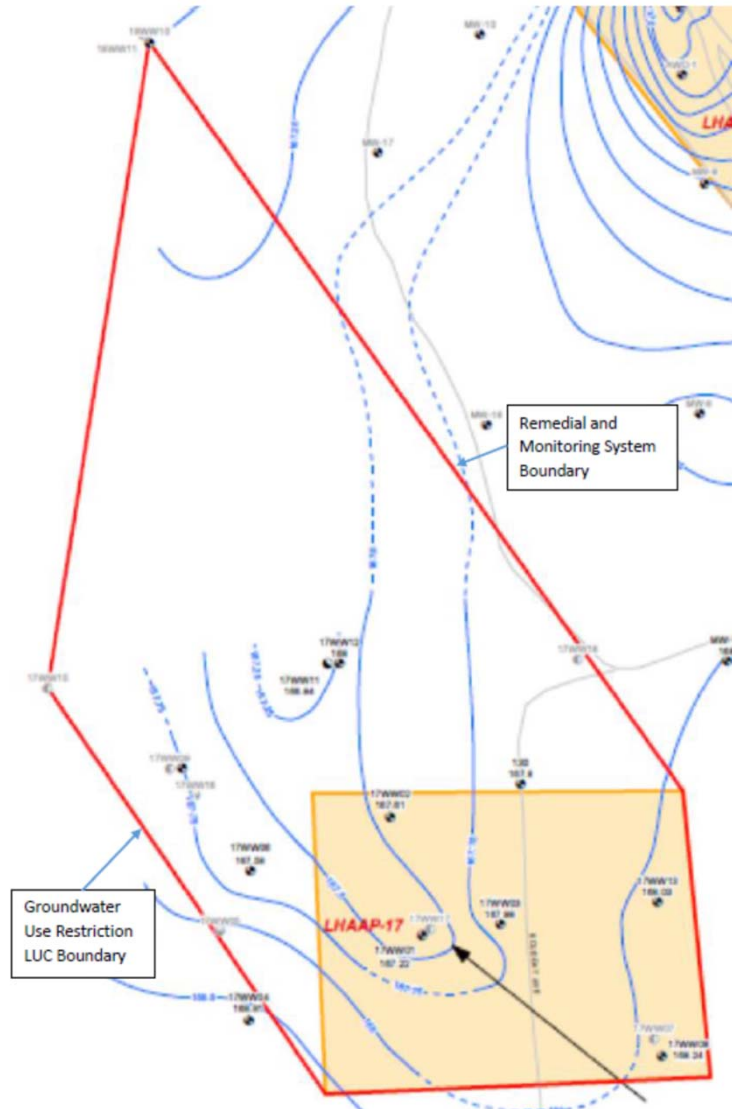
Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-17, Burning Ground No. 2/Flashing Area

SELECTED REMEDY: Excavation and Offsite Disposal of Soil, Groundwater Extraction, Monitored Natural Attenuation and Land Use Controls

Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



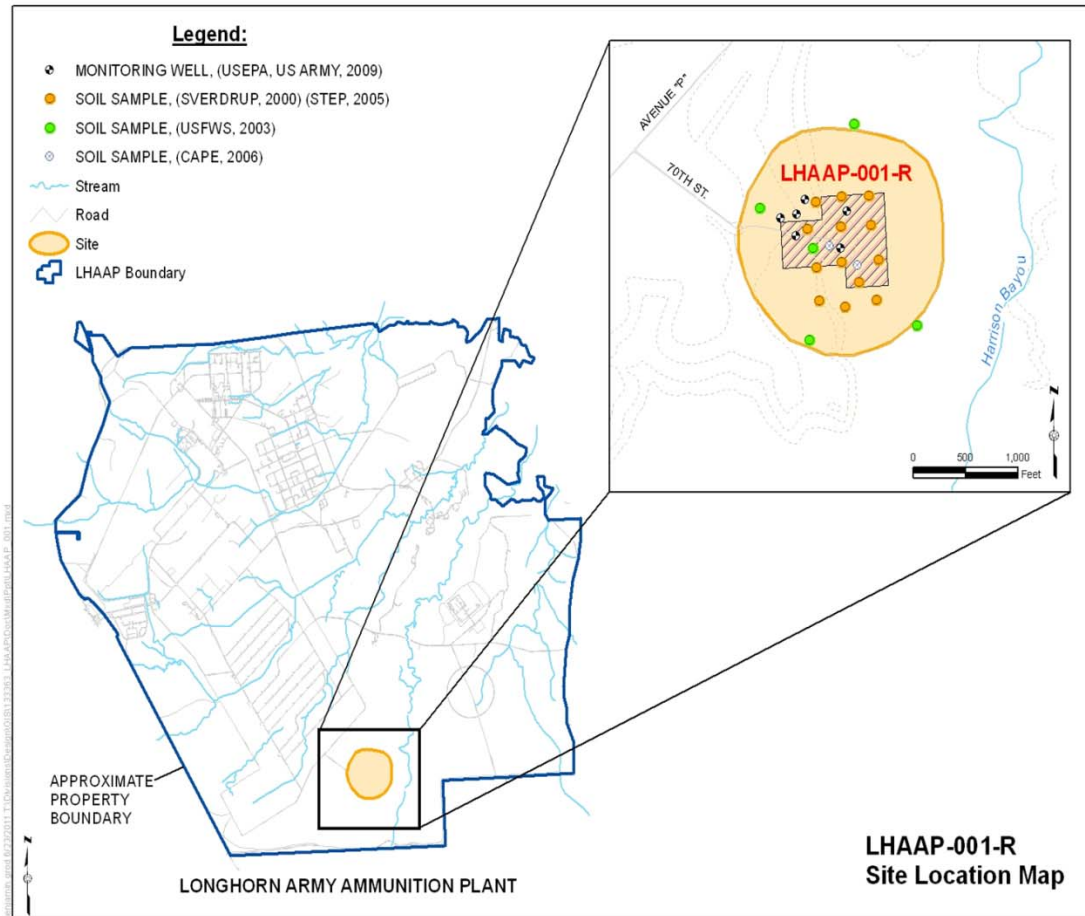
LHAAP-17, Burning Ground No. 2/Flashing Area
SELECTED REMEDY: Excavation and Offsite Disposal of Soil, Groundwater Extraction, Monitored Natural Attenuation and Land Use Controls

Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)

Final RODs for LHAAP-001-R and LHAAP-003-R

- The Selected Remedy is **LUCs and Limited Groundwater Monitoring**
- The Selected Remedy will achieve the following RAO:
 - Protection of human health and safety from explosive hazards that may have remained at the site after the Munitions and Explosives of Concern (MEC) removal action, and confirmation that perchlorate is still present in groundwater at levels below the chemical specific criterion
- Implementation of the LUCs will:
 - Prohibit development and use of the property for residential housing, schools, and child care facilities and playgrounds, and prohibit intrusive activities such as digging and any other activity that will result in explosive safety risks
 - Prohibit residential land use until it is demonstrated that the MEC no longer presents a threat to public/human safety
 - Restricts land use to non-residential until it is demonstrated that MEC no longer presents a threat to public/human safety; and
 - Prohibits intrusive subsurface activities, including digging, until it is demonstrated that MEC no longer presents a threat to public/human safety
- Implementation of Limited Groundwater Monitoring will confirm the perchlorate level is below the residential cleanup level (Texas Risk Reduction Program [TRRP] Tier 1 Groundwater Residential Protective Concentration Level [PCL] of 17 ug/L)
- **Fact Sheets** that provide additional information on the Final LHAAP-001-R and LHAAP-003-R RODs are available at the check in table

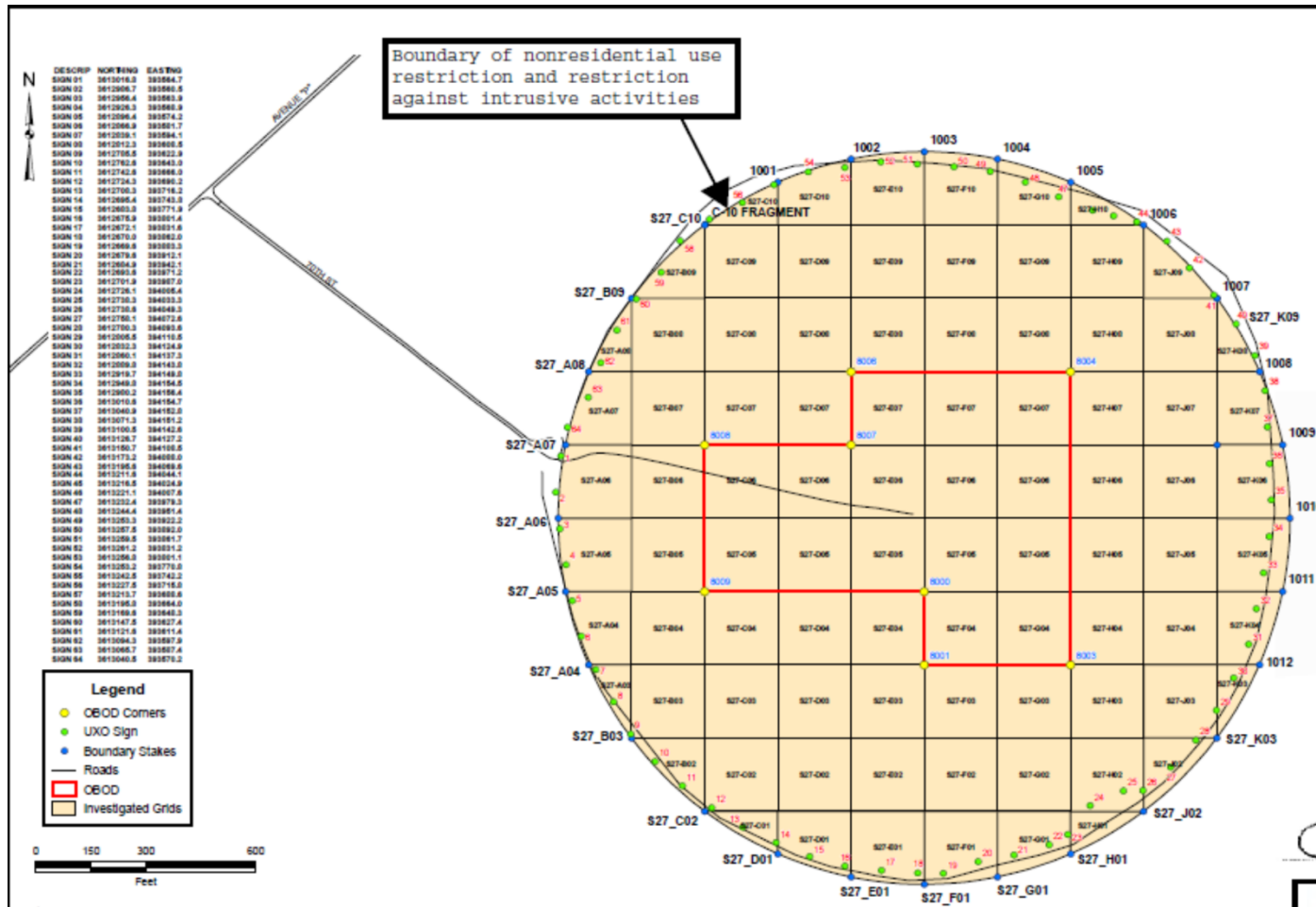
Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-001-R, South Test Area/Bomb Test Area

SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring

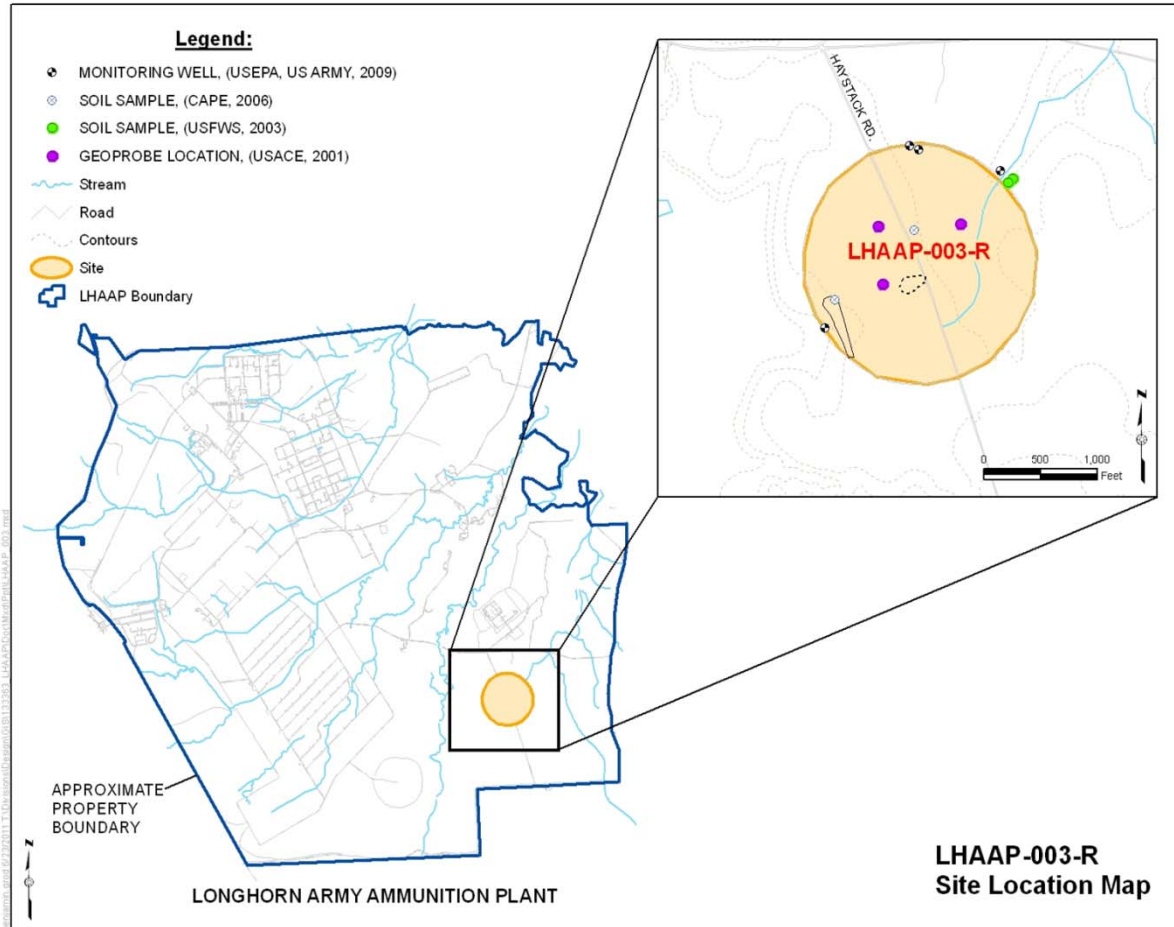
Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-001-R, South Test Area/Bomb Test Area

SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring

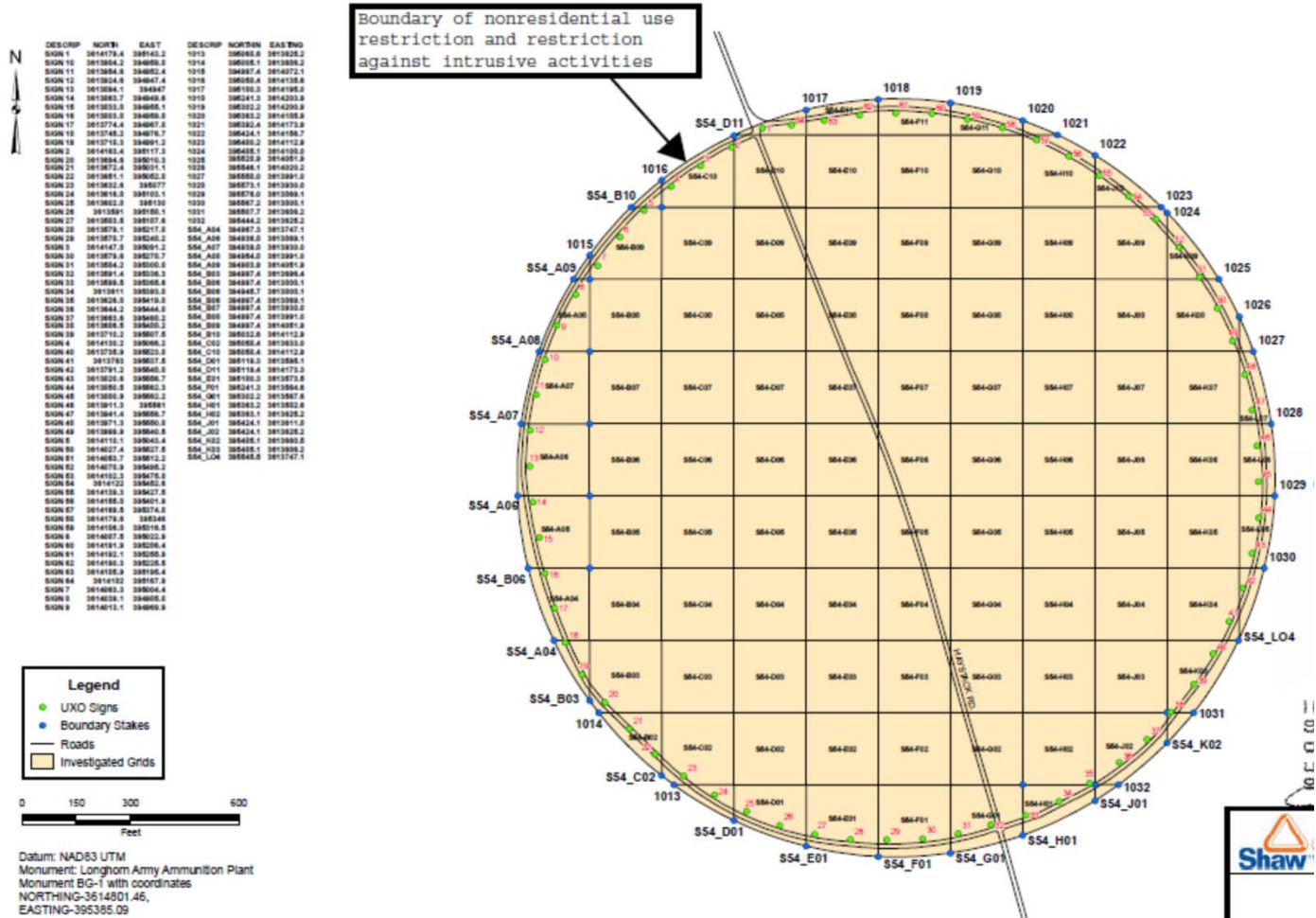
Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-003-R, Ground Signal Test Area

SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring

Final RODs for Disputed Sites LHAAP-16, LHAAP-17, and LHAAP-001-R and -003-R (cont.)



LHAAP-003-R, Ground Signal Test Area

SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring

Post-ROD Schedule for the Four Disputed ROD Sites

- LHAAP-16 Draft Remedial Design (RD) submitted October 14, 2016
Draft Remedial Action Work Plan (RAWP) due February 13, 2018
- LHAAP-17 Draft Pre-Design Investigation WP submitted September 29, 2016
Draft Pre-Design Investigation Report due May 14, 2018
Draft RD due November 14, 2018
Draft RAWP due April 15, 2019
- LHAAP-001-R Draft Land Use Control RD February 7, 2018
- LHAAP-003-R Draft Land Use Control RD February 7, 2018

Revised Draft Final ROD for Dispute Impacted Site LHAAP-004

Draft Final Revised ROD for LHAAP-004

- The Selected Remedy is **Alternative 3** from the Proposed Plan – **Targeted In-Situ Bioremediation, Long-Term Monitoring (LTM), and LUCs**
- The Selected Remedy will achieve the following RAOs:
 - Protection of human health by preventing ingestion of groundwater contaminated with perchlorate;
 - Return groundwater to its potential beneficial use, wherever practicable, within a reasonable time period, give the site-specific conditions; and
 - Prevent groundwater contaminated with perchlorate from migrating into nearby surface water
- The Draft Final Revised ROD was submitted to EPA and TCEQ earlier this month (October) and is currently undergoing regulatory review

Dispute Impacted Sites

- Other Dispute Impacted Sites
 - LHAAP-03 – Building 722 Paint Shop
 - LHAAP-29 – Former TNT Production Area
 - LHAAP-47 – Plant Area 3
 - LHAAP-50 – Former Sump Water Tank

Updated Schedule, Environmental Contract Ending

- Current AECOM PBR contract ends September 30, 2017
- The deadline for remaining AECOM contract deliverables (reports and plans) is November 30, 2016. These include:
 - Final LHAAP-16 Remedial Design (RD)
 - Final LHAAP-17 Pre-Design Investigation (PDI) Work Plan
 - Final Supplemental to Updated LHAAP-18/24 PSI Report
 - Final LHAAP-18/24 Revised FS
 - Final LHAAP-37 Remedial Action Completion Report (RACR)
 - Final LHAAP-50 Year 1 and Year 2 RA-O Reports
 - Final LHAAP-67 Year 1 and Year 2 RA-O Reports
 - Final LHAAP-002 Year 1 Tech Memo (Oct 2015/Apr 2016)

Updated Schedule, Environmental Contract Ending (cont.)

- Groundwater monitoring will continue at select sites, and results from each event will be documented in a data validation package
- GWTP Operation and Maintenance, Perimeter Wells and Surface Water Sampling; and Mowing/LUC Monitoring will be performed throughout the remaining contract period of performance (September 30, 2017)

Results of 1,4-Dioxane Sampling at LHAAP-18/24

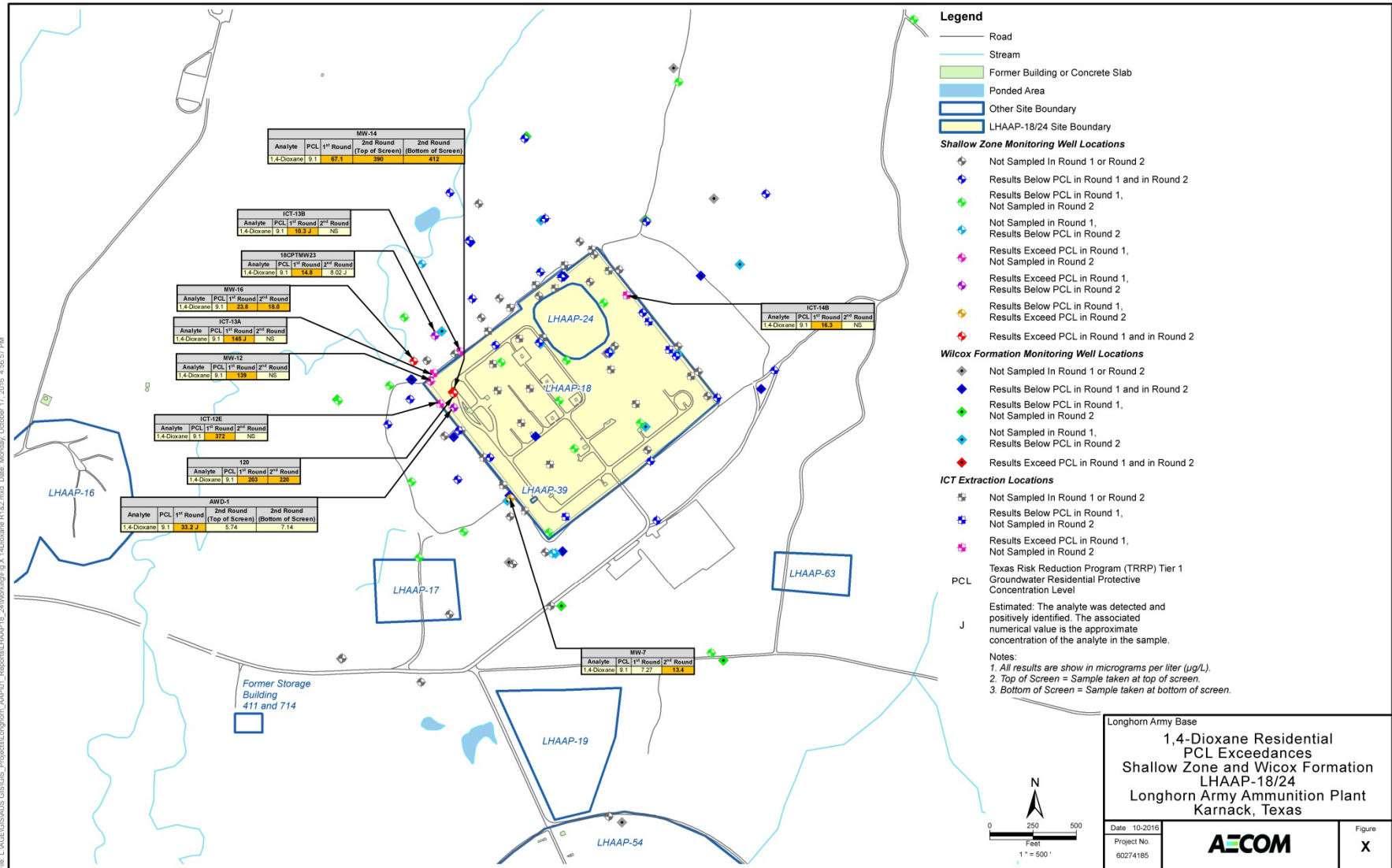
- **RECAP**

- Groundwater samples were collected from 66 monitoring wells and 7 ICTs at LHAAP-18/24 in late October/early November 2015 to evaluate extent of 1,4-dioxane. 1,4-dioxane was detected (>1 ug/L) in 40 samples. The detected concentrations exceed the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL) of 9.1 ug/L in samples from 6 wells (120, 18CPTMW23, AWD-1, MW-12, MW-14, and MW-16) and 4 ICTs (ICT-12E, 13A, 13B, and 14B)

- **1,4-Dioxane Confirmation Sampling Results**

- In June 2016, a total of 52 monitoring wells at LHAAP-18/24 were sampled for 1,4-dioxane. 1,4-dioxane was detected (>1 ug/L) in 17 samples. The detected concentrations exceed the TRRP Tier 1 Groundwater Residential PCL in samples from four of the wells that were resampled (120, MW-7, MW-14, and MW-16).
- The maximum 1,4-dioxane concentration detected in the first round of samples from the monitoring wells is 203 ug/L (well 120) vs. 220 ug/L (well 120) in the June 2016 confirmation sampling round. The overall maximum concentration (412 ug/L) was detected in the second round confirmation sample from MW14.
- The distribution of 1,4-dioxane concentrations detected above the TRRP Tier 1 Groundwater Residential PCL is shown in the following figure.

LHAAP-18/24 First and Second Round Groundwater Confirmation Samples with 1,4-Dioxane Concentrations Above the TRRP Tier 1 Groundwater Residential PCL (9.1 ug/L)



Defense Environmental Restoration Program (DERP) Update

• Monitored Natural Attenuation Sites Updates

- LHAAP-35B (37) – Chemical Laboratory
- LHAAP-46 – Plant Area 2
- LHAAP-50 – Former Sump Water Tank
- LHAAP-35A (58) – Shops Area
- LHAAP-67 – Aboveground Storage Tank Farm

- Land Use Control Boundary Surveys for groundwater use restriction are complete for all sites
- Final Remedial Action Completion Reports (RACRs) are complete for LHAAP-46, -50, 58, and -67; Draft Final Revised RACR for LHAAP-35B(37) currently undergoing regulatory review
- Year 1 Remedial Action Operation (RA-O) report for LHAAP-50 is undergoing regulatory review; and reports for LHAAP-46 and LHAAP-58 are final
- Year 2 RA-O report for LHAAP-50 is undergoing regulatory review; LHAAP-67 is drafted but not submitted; and reports for LHAAP-46 and LHAAP-58 are final
- Quarterly/Semi-Annual Groundwater Monitoring is ongoing at all sites except LHAAP-35B (37)
 - At LHAAP-35B(37), first quarterly sampling round completed in August; results to determine if quarterly sampling will continue

LHAAP-29 - Former TNT Production Area Update

- To address remedy design and implementation questions at the Draft Final ROD stage, the Remedial Investigation (RI) and Feasibility Study (FS) were re-opened to fill data gaps and a Supplemental Investigation was performed
- An RI Addendum based on the Supplemental Investigation results for LHAAP-29 was submitted to EPA and TCEQ and was approved by EPA with TCEQ concurrence in August 2016. The Final RI Addendum documents achievement of the following objectives:
 - Confirmed the extent of methylene chloride DNAPL in the Intermediate Zone groundwater
 - Confirmed the extent of VOC, perchlorate, and explosives contamination in the Shallow Zone groundwater
 - Determined there is no continuing source of VOC contamination in site soil
 - Characterized physical properties (resistivity, hydraulic conductivity, etc.) and microbial activity in Intermediate Zone to support further FS evaluation of remedial alternatives
- An FS Addendum, which incorporates the supplemental data in the Final RI Addendum to develop and evaluate an additional remedial alternative not included in the previous FS, is currently in preparation

LHAAP-18/24 Former Burning Ground No. 3 and Unlined Evaporation Pond Update

- To evaluate remedy alternatives for LHAAP-18/24, a Draft Revised FS was submitted to EPA and TCEQ and is currently undergoing review
- In addition to groundwater confirmation sampling results for 1,4-dioxane, the Revised FS incorporates the June 2016 semi-annual groundwater monitoring results for VOCs, perchlorate, and total metals
- The Revised FS also uses supplemental data obtained between February and June 2016, which is documented in the Draft Supplemental to the Updated Post-Screening Investigation Report, which includes:
 - DPT soil sampling at 17 locations and analysis for VOCs and perchlorate
 - Installation of seven additional monitoring wells (three screened in the Shallow Zone and four in the Wilcox Fm.), with soil samples collected from well borings to create a vertical profile of VOCs and perchlorate in the unsaturated zone
- Above information was used to prepare the Draft Revised FS for LHAAP-18/24, including contingency remedies for 1,4-dioxane, if necessary, which was submitted to EPA and TCEQ for review on October 13th

LHAAP- 47 Plant Area 3 Update

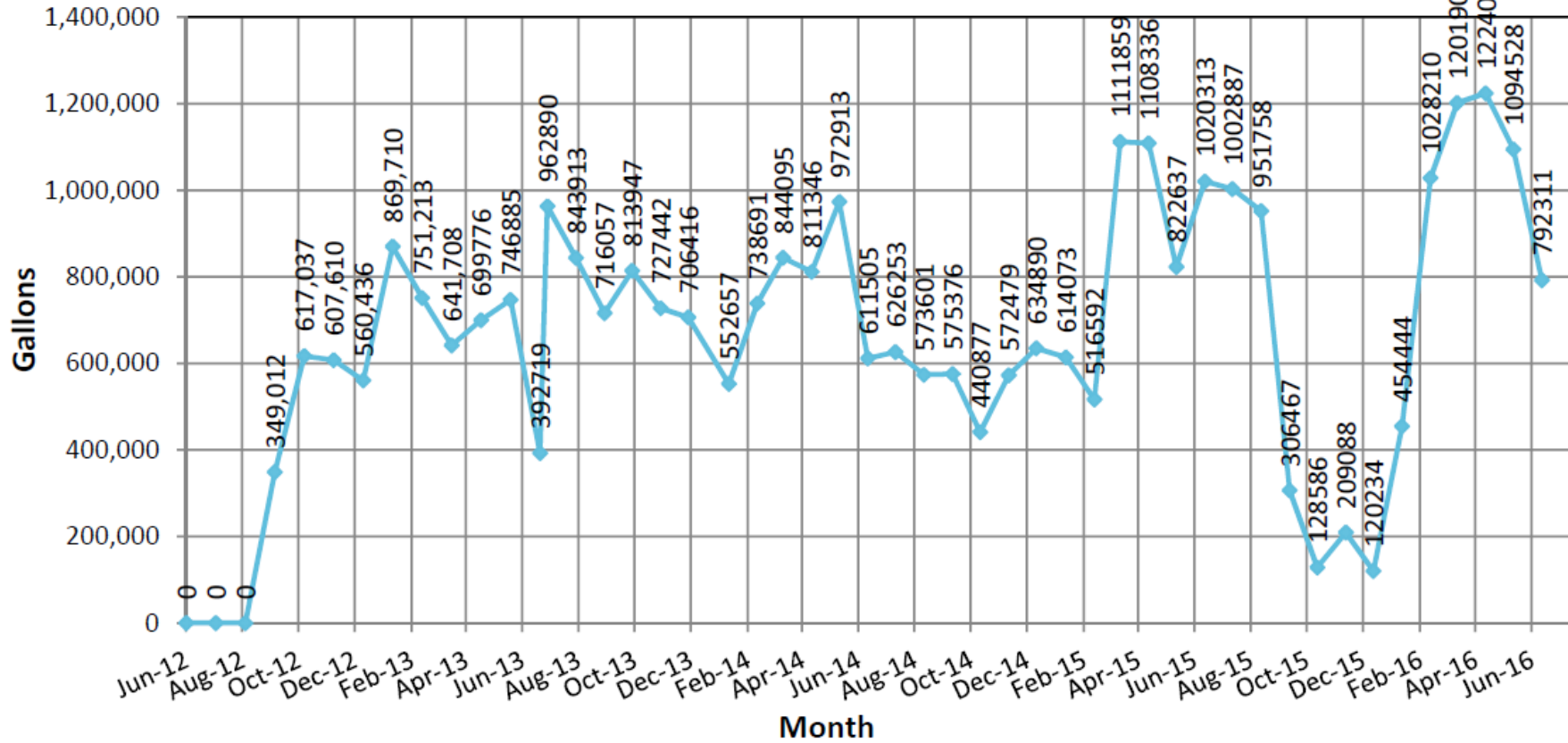
- Final LHAAP-47 Post-Screening Investigation Work Plan was reviewed and approved by EPA with TCEQ concurrence on September 30th
 - Objectives:
 - ✓ Re-assess VOCs and perchlorate in Shallow Zone and Intermediate Zone groundwater, and
 - ✓ Re-assess potential VOC- and perchlorate-contaminated groundwater contribution to surface water in Goose Prairies Creek and tributaries
 - Scope:
 - ✓ Collection of two grab groundwater samples from each of seven Shallow Zone soil borings and six Intermediate Zone soil borings, and analysis for VOCs and perchlorate;
 - ✓ Installation and development of 13 Shallow Zone monitoring wells and 4 Intermediate Zone monitoring wells
 - ✓ Re-development of existing wells and synoptic water level survey of all site wells
 - ✓ Collection and analysis of groundwater samples from the new wells and up to 30 existing Shallow Zone wells and 10 existing Intermediate Zone wells for VOCs, and/or perchlorate, plus additional constituents included in the ROD
 - ✓ Collection and analysis of four surface water samples for perchlorate and VOCs
- Post-Screening Investigation will be implemented under the next PBR contract

Groundwater Treatment Plant (GWTP) Update

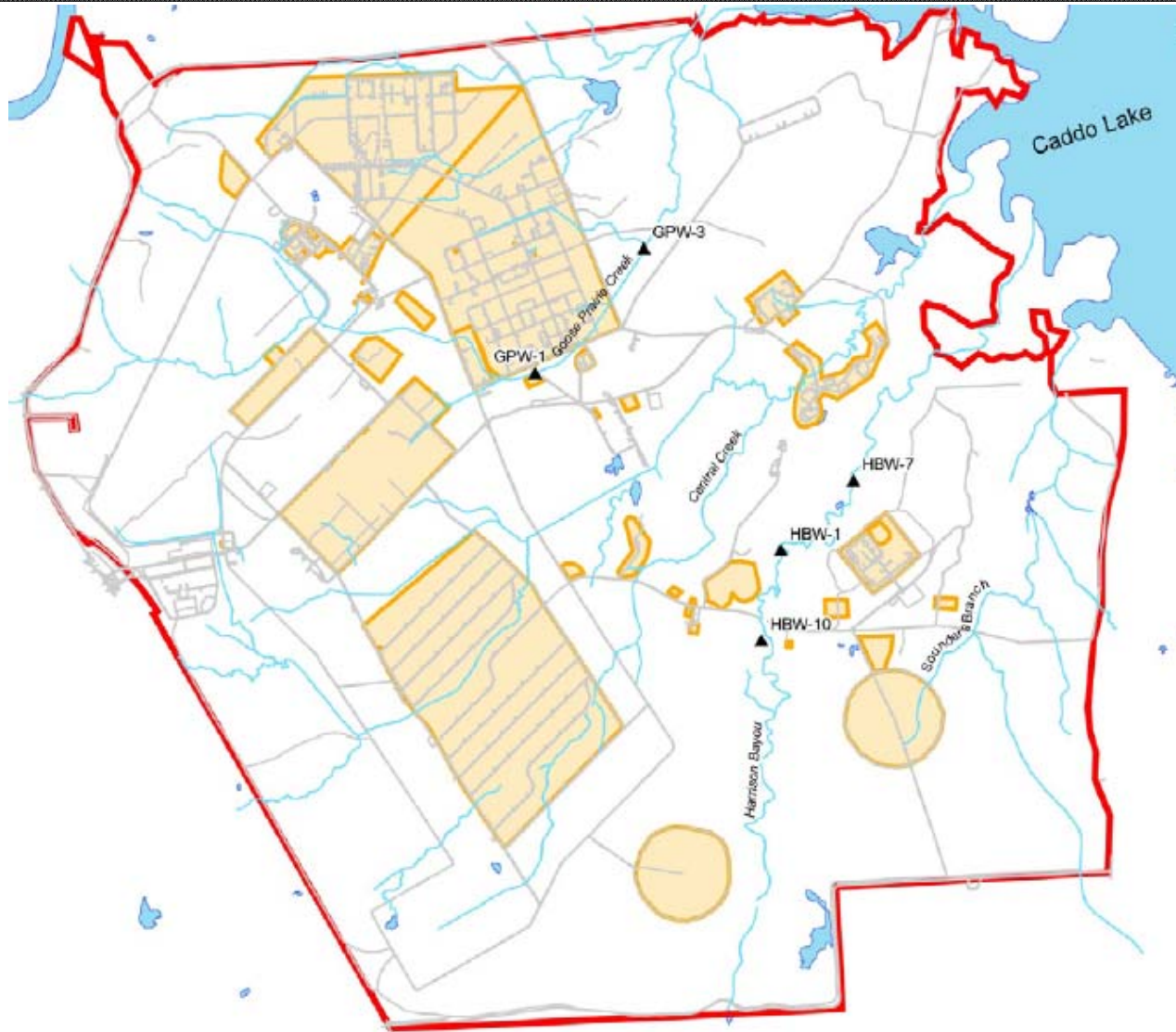
- The GWTP continues to operate to contain the plume at LHAAP-18/24 and LHAAP-16
- Treated groundwater is returned to LHAAP-18/24 through the sprinkler array
- LHAAP-18/24 groundwater compliance monitoring continues per existing sampling plan
- Maintenance and repairs of wells, pumps, tanks, and ancillary equipment is on-going. No major repairs have occurred since the air stripper blower was replaced in January 2016
- The FBR had a number of instances of perchlorate above the effluent limit in 2016. The treated water was released to the burning grounds (no discharge to Harrison Bayou). Potential causes for these excursions were investigated and addressed

GWTP Update (continued)

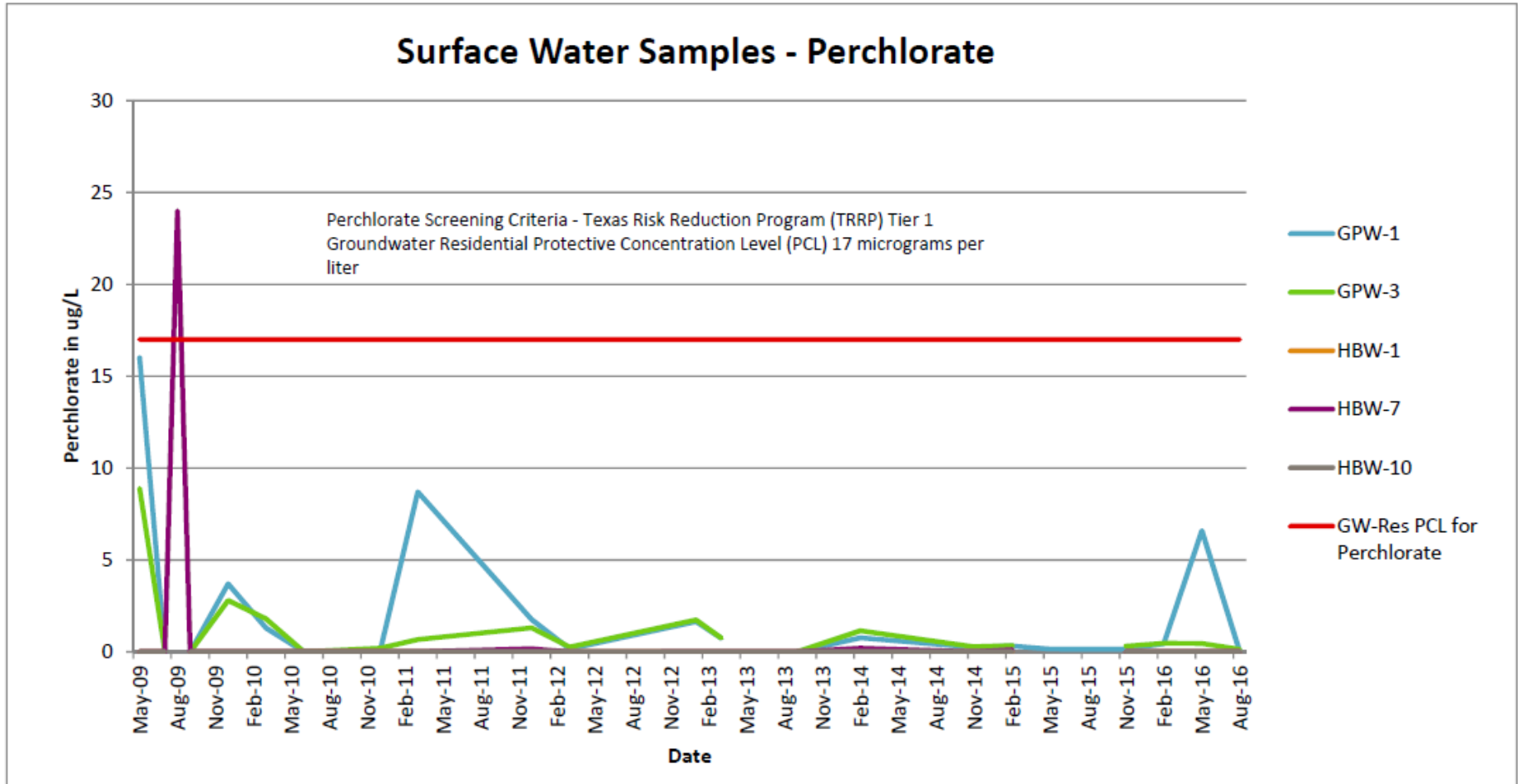
Water Treated Monthly from June 2012 through June 2016



Surface Water Sampling Locations

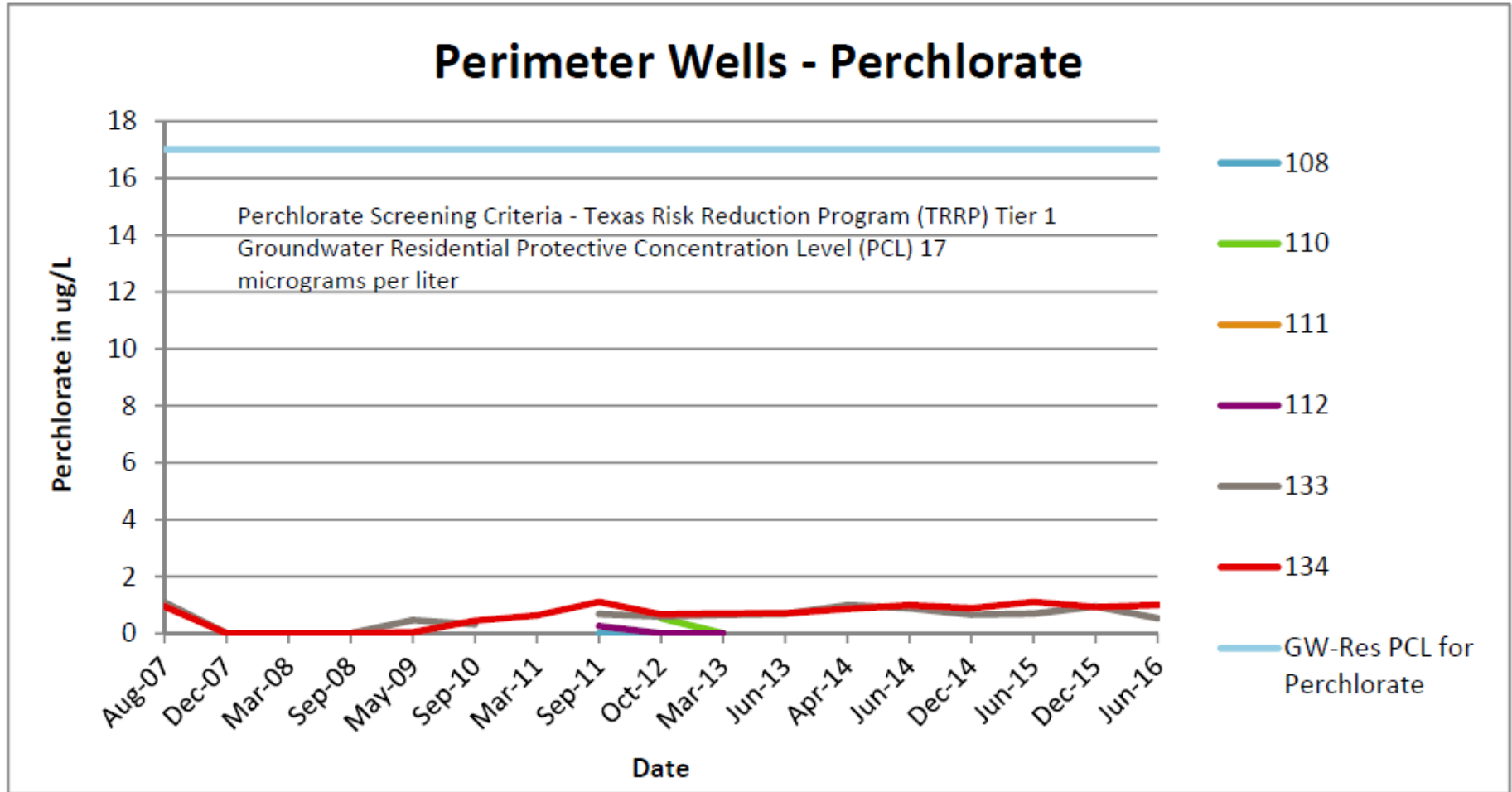


Surface Water Sampling



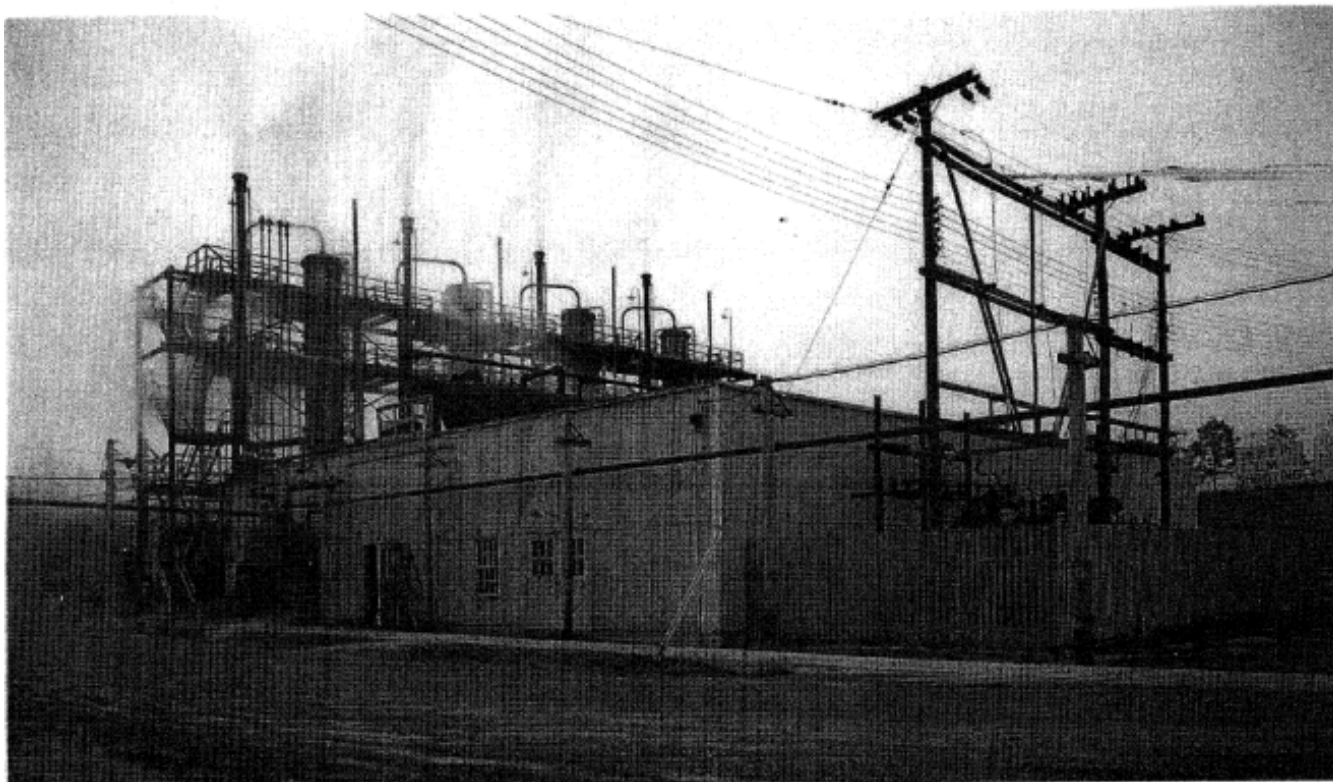
GPW – Goose Prairie Creek
HBW – Harrison Bayou

Perimeter Well Sampling Update



Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant

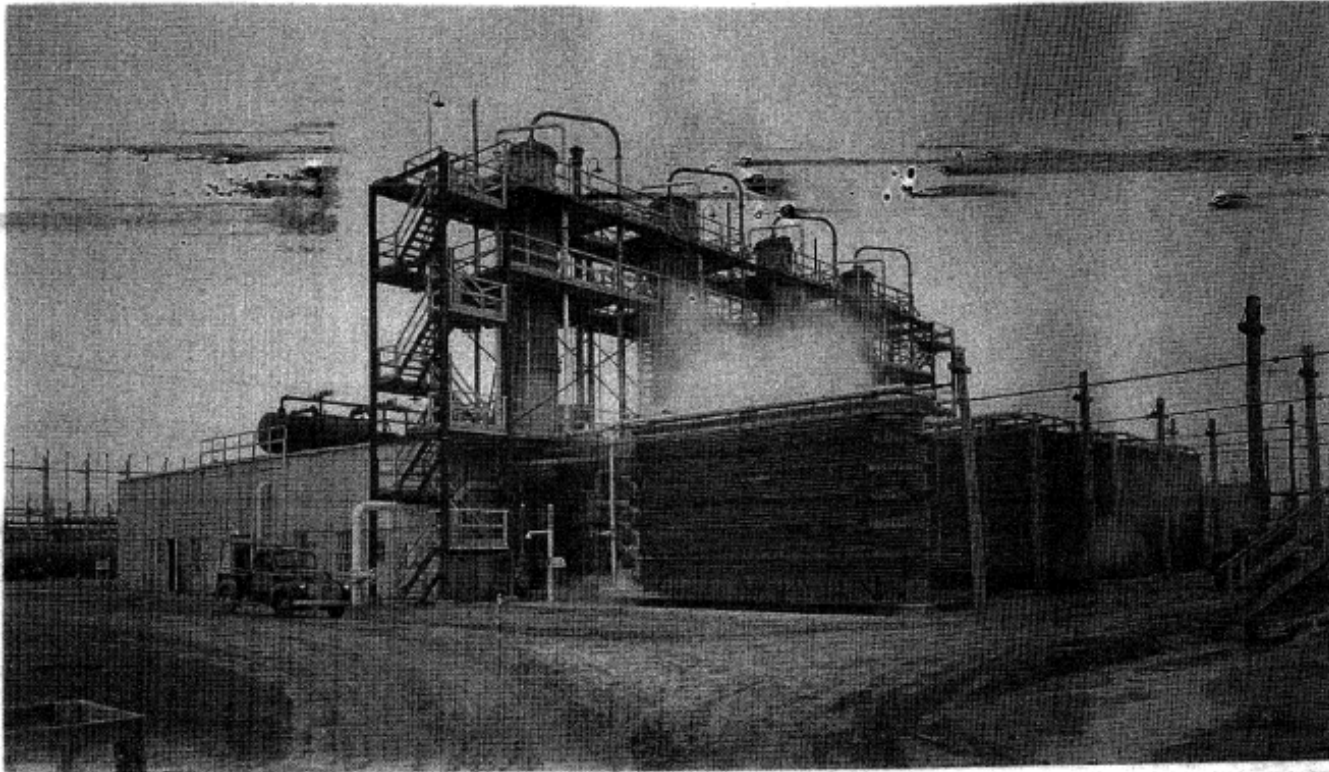
302-A-1



U. S. ENGINEER OFFICE	WAR DEPARTMENT	DENISON, TEXAS
THE INFORMATION AND KNOW-HOW HEREON MAY NOT BE USED NOR REPRODUCED WITHOUT WRITTEN PERMISSION OF E. I. DU PONT DE NEMOURS & CO. ALL REPRODUCTIONS SHALL REFER TO THIS STAMP.	LONGHORN ORDNANCE WORKS	FEBRUARY 1944.
	BUILDING No. 302 A-1 - CONVERSION, ABSORPTION AND COMPRESSION HOUSE, COMPRESSOR HOUSE END, LOOKING SOUTHEAST.	PAGE No. 53
	INDUSTRIAL INVENTORY	

Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant

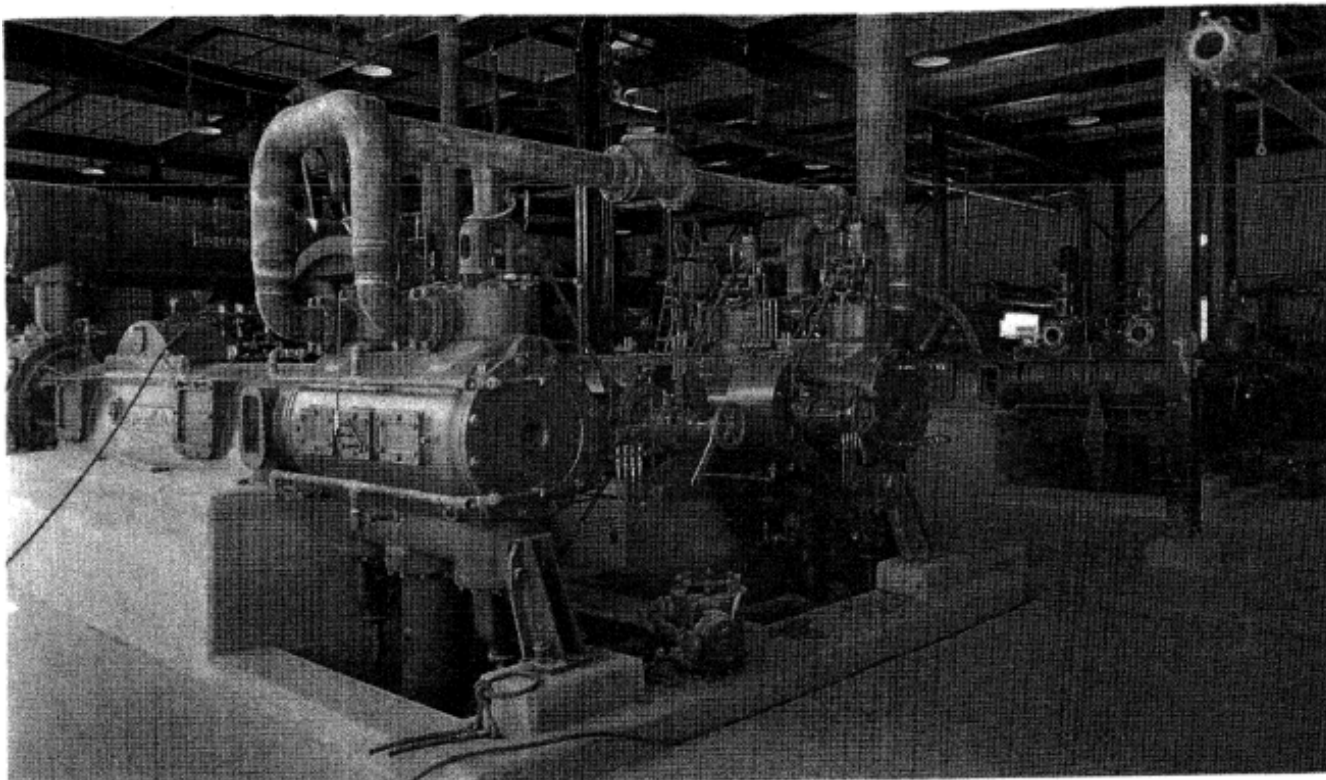
302 A-1



U. S. ENGINEER OFFICE	WAR DEPARTMENT	DENISON, TEXAS
THE INFORMATION AND KNOW-HOW HEREON MAY NOT BE USED NOR REPRODUCED WITHOUT WRITTEN PERMISSION OF E. I. DU PONT DE NEMOURS & CO. ALL REPRODUCTIONS SHALL REFER TO THIS STAMP.	LONGHORN ORDNANCE WORKS	FEBRUARY 1944.
	BUILDING No. 302 A-1 - CONVERSION, ABSORPTION AND COMPRESSION HOUSE, ABSORPTION COLUMN END, LOOKING NORTHWEST.	PAGE No. 52.
	INDUSTRIAL INVENTORY	

Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant

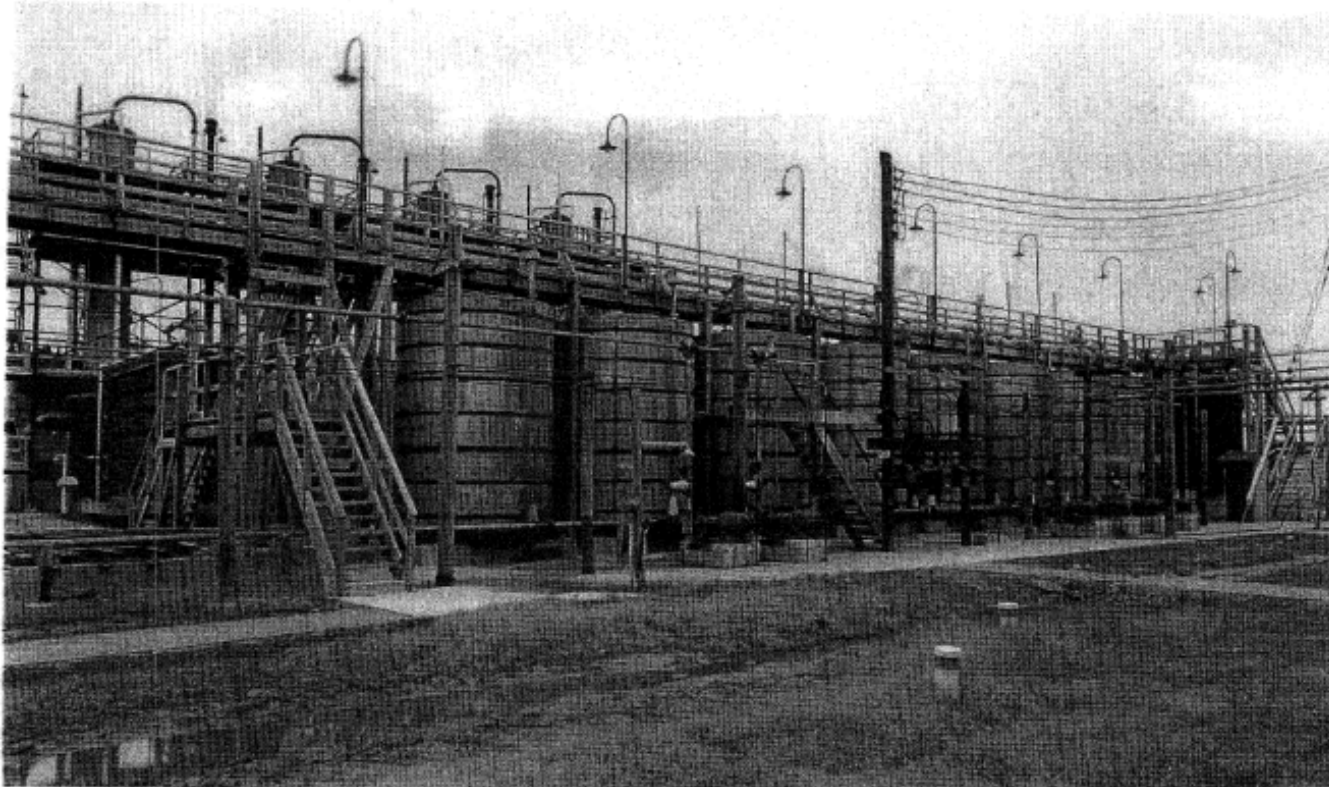
302 A-1



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THE INFORMATION AND KNOW-HOW HEREON MAY NOT BE USED NOR REPRODUCED WITHOUT WRITTEN PERMISSION OF E. I. DU PONT DE NEMOURS & CO. ALL REPRODUCTIONS SHALL REFER TO THIS STAMP.	LONGHORN ORDNANCE WORKS	AUGUST 7, 1942.
	BUILDING No. 302 A-1 - CONVERSION, ABSORPTION AND COMPRESSION HOUSE, LOOKING SOUTHWEST.	PAGE No. 54.
	INDUSTRIAL INVENTORY	

Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant

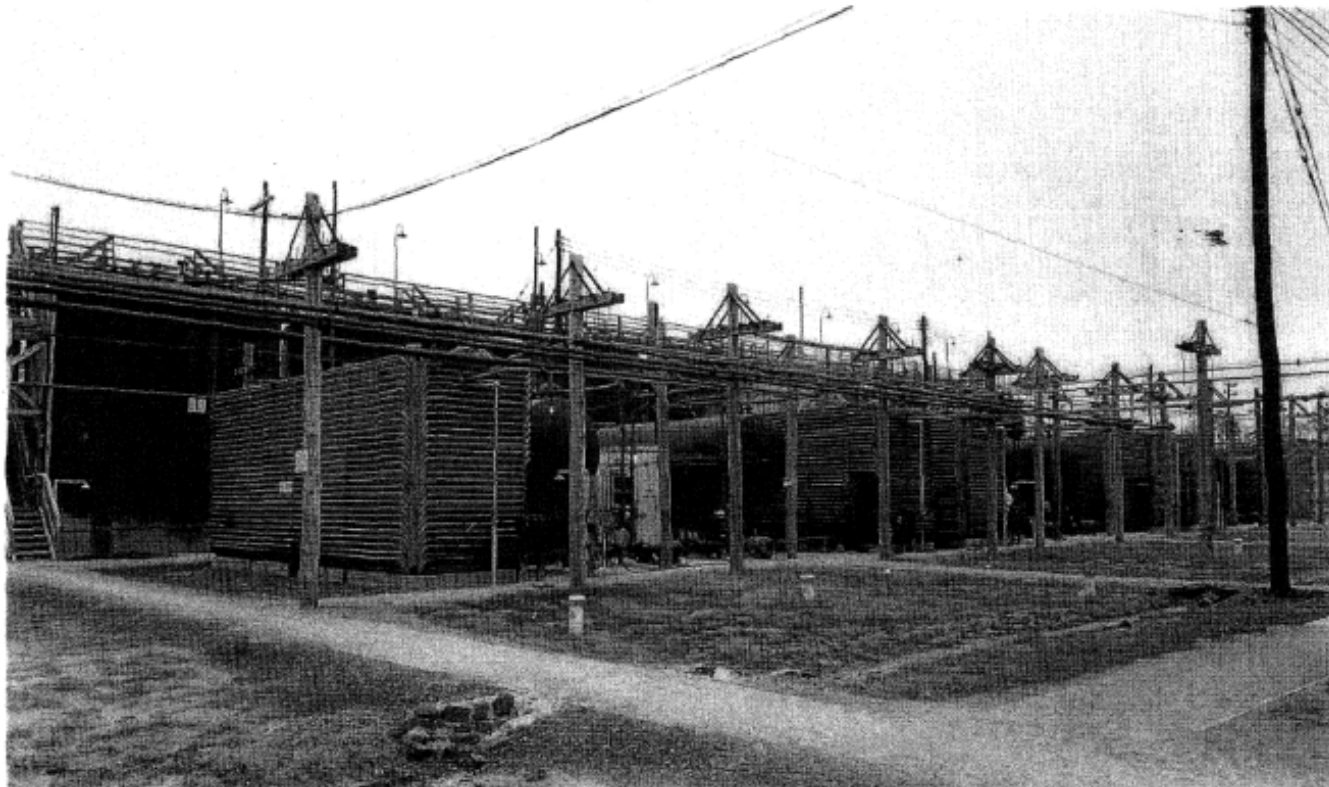
302 A-3



U. S. ENGINEER OFFICE	WAR DEPARTMENT	DENISON, TEXAS
	LONGHORN ORDNANCE WORKS	February 1944.
Industrial Inventory	Structure No. 302 A-3 - 62% N. A. Storage Tanks, looking northwest.	Page No. 92.

Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant

305 A-2



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WAR DEPARTMENT

DENISON, TEXAS

LONGHORN ORDNANCE WORKS

February 1944.

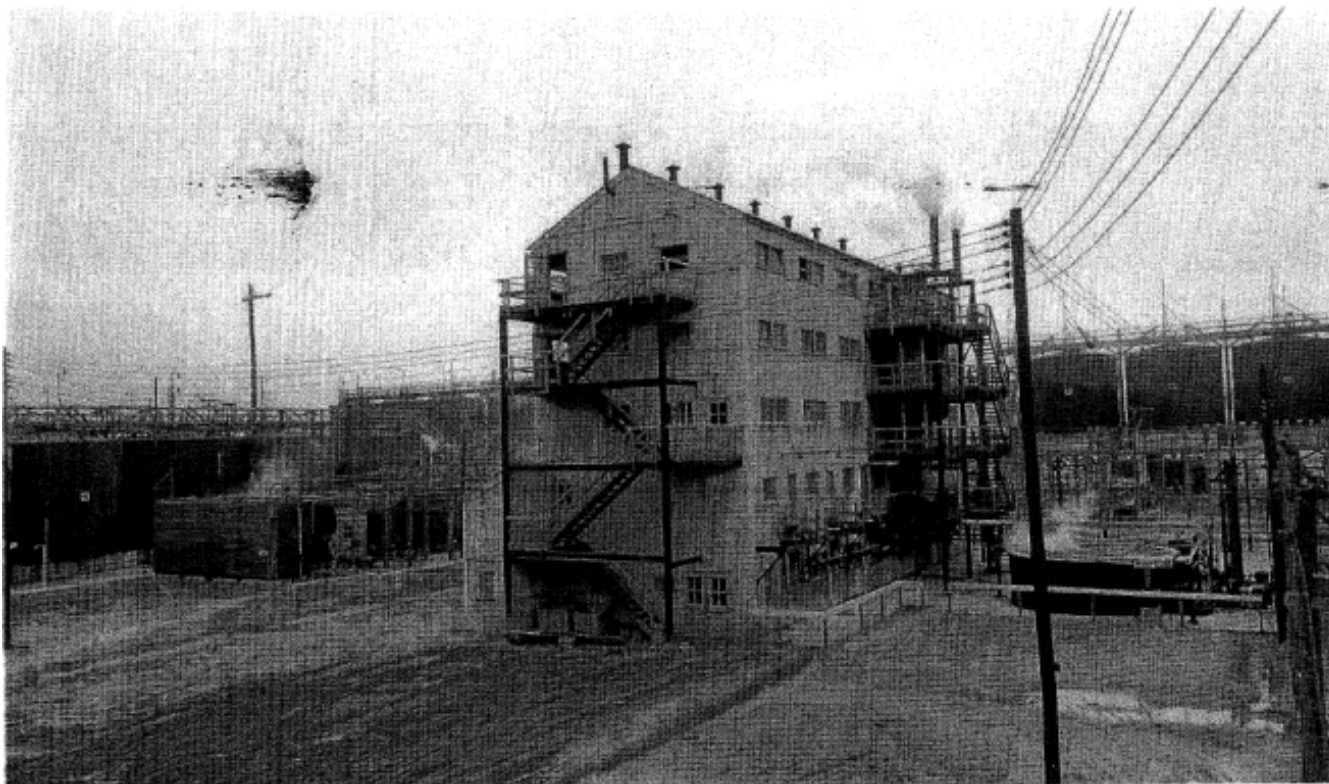
Structure No. 305 A-2 - Concentrating Mix Circulators and Scale House, looking southeast.

Industrial Inventory

Page No. 93.

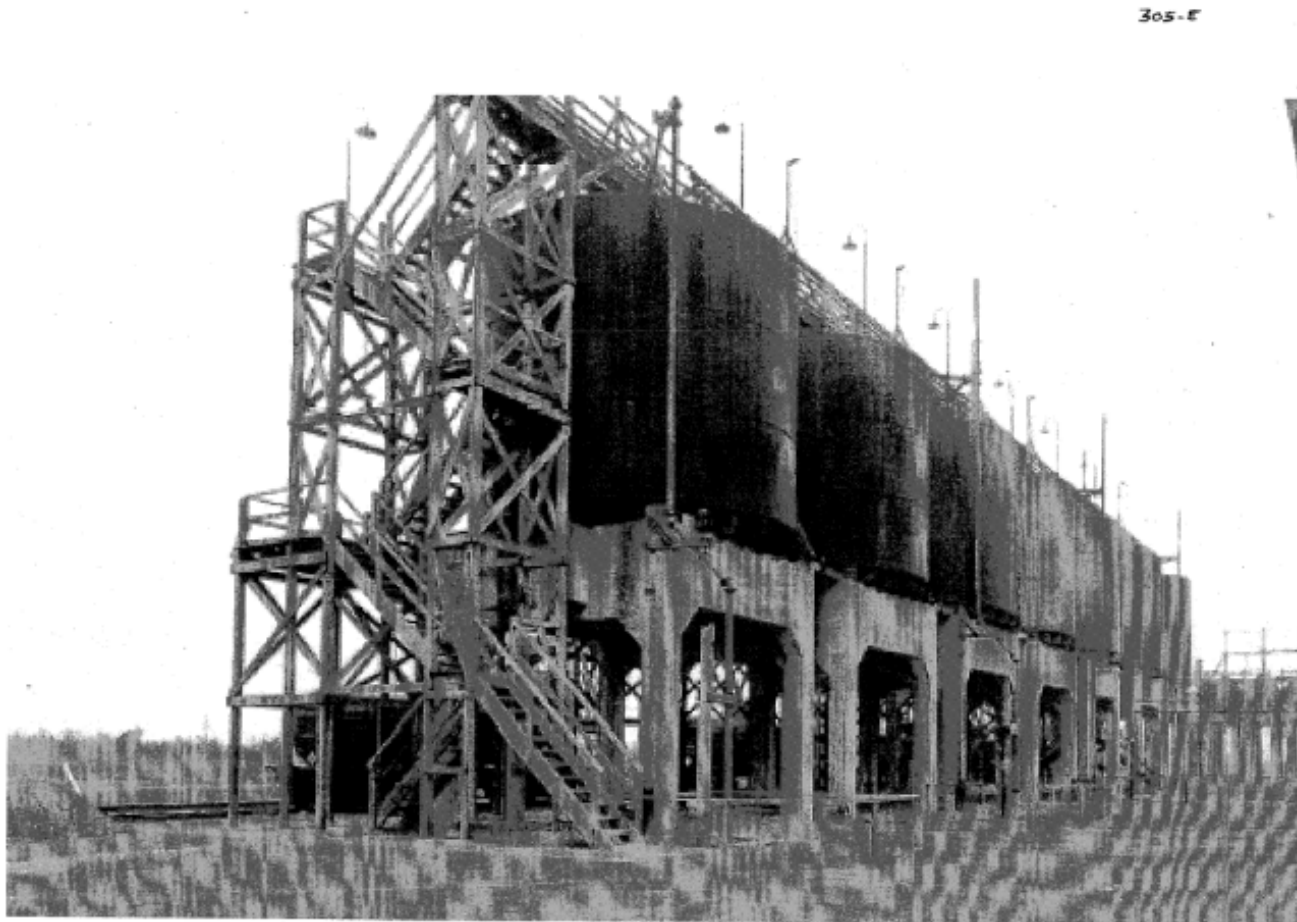
Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant

303-A



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THE INFORMATION AND KNOW-HOW HEREDIN MAY NOT BE USED NOR REPRODUCED WITHOUT WRITTEN PERMISSION OF E. I. DU PONT DE NEMOURS & Co. ALL REPRODUCTIONS SHALL REFER TO THIS STAMP.	LONGHORN ORDNANCE WORKS BUILDING No. 303 A - CONCENTRATOR HOUSE - LOOKING NORTHWEST.	FEBRUARY 1944. PAGE No. 56.
	INDUSTRIAL INVENTORY	

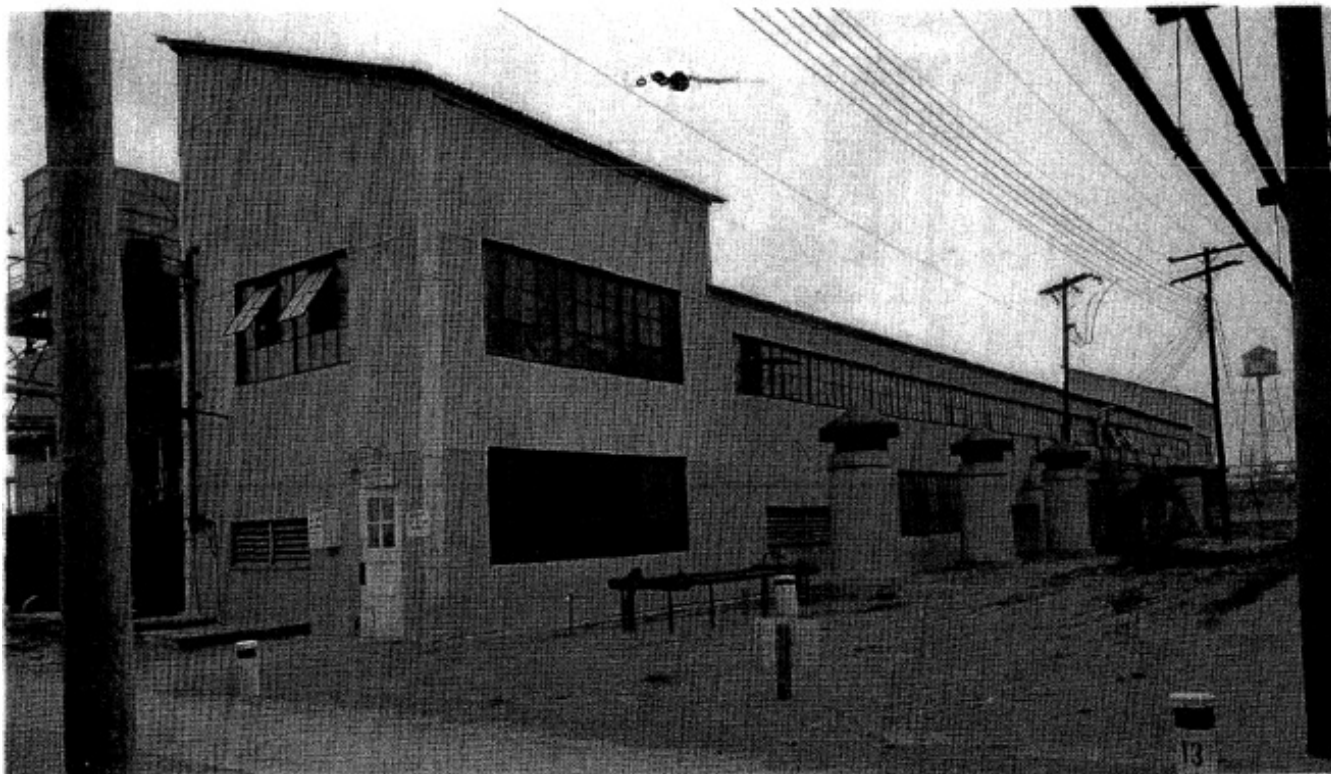
Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant (cont.)



STRUCTURE No. 305-E

Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant (cont.)

306-A

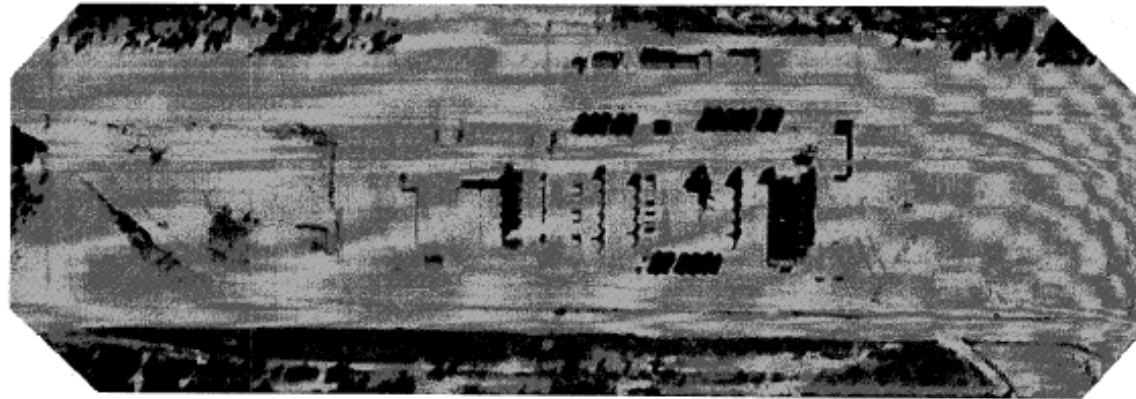


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THE INFORMATION AND KNOW-HOW HEREON MAY NOT BE USED NOR REPRODUCED WITHOUT WRITTEN PERMISSION OF E. I. DU PONT DE NEMOURS & Co. ALL REPRODUCTIONS SHALL REFER TO THIS STAMP. DESIGNED BY CHEMICAL CONST. CORP.	LONGHORN ORDNANCE WORKS BUILDING No. 306 A - DARK S. A. CONCENTRATOR, SHOWING MAIN BUILDING, LOOKING SOUTHEAST.	FEBRUARY 1944. PAGE No. 60.
	INDUSTRIAL INVENTORY	

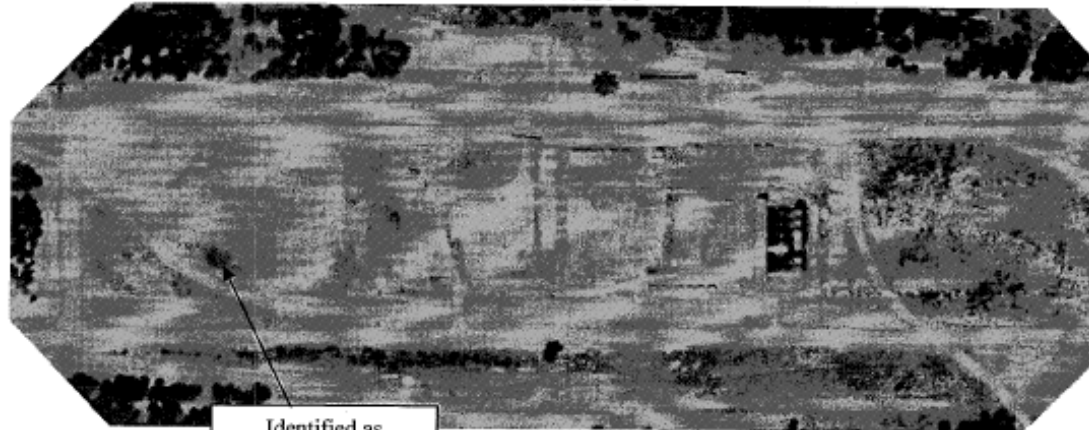
Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant (cont.)

Site 49 - Former Acid Plant

1955 Aerial Photo



1963 Aerial Photo



Identified as
standing water

Vintage World War II ERA and Post-WW II ERA Photos of Longhorn Army Ammunition Plant (cont.)



Next RAB Meeting Schedule and Closing Remarks

- Third Thursday in January 2017 is the 19th
 - Next RAB Meeting would normally be held on January 19th from 6:00 – 7:30 pm at the Karnack Community Center. However, this day/time is creating a conflict with RAB members who also attend the Caddo Lake Water Supply Corporation meetings, which are held the third Thursday of the month
 - Discuss potentially changing the day the RAB meetings are held
- Other Issues/Remarks?

Questions?



Groundwater Treatment Plant - Processed Groundwater Volumes

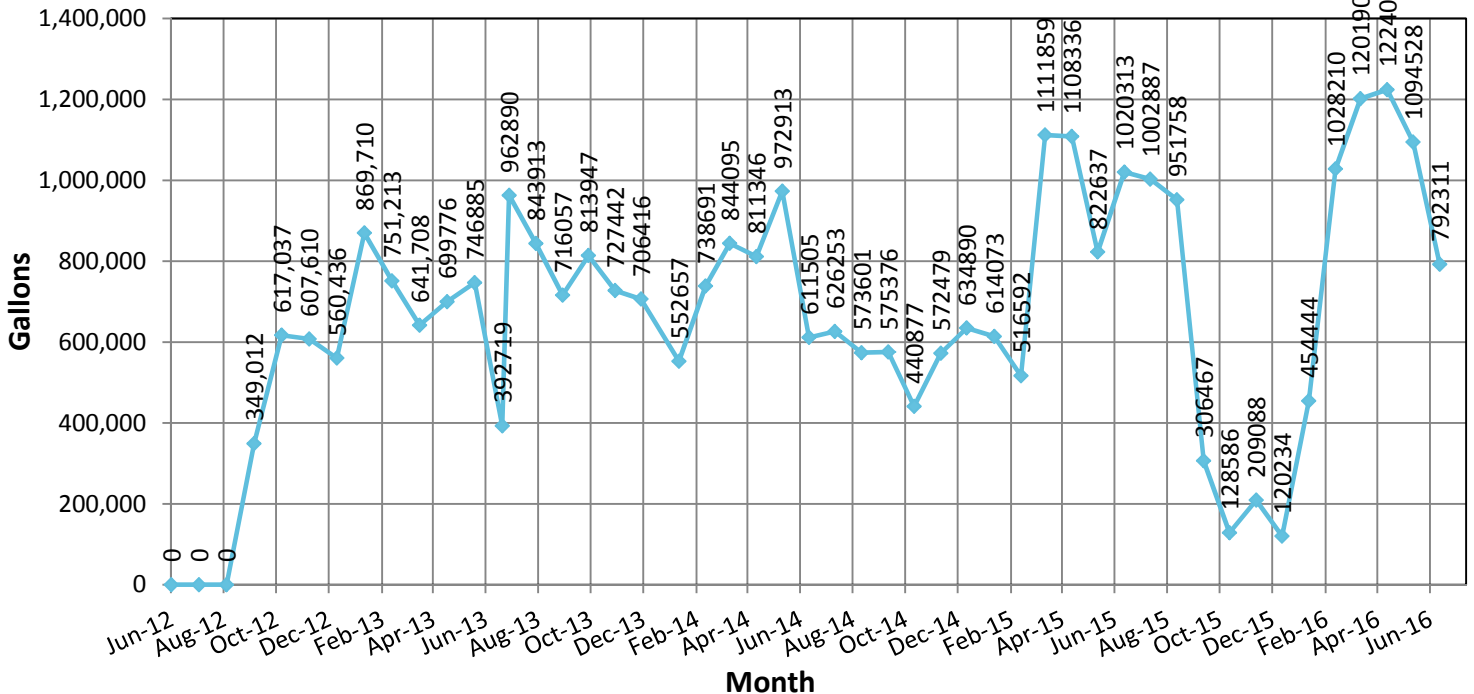
The amount of groundwater treated is determined by measuring the number of gallons of processed water.

Processed Water Data (in gallons)

Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
1,041,491	848,356	804,822	792,148	665,883	818,872	791,306	568,812	776,904	748,377	690,052	617,199
Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09
655,059	619,274	726,118	552,299	598,144	433,800	488,807	526,958	387,644	0	414,853	735,716
Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10
808,322	636,306	727,492	391,898	695,343	802,656	894,731	962,121	1,257,977	1,314,924	1,041,495	1,136,547
Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
956,567	705,805	849,712	811,679	668,281	1,090,348	817,325	900,338	916,552	784,369	652,524	733,456
Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
748,102	658,250	684,903	865,453	725,000*	730,000*	980,000*	630,000*	0	0	0	349,012
Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
617,037	607,610	560,436	869,710	751,213	641,708	699,776	746,885	392,719	962,890	843,913	716,057
Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14
813,974	727,442	706,416	552,657	738,691	844,095	811,346	972,913	611,505	626,253	573,601	575,376
Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15
440,877	572,479	634,890	614,073	516,592	1,111,859	1,108,336	822,637	1,020,313	1,002,887	951,758	306,467
Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16			
128,586	209,088	120,234	454,444	1,028,210	1,201,904	1,224,064	1,094,528	792,311			

*Indicates Estimate

Water Treated Monthly from June 2012 through June 2016



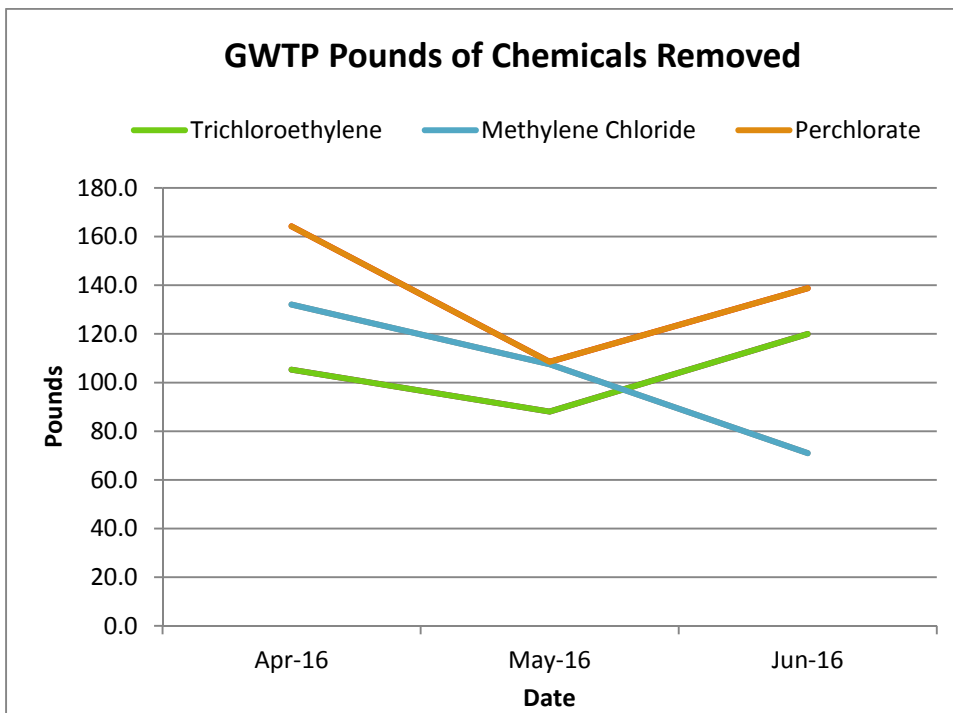
The pounds of chemicals removed for the 2nd Quarter of 2016 can be found below and are calculated by the following formula:

$$\frac{(\text{GWTP Influent Contaminant Concentration } [\mu\text{g/L}] \times \text{Volume [gallons]} \times 3.785 \text{ [liters per gallon]})}{(453,600,000 \mu\text{g per pound})}$$

**Approximate Amount of Pounds of Chemicals
Removed From
LHAAP-18/24, 2nd Quarter 2016**

	Trichloroethylene	Methylene Chloride	Perchlorate
Apr-16	105	132	164
May-16	88.1	108	109
Jun-16	120	71.0	139

ND – no data available



Water Discharge Location and Volume (Gallons)

Month	Harrison Bayou	LHAAP-18/24 Sprinklers	INF Pond
Apr-16	0	1,073,434	0
May-16	0	991,436	0
Jun-16	0	768,600	0

Harrison Bayou and Goose Prairie Creek – Perchlorate Data

Surface water samples are collected quarterly from each location in Harrison Bayou and Goose Prairie Creek, unless the sampling location is dry.

Surface Water Sample Data (in micrograms per liter)

Quarter	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st
Creek Sample ID	Jul 1999	Sep 1999	Feb 2000	Apr 2000	Aug 2000	Dec 2000	Feb 2001	Apr 2001	July 2001	Oct 2001	Jan 2002
GPW-1	<1.0U	-	4	<4.0 U	<4.0 U	<4.0 U	-	2.65	<4.0 U	<4.0 U	<4.0 U
GPW-3	<1.0U	<4.0 U	17	8	<4.0 U	<4.0 U	-	2.28	<4.0 U	<4.0 U	<4.0 U
HBW-1	-	<80.0 U	310	23	-	-	<4.0 U	-	<4.0 U	<4.0 U	<4.0 U
HBW-7	-	<8.0 U	370	110	-	-	<4.0 U	-	<4.0 U	<4.0 U	<4.0 U
HBW-10	-	<8.0 U	905	650	<4.0 U	-	<4.0 U	-	<4.0 U	-	-

Quarter	2 nd	3 rd	4 th	1 st	2 nd	3 rd	3 rd	4 th	2 nd	3 rd	4 th
Creek Sample ID	June 2002	Sept 2002	Dec 2002	Feb 2003	June 2003	Aug 2003	July 2004	Dec 2006	May 2007	Aug 2007	Dec 2007
GPW-1	<4.0 U	<4.0 U	18.3	18.6	59.9	-	2.25	-	<1.0 U	<1.0 U	10.7
GPW-3	<4.0 U	<4.0 U	5.49	12.6	14.7	-	2.2	-	<1.0 U	<1.0 U	7.48
HBW-1	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	99.3	<0.2U	<1.0 U	<1.0 U	122	<1.0 U
HBW-7	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	<4.0 U	<0.2U	<1.0 U	<1.0 U	1.02	<1.0 U
HBW-10	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	-	<0.2U	<1.0 U	<1.0 U	<1.0 U	<1.0 U

Quarter	1 st	2 nd	3 rd	4 th	2 nd	3 rd	3 rd	3 rd	4 th	1 st	2 nd
Creek Sample ID	Mar 2008	Jun 2008	Sep 2008	Dec 2008	May 2009	Jul 2009	Aug 2009	Sep 2009	Dec 2009	Mar 2010	Jun 2010
GPW-1	27	<0.5U	<0.5U	<0.22U	16	<4U	NS	<1.2U	3.7	1.3J	<0.6U
GPW-3	21.9	9.42	1.1	<0.22U	8.9	<4U	NS	<0.6U	2.8	1.8J	<0.6U
HBW-1	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	NS	<1.5U	<0.275U	1.5U	<0.6U
HBW-7	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	24	<1.2U	<0.275U	1.5U	<0.6U
HBW-10	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	NS	<1.5U	<0.275U	1.2U	<0.6U

Quarter	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st
Creek Sample ID	Sep 2010	Dec 2010	Mar 2011	Jun 2011	Sep 2011	Dec 2011	Mar 2012	Jun 2012	Not Applicable	Jan & Feb 2013	Mar 2013
GPW-1	dry	<0.1U	8.7	dry	dry	1.76	0.163J	dry	NS	1.65	0.735
GPW-3	dry	0.199J	0.673	dry	dry	1.31	0.261	dry	NS	1.74	0.754
HBW-1	dry	<0.1U	<0.2U	dry	dry	<0.1U	0.1U	dry	NS	<0.2U	<0.2U
HBW-7	dry	<0.1U	<0.2U	dry	dry	0.171J	0.1U	dry	NS	<0.2U	<0.2U
HBW-10	dry	<0.1U	<0.2U	dry	dry	<0.1U	0.1U	dry	NS	<0.2U	<0.2U

Quarter	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th
Creek Sample ID	Jun 2013	Sept 2013	Dec 2013	Feb 2014	May 2014	Aug 2014	Nov 2014	Feb 2015	May 2015	Aug 2015	Nov 2015
GPW-1	dry	<0.2 U	dry	0.766	dry	dry	0.244 J	0.311 J	0.156J	dry	0.142 J
GPW-3	dry	<0.2 U	dry	1.15	dry	dry	0.276 J	0.344 J	dry	dry	0.311 J
HBW-1	<0.2U	<0.2 U	dry	<0.2 U	dry	dry	<0.2 U	<0.2 U	dry	dry	<0.2 U
HBW-7	<0.2U	<0.2 U	dry	0.201 J	dry	dry	<0.2 U	0.124 J	dry	dry	<0.2 U
HBW-10	<0.2U	<0.2 U	dry	<0.2 U	dry	dry	<0.2 U	<0.2 U	dry	dry	<0.2 U

Quarter	1 st	2 nd	3 rd
Creek Sample ID	Feb 2016	May 2016	Aug 2016
GPW-1	0.447	6.59	<0.2 U
GPW-3	0.474	0.457	0.141
HBW-1	<0.2 U	<0.2 U	<0.2 U
HBW-7	<0.2 U	<0.2 U	<0.2 U
HBW-10	<0.2 U	<0.2 U	<0.2 U

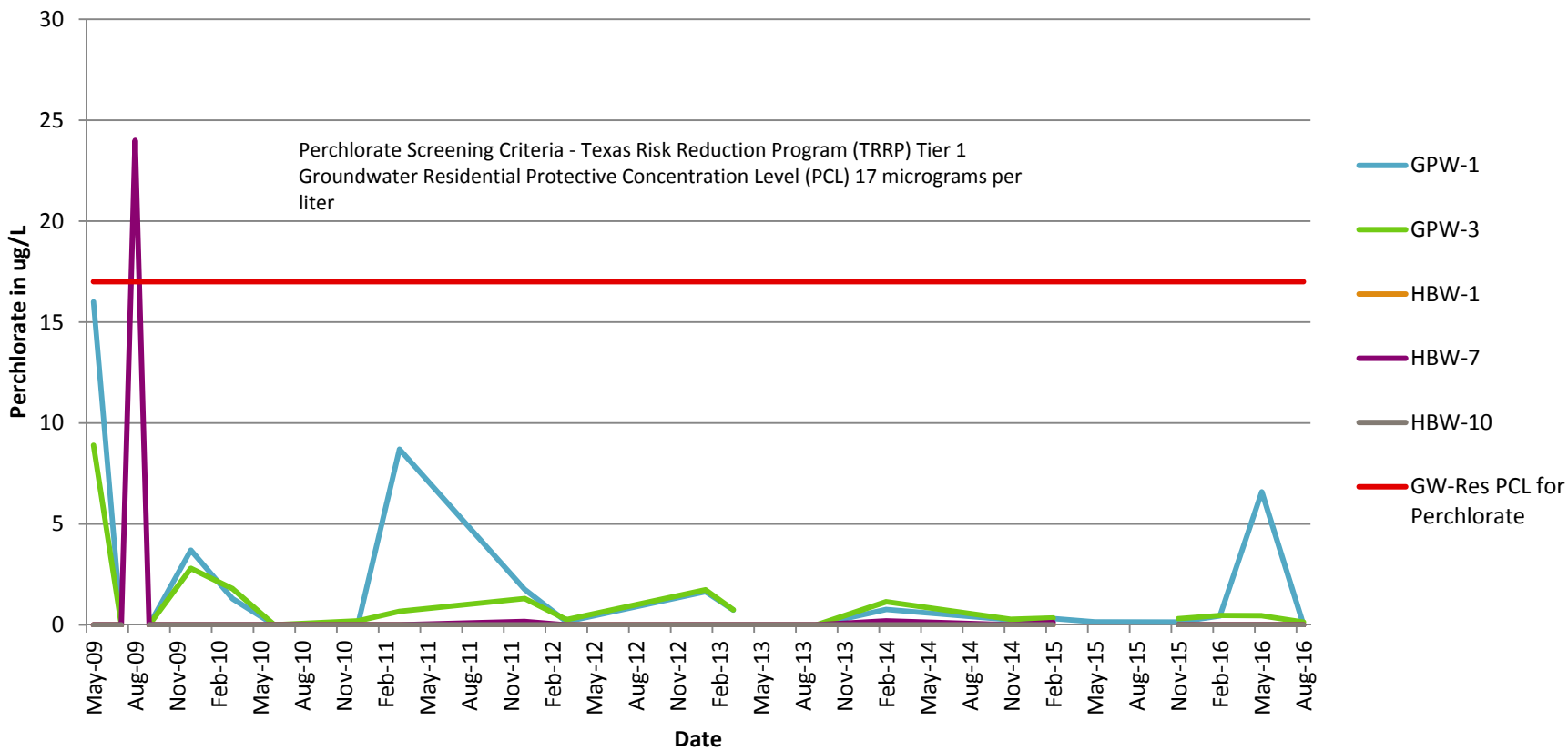
NS – not sampled

U – non-detect

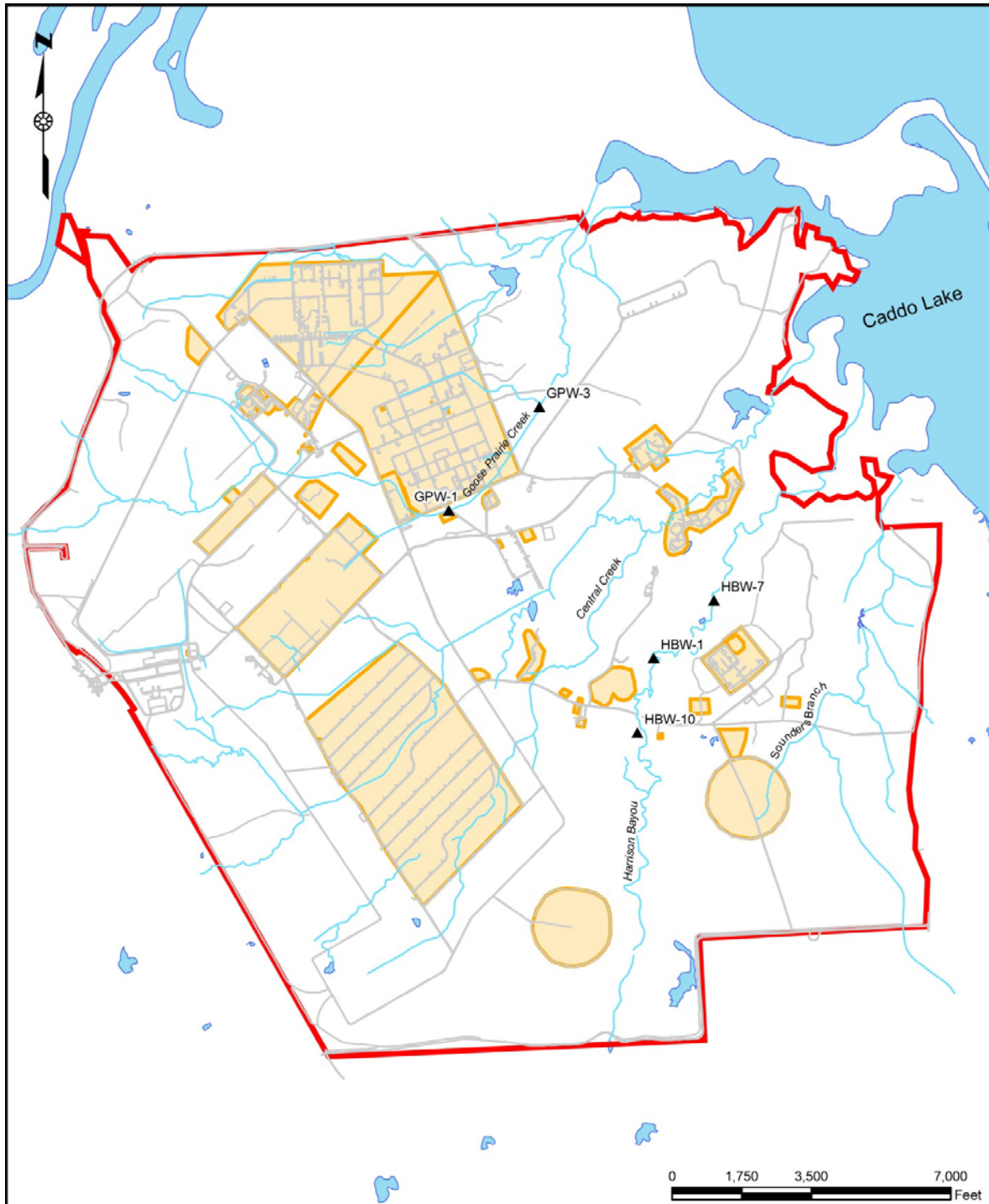
J – Estimated

Dry – no surface water

Surface Water Samples - Perchlorate



Longhorn Army Ammunition Plant Creek Sampling Locations



Legend <ul style="list-style-type: none">▲ Surface Water Sampling Location— Stream— Road■ Site■ Lake	U.S. ARMY CORPS OF ENGINEERS TULSA DISTRICT TULSA, OKLAHOMA
SURFACE WATER SAMPLING LOCATION LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS	

LHAAP Perimeter Well Monitoring – Perchlorate Data

Groundwater samples are currently collected annually from four wells and semi-annually from two wells on the LHAAP perimeter.

Perimeter Well Sample Data (in micrograms per liter)

Well ID	Jun 2005	Sep 2005	Sep 2006	May 2007	Aug 2007	Dec 2007	Mar 2008	Sep 2008	May 2009	Sep 2009	Mar 2010
108	NS	NS	10 U	NS	0.5 U	NS	NS	2.5 U	NS	1.2 U	NS
110	NS	NS	10 U	NS	10 U	NS	NS	5.0 U	NS	6 U	NS
111	NS	NS	4 U	NS	0.5 U	NS	NS	0.5 U	NS	0.3 U	NS
112	NS	NS	5 U	NS	3 U	NS	NS	2.0 U	NS	3 U	NS
133	0.541	0.597	1.08	1 U	1.09	0.5 U	0.5 U	0.5 U	0.47 J	0.32	Dry
134	0.881	0.725	0.708 J	1 U	0.949 J	0.5 U	0.5 U	0.829 U	0.04 J	0.3 U	0.3 U

Well ID	Sep 2010	Mar 2011	Sep 2011	Oct 2012	Mar 2013	Jun 2013	Apr 2014	Jun 2014	Dec 2014	Jun 2015	Dec 2015
108	3 U	NS	0.1 U	0.2 U	0.2 U	NS	NS	0.2 U	NS	0.566	NS
110	Dry	NS	Dry	0.535	0.2 U	NS	NS	0.2 U	NS	2U	NS
111	Dry	NS	Dry	Dry	1.32	NS	NS	Dry	NS	0.2U	NS
112	3 U	NS	0.26	0.2 U	0.2 U	NS	NS	0.458	NS	2U	NS
133	0.32	Dry	0.68	0.598	0.655	0.685	0.988	0.887	0.665	0.692	0.952
134	0.45	0.636	1.11	0.671	0.698	0.706	0.863	0.989	0.890	1.11	0.925

Well ID	Jun 2016
108	0.2 U
110	0.2 U
111	0.2 U
112	0.2 U
133	0.536
134	0.997

Notes:

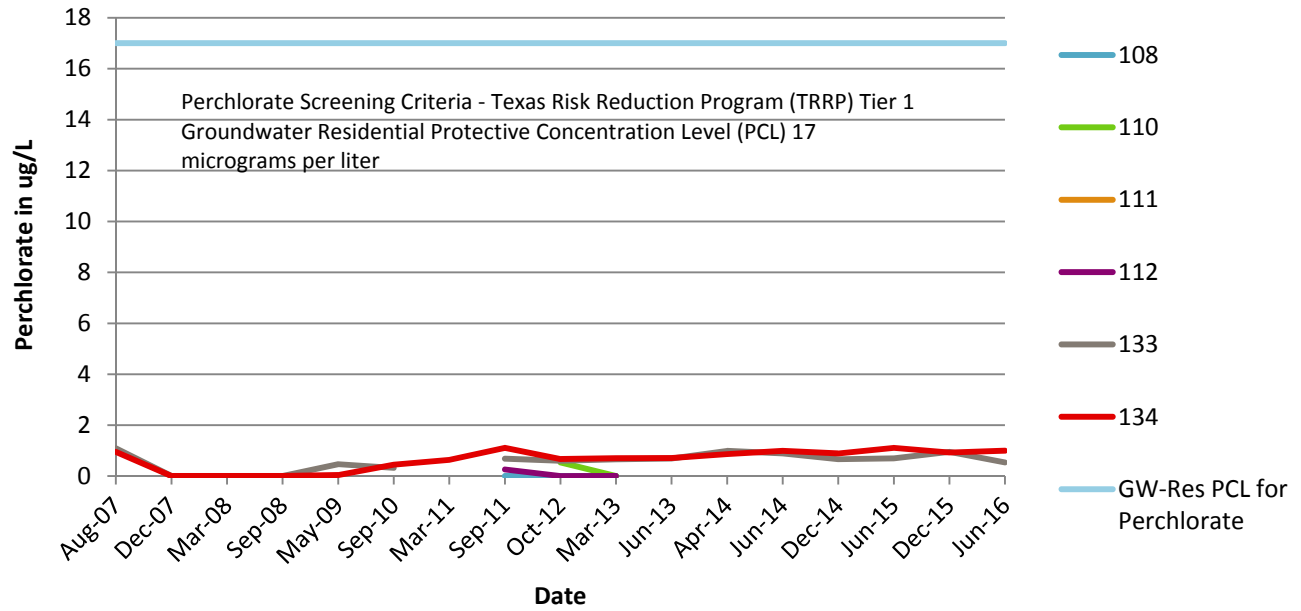
J – Estimated

U – Non-Detect

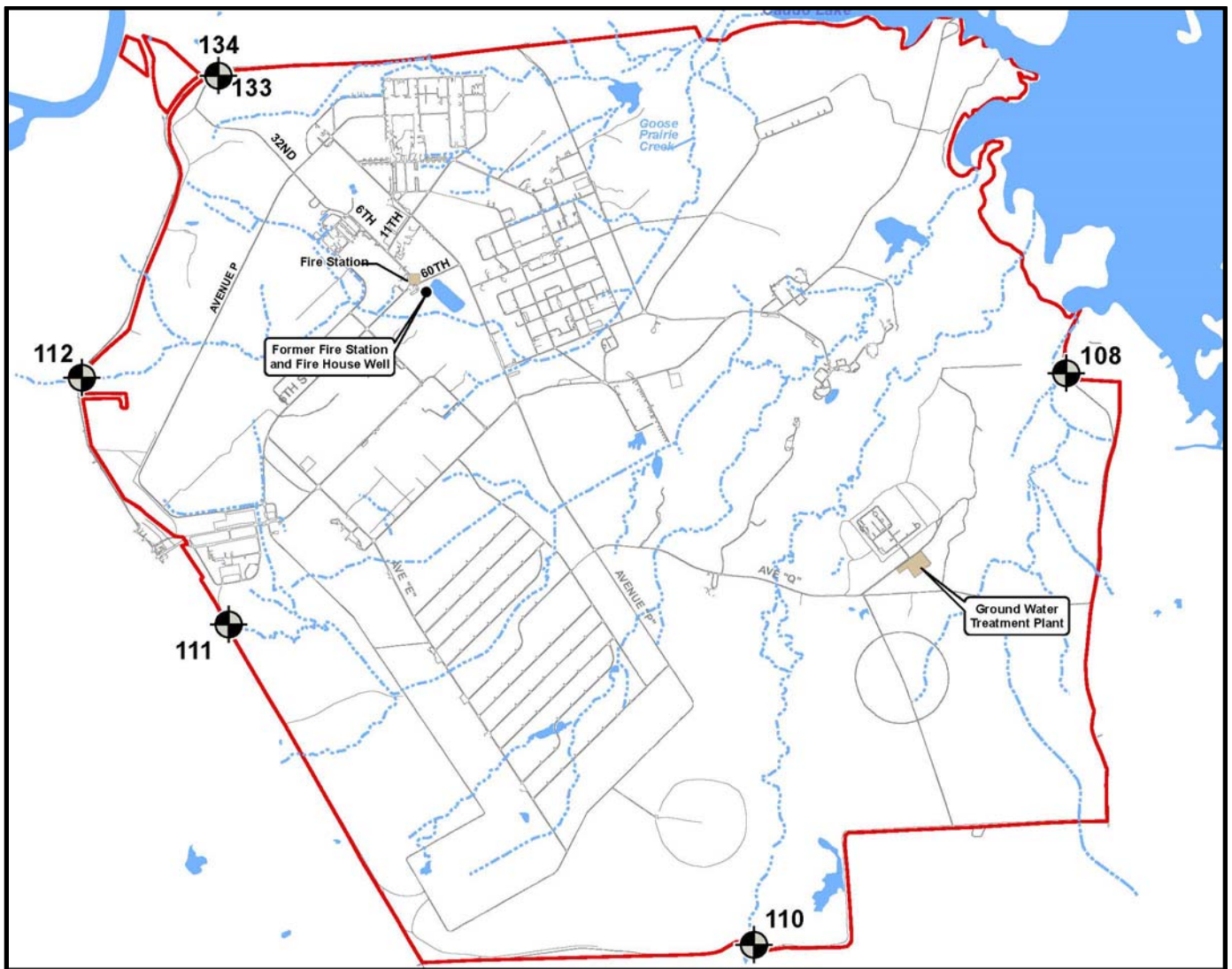
Dry – Well Dry

NS – Not Sampled

Perimeter Wells - Perchlorate



Longhorn Army Ammunition Plant Map with Perimeter Well Locations



SELECTED REMEDY: Cap Maintenance, Land Use Controls, In Situ Enhanced Bioremediation, Biobarriers, and Monitored Natural Attenuation

Site History

LHAAP-16 is a capped landfill located in the south-central portion of the Longhorn Army Ammunition Plant (LHAAP). The site encompasses approximately 20 acres, of which approximately 13 acres are covered by the landfill cap. The landfill was established in 1940s and was used for disposal of solid and industrial wastes until the 1980s when disposal activities were terminated. The Army and the USEPA signed a Record of Decision (ROD) in 1995 approving an interim remedial action which included the construction of a multilayer landfill cap that was completed in 1998. In 1996 and 1997, a groundwater extraction system was installed by the Army to prevent the groundwater plume from migrating to Harrison Bayou. After resolution of a dispute between Army and EPA in March 2016, the 2011 Draft Final ROD was revised and the final ROD was finalized in September with a selected remedy of Cap Maintenance, Land Use Controls (LUCs), In Situ Enhanced Bioremediation, Biobarriers, and Monitored Natural Attenuation (MNA).

Site Characteristics

Harrison Bayou runs along the northeastern edge of LHAAP-16. Much of the site is relatively flat, though land becomes steeper near Harrison Bayou. Surface drainage from LHAAP-16 flows mostly through small gullies and ditches to Harrison Bayou which discharges into Caddo Lake to the northeast of the site. The subsurface at the site 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. The groundwater flow direction is northeast toward Harrison Bayou in the shallow, intermediate and deep zones, while flow direction is southeast toward Harrison Bayou in the upper deep groundwater zone. Groundwater flow between the landfill and Harrison Bayou is also influenced by the presence of an extraction well system.

Remedial Action Objectives (RAOs)

- 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 and;
- Return of groundwater to its potential beneficial uses as drinking water, wherever practicable

Chemicals of Concern

In the groundwater, the COCs are trichloroethene [TCE], cis-1,2-dichloroethene [DCE], vinyl chloride [VC], perchlorate, and five metals (arsenic, chromium, manganese, nickel and thallium).

Description of the Selected Remedy:

Cap Maintenance:

Maintenance and repair of the existing landfill cap.

LUCs include:

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

In Situ Enhanced Bioremediation:

In situ enhanced bioremediation in the most contaminated portion of the shallow and intermediate groundwater zones to reduce contaminant mass and lower the contaminant concentrations.

Biobarriers:

Installation of a biobarrier in the downgradient portion of the contaminant plume to prevent contaminated groundwater from seeping into Harrison Bayou at concentrations that would cause surface water to exceed Texas Surface Water Quality Standards, the Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs), and in the absence of federal drinking water standards, cleanup levels based on Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Levels (PCLs). A second biobarrier will be installed at the edge of the landfill to control potential migration of volatile organic compounds (VOCs) from the landfill.

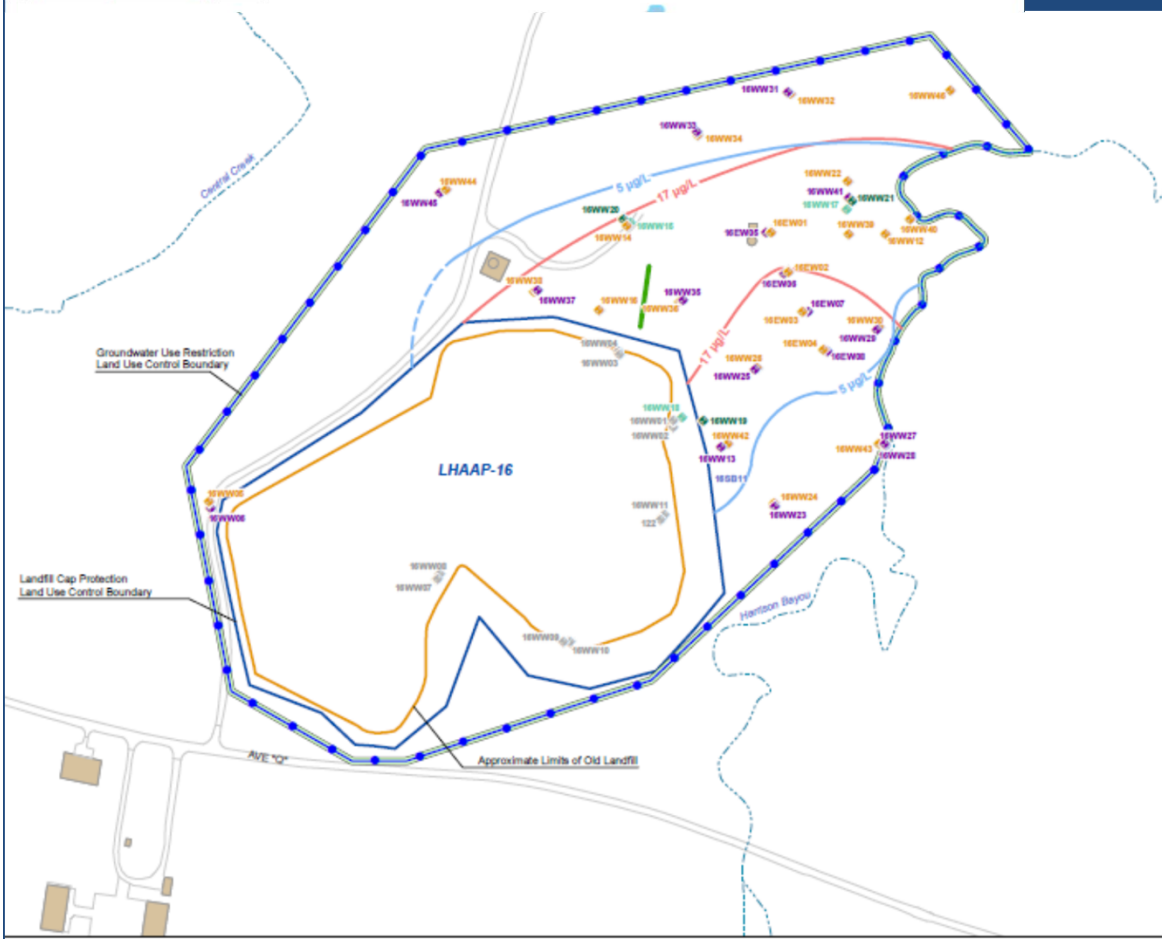
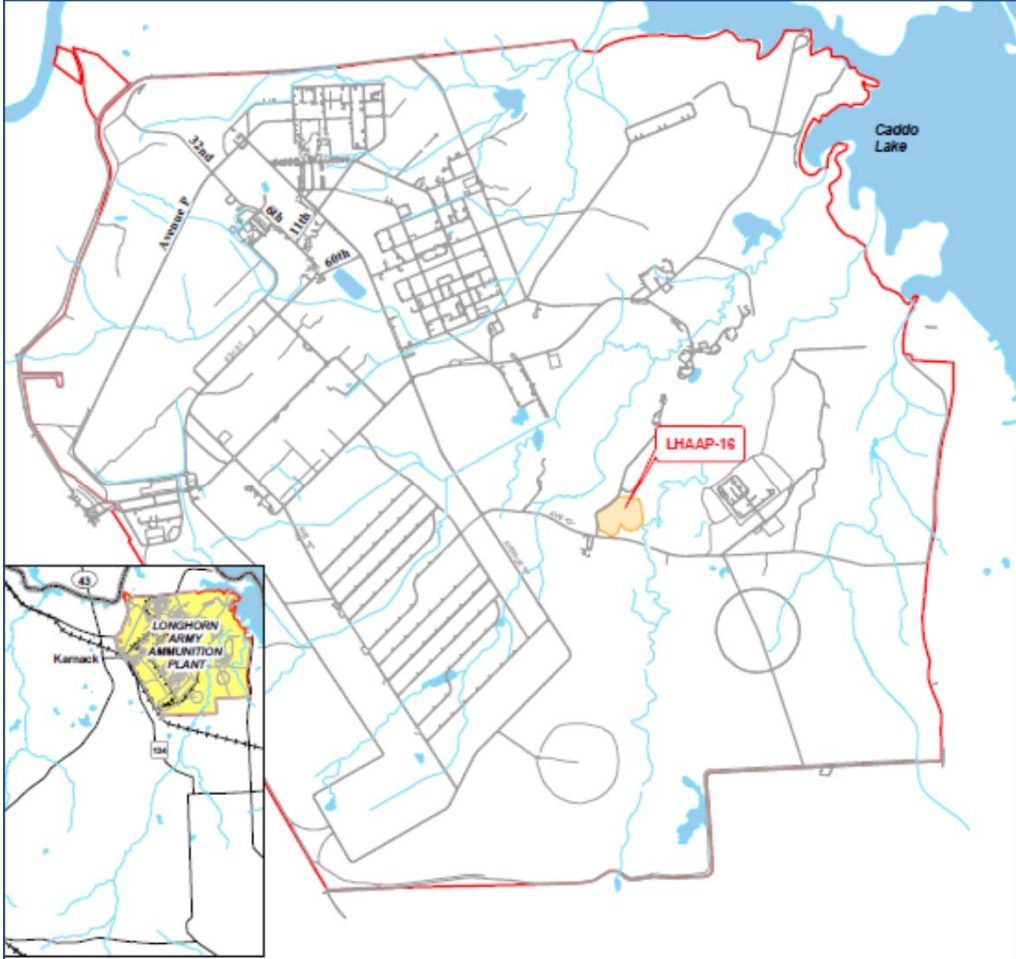
MNA:

MNA will be implemented for areas outside the influence of the active remedies to assure protection of human health and the environment by documenting that further reductive dechlorination is occurring within the plume and that contaminant concentrations are being reduced to cleanup levels. MNA will also be implemented in the areas of active remediation following successful implementation of in situ bioremediation and the biobarriers.

CERCLA Five Year Reviews and inspections of physical mechanisms at LHAAP-16.

LHAAP-16, Landfill

SELECTED REMEDY: Cap Maintenance, Land Use Controls, In Situ Enhanced Bioremediation, Biobarriers, and Monitored Natural Attenuation



- Legend**
- Existing Shallow Monitoring Well
 - Existing Intermediate Monitoring Well
 - Existing Upper Deep Monitoring Well
 - Existing Lower Deep Monitoring Well
 - Abandoned or Plugged Well
 - Extent of Perchlorate Contamination > 17 ug/L in Intermediate and Shallow Zones
 - Extent of TCE Contamination > 5 ug/L in Intermediate and Shallow Zones (Dashed Where Inferred)
 - Location of Semi-Passive Biobarrier Demonstration (February 2004 through June 2006 (ESTCP 2009)).
 - Road
 - Stream
 - Remedial and Monitoring System Boundary
 - Groundwater Use Restriction Land Use Control Boundary
 - LHAAP-16 Landfill Fence

LHAAP-17, Burning Ground No. 2/Flashing Area

SELECTED REMEDY: Excavation and Offsite Disposal of Soil, Groundwater Extraction, Monitored Natural Attenuation and Land Use Controls

Site History

LHAAP-17, known as the former Burning Ground No.2/Flashing Area, is located in the southeastern portion of LHAAP and covers approximately 4 acres. Historically, LHAAP-17 was used as a burning ground from 1959 through 1980. Materials burned included trinitrotoluene (TNT), photo flash powder, reject material from Universal Match Corporation and materials removed from the TNT Production Area (LHAAP-29) and the TNT Waste Disposal Area (LHAAP-32). It was also used as a flashing area to decontaminate recoverable metal byproducts. After resolution of a dispute between Army and EPA in March 2016, the 2011 Draft Final ROD was revised and the final ROD was finalized in September with a selected remedy of Excavation and Offsite Disposal of Soil, Groundwater Extraction, Monitored Natural Attenuation (MNA) and implementation of Land Use Controls (LUCs).

Site Characteristics

The surface features include two 184 foot by 305 foot cleared areas separated by a gravel access road. The site is covered with grass, scattered brush, and small trees. The topography is relatively flat. Harrison Bayou is located to the west and north of LHAAP-17 within approximately 1,200 feet of the site. The surface drainage flows to ditches along the boundaries of the site which flow into Harrison Bayou. The bayou discharges to Caddo Lake, a source of drinking water for several neighboring communities in Louisiana. Shallow zone groundwater is approximately 18 to 35 feet below ground surface (bgs), the intermediate zone is approximately 55 feet bgs and the deep zone is approximately 151 feet bgs. The predominant groundwater flow direction in the shallow and intermediate zones varies seasonally, but is generally to the northwest towards Harrison Bayou.

Remedial Action Objectives (RAOs)

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

Chemicals of Concern

In the soil, chemicals of concern (COCs) are explosives (2,4,6-trinitrotoluene [TNT], 2,4-dinitrotoluene [DNT], 2,6-DNT) and perchlorate (potential soil COC based on groundwater concentrations); and chemicals of potential ecological concern (COPECs) are explosives (2,4,6-TNT, 2,4-DNT, 2,6-DNT); dioxins (2,3,7,8-tetrachlorodibenzo-p-dioxin [TCDD] toxicity equivalence concentration [TEC]); and barium.

In the shallow groundwater zone, the COCs are perchlorate and volatile organic compounds (VOCs) (1,2-dichloroethane [DCA], 1,1-dichloroethene [DCE], cis-1,2-DCE, trichloroethene [TCE], and vinyl chloride [VC]). In the intermediate groundwater zone, the COCs are TCE and its daughter products (DCE and VC).

Description of the Selected Remedy:

Soil Excavation:

The excavation will remove explosives, barium and dioxin contamination for off-site disposal that is a direct risk to the hypothetical future maintenance worker, is a potential source of contaminant migration to groundwater, and poses a risk to ecological receptors.

Groundwater Extraction:

The desired outcome is to reduce perchlorate concentrations in the groundwater to 20,000 ug/L or lower during an operational period of 1.5 years at which point MNA is anticipated to be favorable.

Contingency Remedy for Groundwater Extraction:

If groundwater extraction does not reduce perchlorate levels to 20,000 ug/L in the 1.5 year extraction timeframe, the contingency remedy would implement in situ bioremediation.

MNA:

MNA begins following groundwater extraction activities and the performance objectives of MNA will be evaluated after 2 years.

Contingency Remedy for MNA:

If MNA is found to be ineffective, the contingency remedy would implement in situ bioremediation.

LTM:

If MNA is determined to be effective, monitoring will be conducted to evaluate the remedy performance and determine if the plume conditions remain constant, improve or worsen after the baseline is established.

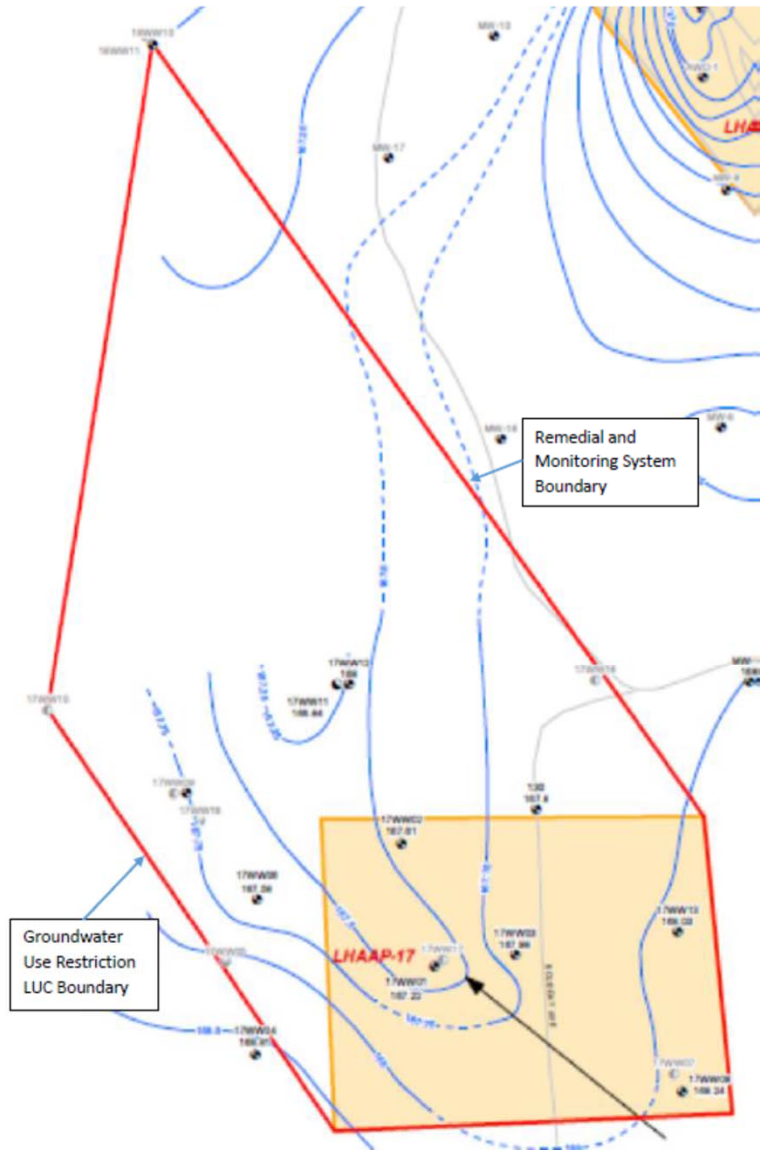
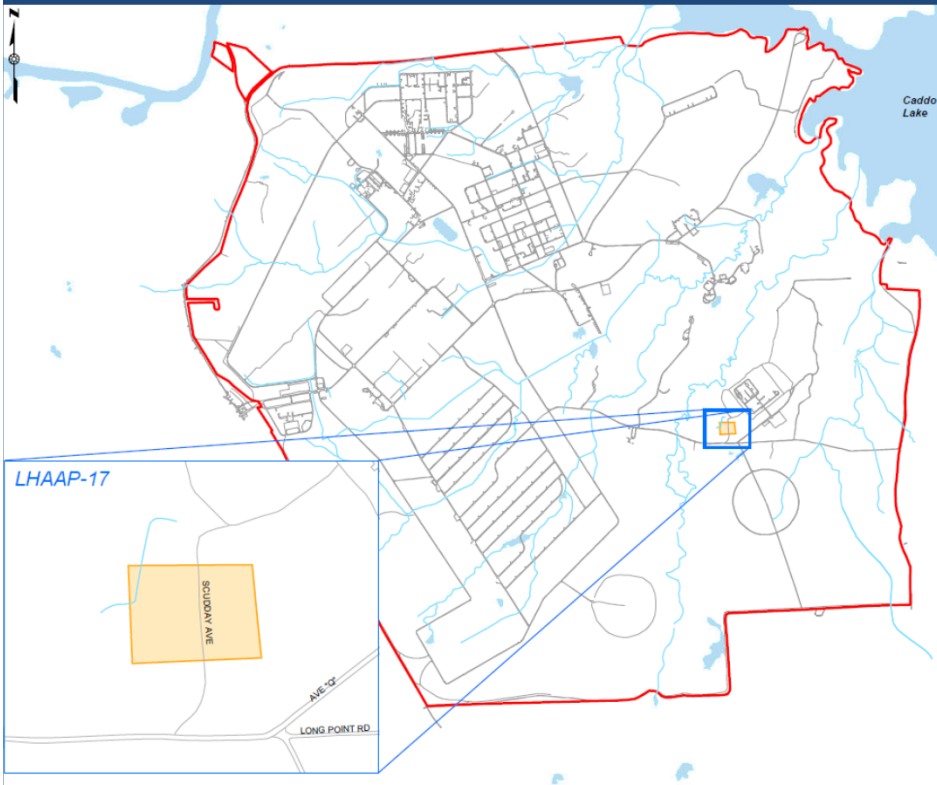
Implementation of LUCs:

- restrict the use of groundwater to environmental monitoring and testing only and restricting land use to nonresidential will remain in place until the levels of COCs in surface and subsurface soil and groundwater allow for unlimited use and unrestricted exposure.
- maintain the integrity of any current or future remedial or monitoring systems will remain in place until groundwater cleanup levels of COCs are met.
- prohibit groundwater use (except for environmental monitoring and testing) as a potable source will remain in place until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.

CERCLA Five Year Reviews until the levels of COCs in soil and groundwater allow for unlimited use and unrestricted exposure.

LHAAP-17, Burning Ground No. 2/Flashing Area

SELECTED REMEDY: Excavation and Offsite Disposal of Soil, Groundwater Extraction, Monitored Natural Attenuation and Land Use Controls



SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring**Site History**

LHAAP-001-R, the South Test Area/Bomb Test Area, is located in the southern portion of LHAAP and covers an area of approximately 79 acres. LHAAP-001-R was constructed in 1954 and used for testing photoflash bombs produced at the facility until about 1956. During the late 1950s, illuminating signal devices were also demilitarized within pits excavated in the vicinity of the test pad. During the early 1960s, leaking production items may have been demilitarized by detonation. Leaking white phosphorus (WP) munitions were supposedly disposed of although no primary source documentation concerning this effort was located. A 1984 LHAAP Contamination Survey stated the area had been relatively inactive since the early 1960s and no disposal or testing activities were carried out in this area. LHAAP-001-R is co-located with Installation Restoration Program site LHAAP-27. LHAAP-001-R was identified as a munitions and explosives of concern (MEC) area of concern based on the visual confirmation of MEC. In 2008, a MEC removal action was conducted and LUCs were developed. A total of 384 MEC/material potentially presenting explosive hazard (MPPEH) items and 14 inert items were located and destroyed and a total of 22,139 pounds of munitions debris and 1,876 pounds of cultural debris were removed during the course of clearance. In addition, LUCs were developed that included restrictions against intrusive activities including digging; signage at the perimeter of the site; and an education program for future refuge visitors, staff, and volunteers. After resolution of a dispute between Army and EPA in March 2016, the 2011 Draft Final ROD was revised and the final ROD was finalized in September with a selected remedy of implementation of LUCs and limited groundwater monitoring for perchlorate, in addition to the completed removal action.

Site Characteristics

The topography slopes gently to the east and surface water runoff from the hillside flows generally to the southeast and into Harrison Bayou. Groundwater at the site was encountered between 7 and 9 ft below ground surface. Groundwater is topographically controlled with a general flow direction to the east toward the floodplain of Harrison Bayou. Sampling conducted by the USEPA and Army in 2009 resulted in a detection of perchlorate in one well at a concentration above the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL) of 17 ug/L.

Remedial Action Objective (RAO)

- Protection of human health and safety from explosive hazards that may have remained at the site after the MEC removal action and confirmation that perchlorate is present in groundwater at levels below the chemical specific criterion

Description of the Selected Remedy:**Implementation of LUCs:**

- to prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds, and to prohibit intrusive activities such as digging or any other activity which could result in explosive safety risks.
- to prohibit residential land use will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- to restrict land use to nonresidential will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- to prohibit intrusive subsurface activities, including digging, will remain in place until it is demonstrated that the MEC no longer present an explosive hazard

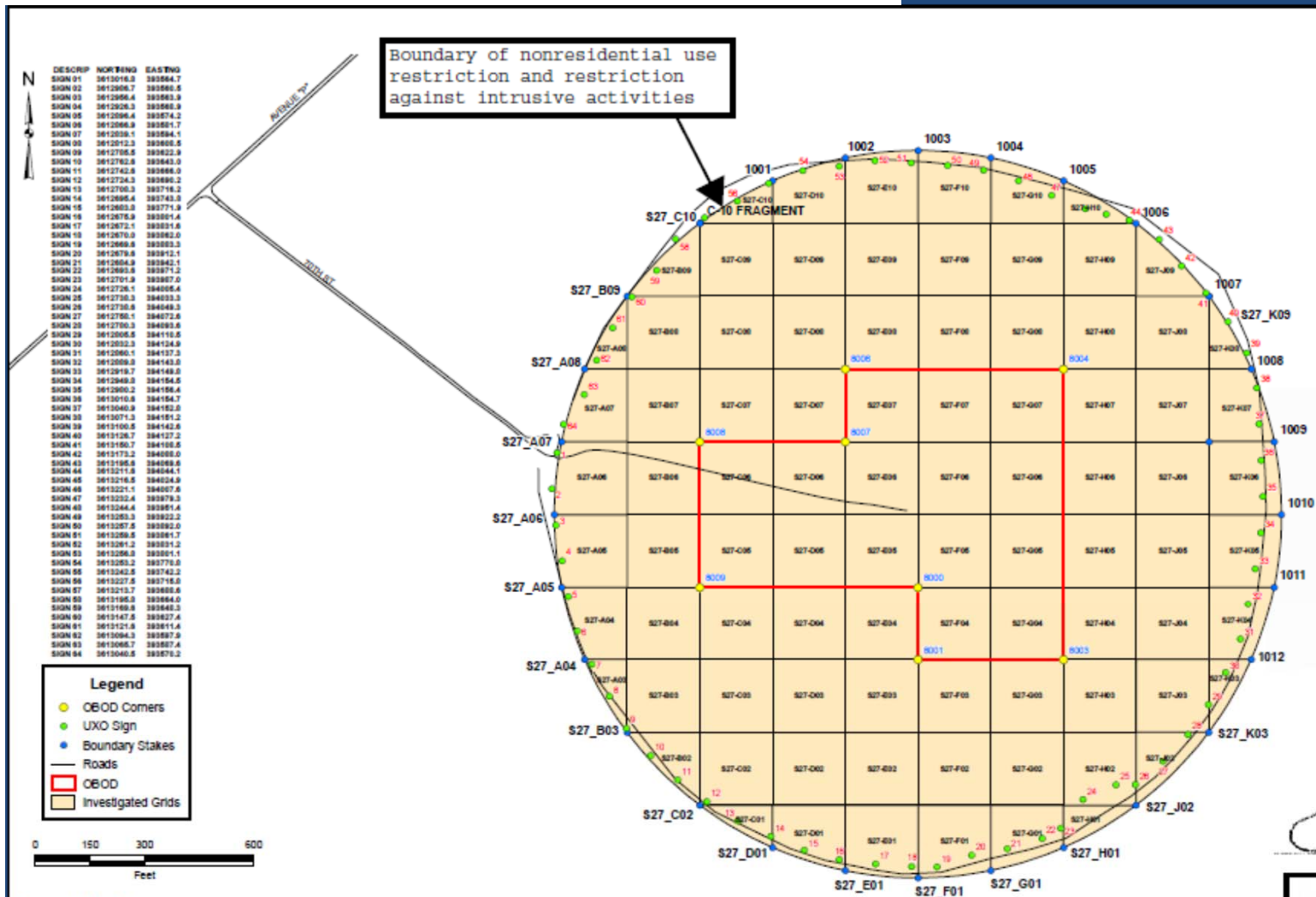
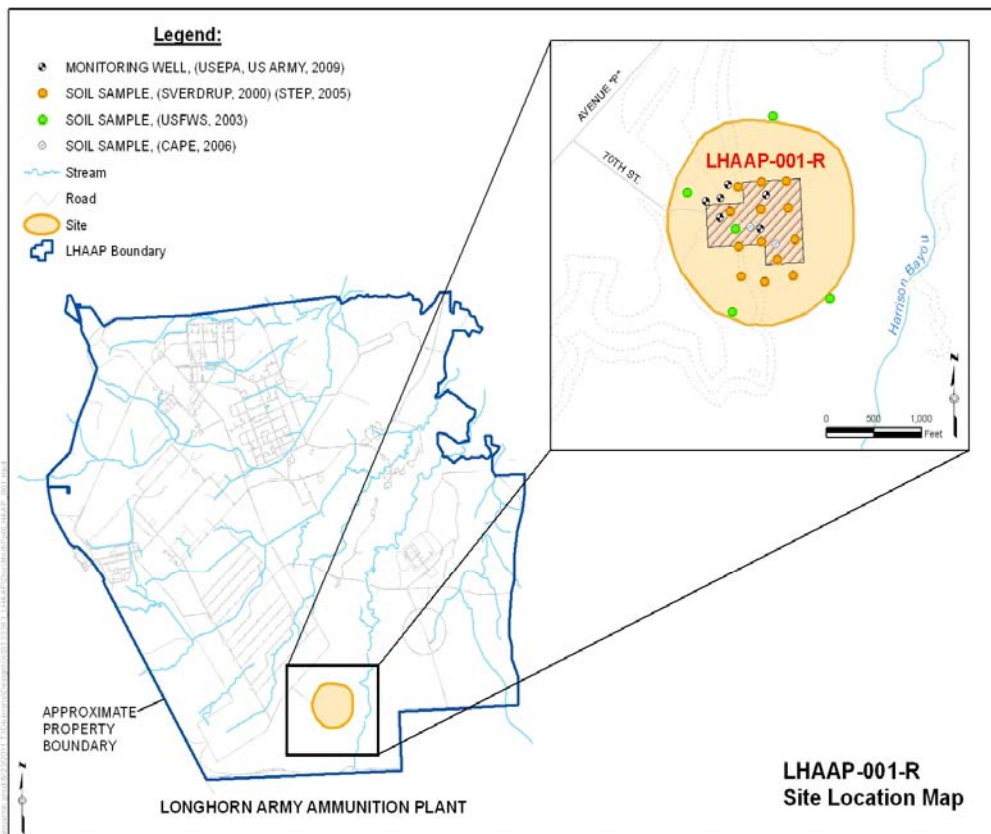
Limited groundwater monitoring:

Limited groundwater monitoring for perchlorate will confirm perchlorate level in groundwater is below the TRRP Tier 1 Groundwater Residential PCL which is the state remedial standard utilized in the absence of a federal drinking water standard.

Five Year Reviews will be conducted because explosive hazards may remain at the sites that do not allow for unlimited use and unrestricted exposure.

LHAAP-001-R, South Test Area/Bomb Test Area

SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring



SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring

Site History

LHAAP-003-R, the Ground Signal Test Area, is located in the southeastern portion of LHAAP and covers an area of approximately 80 acres. LHAAP-003-R was used intermittently starting in April 1963 for aerial and on-ground testing and destruction of a variety of devices, including pyrotechnic signal devices, red phosphorus smoke wedges, infrared flares, illuminating mortar shells and cartridges, button bombs, and various types of explosive simulators. The site was also used intermittently over a 20-year period for testing and burn-out of rocket motors. From late 1988 through 1991, the site was also used for burn-out of rocket motors in Pershing missiles. Occasionally, leaking white phosphorus (WP) munitions were burned at the site as a demilitarization activity. LHAAP-003-R is co-located with Installation Restoration Program site LHAAP-54. LHAAP-003-R was identified as a munitions and explosives of concern (MEC) area of concern based on the reported presence of MEC. In 2008 MEC removal action was conducted and LUCs were developed. A total of 12 MEC/material potentially presenting explosive hazard (MPPEH) items and one inert item were located and destroyed and 6,880 pounds of munitions debris and 5,981 pounds of cultural debris were removed during the course of surface clearance. In addition, LUCs were designed that include restrictions against intrusive activities including digging; signage at the perimeter of the site; and education programs for future refuge visitors, staff, and volunteers. After resolution of a dispute between Army and EPA in March 2016, the 2011 Draft Final ROD was revised and the final ROD was finalized in September with a selected remedy of implementation of LUCs and limited groundwater monitoring for perchlorate, in addition to the completed removal action.

Site Characteristics

The site is located within the watersheds of Saunders Branch and Harrison Bayou. Both Saunders Branch and Harrison Bayou flow into Caddo Lake. Surface water runoff from the site is towards drainage ditches located alongside the circular dirt road forming the outer margin of the site. The ditches converge to the northeast and the southwest directing surface water to Saunders Branch and Harrison Bayou, respectively. The depth to groundwater at the site averages about 15 feet below ground surface with some seasonal fluctuations. The regional groundwater flow direction is to the north-northeast toward Caddo Lake; however, during periods of high precipitation the groundwater flow direction in the southwestern portion of the site diverts to the northwest towards Harrison Bayou. The additional groundwater sampling conducted by the USEPA and U.S. Army in 2009 indicated that perchlorate was detected in one well at a concentration below the Texas Risk Reduction Program (TRRP) Tier 1 Groundwater Residential Protective Concentration Level (PCL) of 17 ug/L.

Remedial Action Objective (RAO)

- Protection of human health and safety from explosive hazards that may have remained at the site after the MEC removal action and confirmation that perchlorate is present in groundwater at levels below the chemical specific criterion

Description of the Selected Remedy:**Implementation of LUCs:**

- to prohibit the development and use of the property for residential housing, elementary and secondary schools, and child care facilities and playgrounds, and to prohibit intrusive activities such as digging or any other activity which could result in explosive safety risks.
- to prohibit residential land use will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- to restrict land use to nonresidential will remain in place until it is demonstrated that the MEC no longer presents a threat to public/human safety.
- to prohibit intrusive subsurface activities, including digging, will remain in place until it is demonstrated that the MEC no longer present an explosive hazard

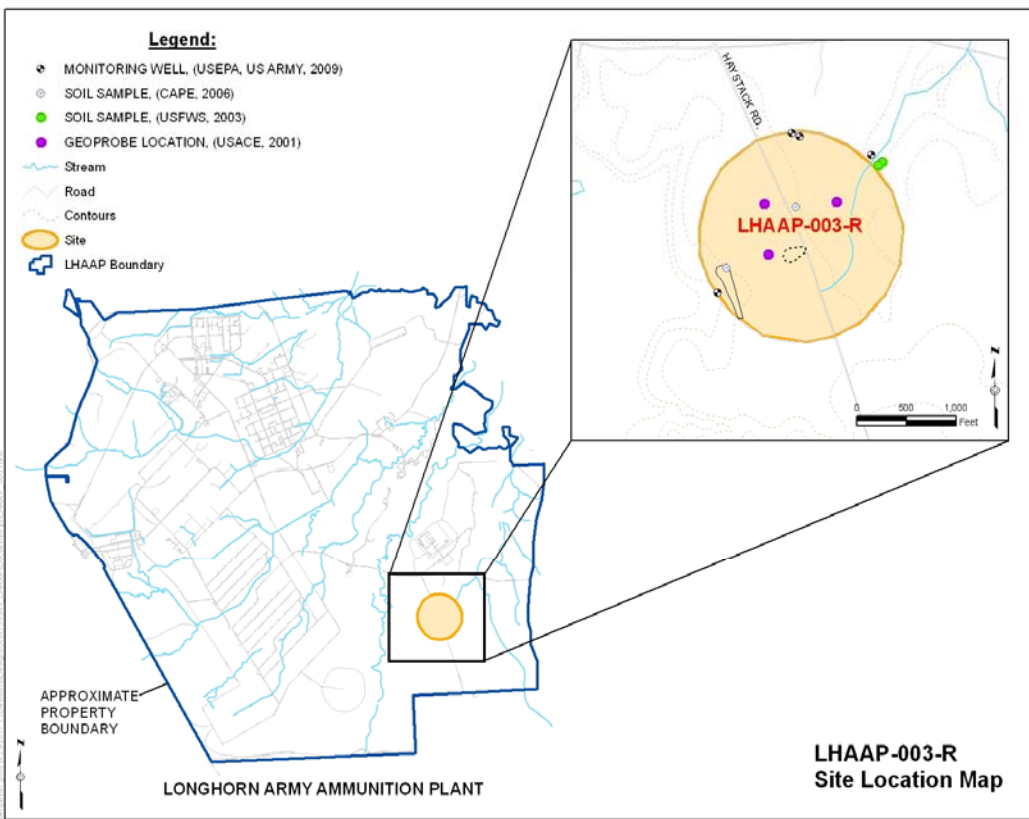
Limited groundwater monitoring:

Limited groundwater monitoring for perchlorate will confirm perchlorate level in groundwater is below the TRRP Tier 1 Groundwater Residential PCL which is the state remedial standard utilized in the absence of a federal drinking water standard.

Five Year Reviews will be conducted because explosive hazards may remain at the sites that do not allow for unlimited use and unrestricted exposure.

LHAAP-003-R, Ground Signal Test Area

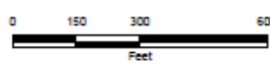
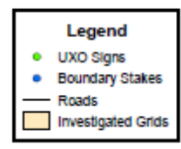
SELECTED REMEDY: Land Use Controls and Limited Groundwater Monitoring



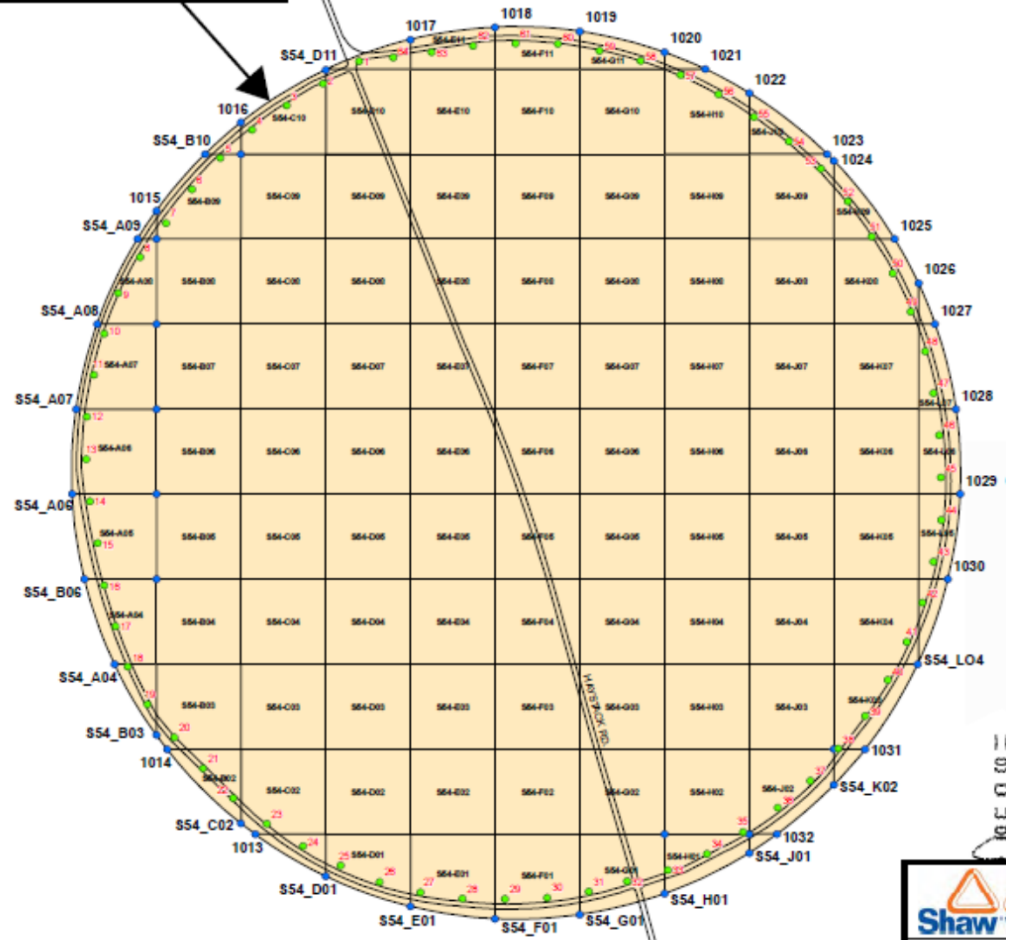
Boundary of nonresidential use restriction and restriction against intrusive activities



DESCRIP	NORTH	EAST	DESCRIP	NORTH	EAST
SIGN 1	3614179.4	398143.2	1013	398086.0	3613628.2
SIGN 10	3613954.8	394952.4	1014	398005.1	3613658.2
SIGN 11	3613954.8	394952.4	1015	394987.4	3614072.1
SIGN 12	3613924.6	394947.4	1016	398082.4	3614158.6
SIGN 13	3613984.1	394947.4	1017	398153.3	3614158.6
SIGN 14	3613983.7	394949.6	1018	398241.3	3614233.9
SIGN 15	3613923.0	394956.1	1019	398302.2	3614200.9
SIGN 16	3613923.0	394956.9	1020	398383.2	3614158.6
SIGN 17	3613774.4	394967.8	1021	398382.4	3614173.9
SIGN 18	3613746.2	394971.7	1022	398424.1	3614158.6
SIGN 19	3613716.3	394991.2	1023	398458.1	3614112.9
SIGN 2	3614183.4	399117.3	1024	398485.1	3614193.0
SIGN 20	3613984.6	399119.3	1025	398523.9	3614051.9
SIGN 21	3613971.4	399117.1	1026	398546.1	3614023.2
SIGN 22	3613981.1	399022.0	1027	398580.0	3613991.9
SIGN 23	3613932.9	399077.7	1028	398671.1	3613930.0
SIGN 24	3613916.8	399103.1	1029	398678.0	3613989.1
SIGN 25	3613962.0	399130.0	1030	398687.2	3613900.1
SIGN 26	3613981.1	399158.1	1031	398697.7	3613888.2
SIGN 27	3613953.5	399157.8	1032	398644.2	3613828.2
SIGN 28	3613879.1	399217.8	S54_A04	394987.3	3613747.1
SIGN 29	3613873.7	399248.2	S54_A06	394939.0	3613881.1
SIGN 3	3614147.8	399091.2	S54_A07	394939.0	3613930.0
SIGN 30	3613879.8	399270.7	S54_A08	394984.0	3613991.0
SIGN 31	3613954.2	399200.8	S54_A09	394939.0	3614051.9
SIGN 32	3613891.4	399336.3	S54_B00	394987.4	3613994.4
SIGN 33	3613984.6	399306.6	S54_B01	394987.4	3613991.0
SIGN 34	3613911.1	399302.0	S54_B02	394948.7	3613991.0
SIGN 35	3613924.0	399419.0	S54_B03	394987.4	3613991.0
SIGN 36	3613964.2	399448.0	S54_B04	394987.4	3613991.0
SIGN 37	3613983.6	399460.2	S54_B05	394987.4	3613991.0
SIGN 38	3613986.5	399460.2	S54_B06	394987.4	3614051.9
SIGN 39	3613716.3	399607.8	S54_C00	399032.0	3614112.9
SIGN 4	3614130.2	399066.2	S54_C02	399058.4	3613933.0
SIGN 40	3613736.9	399233.0	S54_C10	399080.4	3614112.9
SIGN 41	3613793.0	399217.8	S54_C11	399119.0	3613881.1
SIGN 42	3613791.2	399248.2	S54_C11	399119.0	3614173.3
SIGN 43	3613920.6	399306.7	S54_C01	399100.3	3613873.9
SIGN 44	3613950.6	399362.2	S54_C01	399241.0	3613884.6
SIGN 45	3613950.9	399362.2	S54_C01	399302.2	3613987.8
SIGN 46	3613911.3	399398.1	S54_D01	399363.0	3613882.8
SIGN 47	3613941.4	399506.7	S54_D02	399363.0	3613923.0
SIGN 48	3613871.3	399550.0	S54_D01	399424.1	3613911.0
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SIGN 9	3614813.1	399485.0			



Datum: NAD83 UTM
 Monument: Longhorn Army Ammunition Plant
 Monument BG-1 with coordinates
 NORTHING=3614801.46,
 EASTING=395385.09



LHAAP-16

3.0 *Responsiveness Summary*

The Responsiveness Summary serves three purposes. First, it provides the U. S. Army, USEPA, and TCEQ with information about community concerns with the preferred alternative at LHAAP-16 as presented in the Proposed Plan. Second, it shows how the public's comments were considered in the decision-making process for selection of the remedy. Third, it provides a formal mechanism for the U.S. Army to respond to public comments.

The U.S. Army, USEPA, and TCEQ provide information regarding LHAAP-16 through public meetings, the Administrative Record for the facility, and announcements published in the Shreveport Times and Marshall News Messenger newspapers. **Section 2.3** discusses community participation on LHAAP-16, including the dates for the public comment period, the date, location, and time of the public meetings, and the location of the Administrative Record. The following documents related to community involvement were added to the Administrative Record:

- Transcript of the public meeting on October 19, 2010
- Presentation slides from the October 19, 2010 public meeting
- Written questions and comments from the public during the public comment period, and the U.S. Army response to those comments dated March 14, 2011.

3.1 *Stakeholder Issues and Lead Agency Responses*

This section responds to significant issues raised by stakeholders including the public and community groups that were received in written or verbal form.

Question/comment: The Army states that it could take 280 years to reduce groundwater contaminant concentrations to acceptable levels. It is not reasonable to propose plans that could require water quality monitoring, maintenance of the landfill cap, maintenance of the biobarriers, and maintenance of LUCs for such a length of time.

The Army should take steps to reduce the length of time that will be required to achieve acceptable contaminant concentrations. These steps could include: installation of an effective pump and treat system, modification of the proposed in-situ bioremediation system to cover a greater portion of the site and to operate until acceptable concentrations are achieved, thermal treatment (e.g., steam stripping), and elimination or reduction of the contaminant source by removing the landfill or reducing the mass of contaminants that it contains.

Response: Given the nature of the residual contaminants that are present at LHAAP-16, the length of time that will be required to achieve cleanup levels would be long for any of the remedial alternatives, whether treatment, migration control, or source control by removal.

It is believed that TCE was present within the landfill as DNAPL has dissolved into the groundwater at very high concentrations and migrated to the east (down-gradient of the landfill). This high concentration region acts as a secondary source of groundwater contamination. Although TCE may remain in the landfill, the landfill cover system has significantly reduced the driving force of recharge and added a degree of isolation to the remaining waste. Removal of the landfill would not affect the secondary source of groundwater contamination outside the landfill and would be a very large cost without corresponding benefit.

The LUCs restricting the use of groundwater will be highly effective as will be long term maintenance of the LUCs, given that the reasonably anticipated future use of the site is as a national wildlife refuge (i.e., Caddo Lake National Wildlife Refuge) and the owner a federal agency. Once the property is transferred into the refuge system, the property must be kept as a National Wildlife Refuge unless there is an act of Congress which removes the parcel or the land is exchanged in accordance with the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Act Amendments of 1974. A national wildlife refuge by its very nature includes physical access and use restrictions, and is subject to control and continual inspection by Refuge personnel. The LUCs will restrict access to the groundwater for purposes other than environmental testing until cleanup levels are met. Additionally, access of groundwater through well installations requires a permit from the Texas Department of Licensing and Regulation or Texas Water District authority. The department will be provided a copy of the county recordation that indicates the location of contaminated groundwater at the site and associated restriction.

Since LHAAP-16 is enclosed within a national wildlife refuge with no current or planned use of groundwater for human consumption, plume stability and protection of Harrison Bayou are key measures for evaluation of a remedial strategy. A detailed analysis of alternatives, including those with aggressive treatments, was conducted according to the evaluation criteria identified in the NCP (40CFR 300.430). Advantages, disadvantages, and trade-offs were considered as part of the evaluation process during the feasibility study (Jacobs, 2002). The suggested alternatives were considered in the FS and were not seen as sufficiently advantageous over the preferred alternative (Shaw, 2010).

Question/Comment: Groundwater contamination at LHAAP-16 is caused by contaminants being leached from wastes in the landfill. The landfill could continue to generate large amounts of contaminants for decades or centuries. The Army's preferred alternative does not attempt to reduce the length of time that the landfill will generate contaminants.

The Army should attempt to reduce the length of time the landfill will generate large amounts of contaminants. This could be done by 1) removing the landfill or 2) treating the landfill to reduce the mass of contaminants it contains (e.g., hot-spot removal, flushing with surfactants or solvents, bioremediation, vapor extraction).

Response: It is believed that TCE was present within the landfill as DNAPL has dissolved into the groundwater at very high concentrations and migrated to the east (down-gradient of the landfill). This high concentration region acts as a secondary source of groundwater contamination. Although TCE may remain in the landfill, the landfill cover system has significantly reduced the driving force of recharge and added a degree of isolation to the remaining waste. The biobarrier will be installed at the edge of the landfill to treat/remediate and thereby control potential migration of contaminants from the landfill. Removal of the landfill would not affect the secondary source of groundwater contamination outside the landfill and would be a very large cost without corresponding benefit. Since LHAAP-16 is enclosed within a national wildlife refuge with no current or planned use of groundwater for human consumption, plume stability and protection of Harrison Bayou are more important measures for evaluation of remedial alternatives than the time factor.

In 1998 a landfill system was placed over the site and was completed as part of an early Interim Remedial Action (IRA) in accordance with the USEPA presumptive remedy guidance under CERCLA for municipal landfills (EPA 540-F-93-035) and for military landfills (EPA 540-F-96-020). Capping as opposed to waste treatment or removal, is a presumptive remedy at landfills as it has been shown to be more appropriate in comparison to other remedies. The IRA was intended to be consistent with the final remedy and is considered a component of the final remedy being proposed for LHAAP-16.

Landfill removal and landfill source treatment alternatives were included in the comparative analysis of alternatives performed during the feasibility study (Jacobs, 2002) and during the generation of the proposed plan (Shaw 2010) for LHAAP-16. These remedial alternatives did not demonstrate increases in effectiveness that were balanced by their increased costs and short-term impacts.

Question/Comment: The Army's 280 year estimate of cleanup time due to natural attenuation is not based on solid evidence. It appears that the Army chose this number because it was the cleanup time calculated for natural attenuation of TCE at well 16WW16. However, a longer TCE cleanup time (492 years) was calculated for well 16WW12. In addition, contaminant concentrations in some wells are stable or increasing rather than decreasing (e.g., perchlorate in well 16WW12, and TCE in well 16WW36). The calculated cleanup time due to natural attenuation for these wells would be infinity.

The Army does not address the question of whether the remedial actions it has conducted at the site have affected the cleanup time calculations. That is, are the contaminant reductions seen at the site due to natural attenuation, the remedial actions, or both?

Response: The duration of 280 years was considered as a reasonable estimate based on the prior history of TCE concentrations at 16WW16. The wells with stable or increasing concentrations are in areas where treatment will be applied, or where biobarriers will cut off renewal of contaminants from upgradient areas. Implementing the remedy is expected to expedite attenuation rates, making them faster, so the worst case scenario at 16WW12 was not chosen as a representative case. Instead the second slowest measurable attenuation was used as an initial estimate for duration.

Contaminant reductions thus far are due to a combination of past actions and natural attenuation. Past actions have removed contaminant mass in some areas of the site and can thus be assumed to have reduced cleanup time in those specific areas, though there is insufficient historical data to quantify the extent of that reduction. The areas most affected in this way would be the capture zone of the extraction wells and a small area immediately down-gradient of the semi-passive biobarrier. The cleanup times at locations that are outside the immediate down-gradient vicinity of the semi-passive biobarrier and far from the extraction wells can be assumed to be outside any significant influence from either of those past actions. Most of the wells at the site (e.g., 16WW16, 16WW12, 16WW43, etc.) are outside those influences.

Question/Comment: The Army intends to evaluate the effectiveness of natural attenuation in a 28 month period following the installation of the biobarriers and the in-situ bioremediation system, and after groundwater extraction has been discontinued. This does not appear to make sense. The effects of the remedial actions will persist for some unknown period of time. How will the Army distinguish between the effects of the remedial actions, and the effects of natural attenuation?

Response: The application of biobarriers and bioremediation will be in discrete areas. The effectiveness of remedial actions will be evaluated for wells in those areas. MNA will be evaluated for wells that are outside the remedial action areas.

Question/Comment: The Army should clearly explain how it will determine whether natural attenuation is reducing contaminants concentrations at an acceptable rate.

Response: The Army intends to present details of the MNA remedy implementation in a remedial design for LHAAP-16. The regulatory guidance established by USEPA (1998) for MNA will be followed to demonstrate that natural attenuation is occurring.

Question/Comment: The passive biobarriers will intercept groundwater only in the shallow zone. However, the intermediate zone also contains high concentrations of contaminants. The Army should explain why it chose not to extend the passive barriers into the intermediate zone.

Response: Biobarriers were not extended into the intermediate zone because the intermediate zone does not intersect surface water in Harrison Bayou. The intermediate zone is deeper than the flowline elevation of the bayou. The highest recent COC concentrations in the intermediate zone are more than 10 times lower than recent COC concentrations in the shallow zone. Nonetheless, the intermediate zone will be addressed via bioremediation injections in the most contaminated locations that have been detected within that zone. MNA will be implemented for areas outside the influence of the active remedies. Monitoring will verify protection of human health and the environment by documenting that further reductive dechlorination is occurring within the plume, that the plume is not migrating, and that contaminant concentrations are being reduced to cleanup levels.

Question/Comment: The pumping of the extraction wells may be limiting the lateral expansion of the contaminant plume. After the extraction wells are shut down, the plume may expand such that it will flow around the ends of the down gradient biobarrier. The Army should consider this possibility in its final remedial design.

Response: There are no plans to remove the extraction system, just to turn it off. The extraction wells will be shut down after application of in situ bioremediation. In situ bioremediation is expected to greatly reduce contaminant concentrations in the application area, minimizing the migration of contaminants toward the biobarrier that will be installed near the bayou. The biobarrier at the landfill is expected to treat contaminated groundwater thereby controlling renewal of the plume at the landfill boundary. The biobarrier is a treatment remedy for contaminated groundwater and not a physical barrier to preventing flow of groundwater. The remnants of the plume are expected to attenuate over time, and groundwater monitoring will continue to check for future potential migration.

Question/Comment: Groundwater up-gradient of Harrison Bayou is highly contaminated, and the contaminant plume emanating from the landfill is discharging to Harrison Bayou. However, there is no reason to believe that Harrison Bayou acts as a complete barrier to groundwater flow. A portion of the contaminant plume may extend beyond the bayou. The Army should install monitor wells to the east of Harrison Bayou to determine the full extent of groundwater contamination.

Response: Since 1999, the Army has collected quarterly surface water samples from three locations in Harrison Bayou. During August 2003 and August 2007, perchlorate was detected in the surface water samples collected from one sampling location in Harrison Bayou (HBW-1) indicating there is some discharge by seepage into Harrison Bayou. Except for the 2 quarters, perchlorate was not detected in any other samples during any other sampling events.

Many wells exist on the east side of Harrison Bayou. The pair of wells closest to the east is 18WW10 (shallow) and 18WW11 (intermediate), which show no COC contamination.

Question/Comment: The proposed monitor well network will not detect contaminants that flow to the southeast of the down gradient barrier. The Army should install at least one shallow and one intermediate monitor well between the southeast end of the barrier and Harrison Bayou.

The proposed monitor well network does not include an intermediate monitor well between the down gradient barrier and Harrison Bayou. The Army should install an intermediate monitor well next to well 16WW40.

The proposed monitor well network will not detect contaminants that flow thorough the northern portion of the down gradient barrier. The Army should install at least one shallow and one intermediate monitor well between the northern portion of the barrier and Harrison Bayou.

The extent of the contaminant plume in the shallow aquifer north of well 16WW22, and in the intermediate aquifer north of well 16WW41, is unknown. The Army should install at least one shallow well and one intermediate monitor well to the north of these wells.

Response: The need for installation of additional monitoring wells will be evaluated during the remedial design.

Question/Comment: The Army Corps of Engineers determined that the eastern portion of the site is within the floodplain of Harrison Bayou. It is not clear, however, whether any portion of the landfill itself is in the floodplain. The Army should determine whether any portion of the landfill is within the floodplain. If it is, steps should be taken to protect the landfill from the effects of flooding.

Response: The southeastern edge of the landfill is within the floodplain (U.S. Department of Housing and Urban Development, Flood Hazard Boundary Map, Harrison County, Texas, Unincorporated Area, Community Panel Number 480847 0004 A, Effective date: September 6, 1977, Converted by Letter Effective 11/1/89). This was known at the time the record of decision was signed for design and construction of the landfill. The southeastern portion of the landfill was designed with a compacted soil berm to protect the cap from flood waters. Additionally, the landfill cap is inspected periodically and maintenance is performed as necessary. The design and the follow-up inspection/maintenance activities are expected to be sufficient to protect the landfill from the effects of flooding.

Question/Comment: The Army is proposing only one sampling point on Harrison Bayou near site 16. Thus, if contaminants are detected, the Army will not be able to determine whether they are coming from site 16 or from an upstream source. In addition, this single sampling point will

not detect any site 16 contaminants that enter Harrison Bayou downstream of the point. That is, it will not detect contaminants that may flow around the northern end of the biobarrier, or through the barrier if it fails to function as intended.

Response: Based on groundwater flow and the proximity of Harrison Bayou, sampling location HBW-1 is considered the location most likely to reveal contamination resulting from LHAAP-16. Continued sampling of HBW-1 or a nearby location will be required by the ROD for LHAAP-16. In accordance with a 1999 agreement between Army, TCEQ, and EPA, the Army currently collects quarterly surface water samples from HBW-1 plus two other locations in Harrison Bayou - HBW-10, which is upstream, and HBW-7, which is downstream. While the Army, TCEQ, and EPA might agree to alter the locations of HBW-7 and HBW-10 at some later date, perchlorate results over the last 10 years have indicated that HBW-1 is the location of greatest concern.

In addition, the selected remedy also includes a network of monitoring wells down gradient of the biobarrier in addition to the surface water sampling. Therefore, concentrations of groundwater that has the potential to enter into Harrison Bayou would be known.

Question/Comment: Although Harrison Bayou was not flowing on October 19, 2010, there was a pool of standing water in the streambed. This pool was about 30 feet upstream of well 16WW40, and in the same area as the seep that was sampled in 1995. The pool was approximately 20 feet long, three feet wide, and a few inches deep. This pooled water may be groundwater that has discharged to the streambed. During periods when Harrison Bayou was not flowing, the Army should monitor the streambed for pools of water. If they are present, they should be sampled. The Army should also monitor the banks of Harrison Bayou for seeps and should attempt to sample any that are discovered.

Response: Previous sampling of the standing water in Harrison Bayou indicated that in the past contaminated groundwater discharged by seepage into Harrison Bayou. Because the basis for sampling is protection of human health by protecting the surface water that flows through Harrison Bayou to Caddo Lake, continued sampling of standing water in pools will serve no purpose. Periodic sampling of surface water is already conducted on a quarterly basis at three locations in Harrison Bayou. The banks of Harrison Bayou will be inspected for locations of possible seeps.

Question/Comment: The Army performed a 'streamlined' Human Health Risk Assessment for Harrison Bayou at site 16. This risk assessment found that the excess lifetime cancer risk for dermal contact with Harrison Bayou surface water was 1.62×10^{-5} . This is higher than the lower bound (1.0×10^{-6}) of the EPA target risk range. The streamlined assessment did not estimate the human health risk from drinking the water, nor did it estimate the effects that the water could have on Caddo Lake. The Army stated that a full risk assessment of Harrison Bayou would be conducted as part of the Group 2 risk assessment. However, site 16 does not appear to have been included in

the Group 2 risk assessment. The Army should perform a full Human Health Risk Assessment for Harrison Bayou at site 16.

Response: The calculated risk from surface water (1.62×10^{-5}) was within the range of acceptable risk levels for excess lifetime cancer risk (1×10^{-4} to 1×10^{-6}). The Group 2 Risk Assessment included a risk assessment for Harrison Bayou and sampling location HBW-1, which is associated with LHAAP-16 was included as part of that assessment. Additionally the risk assessment report states “because the depth of this surface water body ranges from a few inches to a few feet, it is unlikely that it would be used to any significant extent for swimming; therefore, the incidental ingestion of surface water is not evaluated”.

Question/Comment: Concentrations of antimony and thallium that exceed the EPA MCL are commonly detected in groundwater at site 16. However, the Army has not included antimony or thallium as contaminants of concern (COC). The Army should either include antimony and thallium as a COCs for groundwater at site 16, or explain why they are omitted.

Response: Antimony and thallium are commonly found in groundwater and were detected in groundwater at LHAAP-16. However, they were not found to be significant contributors to cancer risk or non-cancer hazard in groundwater at LHAAP-16 during the human health risk assessment conducted for the site (Jacobs, 2001). The detections of antimony and thallium were erratic and did not appear to represent a plume of contamination. Additionally, they were not detected above background levels in soil at the landfill. These factors indicated that their occurrence was unlikely to be associated with contamination from the landfill. The detections of antimony in groundwater were also within the range of groundwater background values at Longhorn AAP (Shaw, 2007) indicating antimony is naturally occurring at the site. Therefore, antimony has not been included in the list of contaminants of concern at the site. Since thallium does not have a background value and has had historically high detection limits (2003 and 2004 analytical results), additional groundwater sampling for thallium will be integrated into the RD phase for LHAAP-16.

Question/Comment: The Army is using reporting limits for thallium in groundwater that are higher than the EPA MCL. Thus, concentrations of thallium that exceed the MCL may be undetected or unreported. The Army should use a thallium reporting limit that is less than the MCL.

Response: Given the results from 1997 (which had appropriate detection limits) and the lack of significant soil results, the U.S. Army considered thallium in the LHAAP-16 groundwater samples to be naturally occurring sporadic detections that were unrelated to site contamination. However, the Army concurs that analytical results in 2003 and 2004 samples had high detection limits and drive the need for further evaluation of thallium. Thus, thallium will be added to the COC list and

will be the subject of additional groundwater monitoring. Monitoring results will be evaluated at the first five-year review to determine if any further monitoring for thallium is warranted.

Question/Comment: High concentrations of dioxins and/or furans have been detected in surface water and groundwater at site 16. However, neither dioxins nor furans are included as COCs for surface water or groundwater. The Army should either include dioxins and furans as COCs, or explain why they are omitted.

Response: The concentrations of dioxins/furans were evaluated as a composited value for total dioxins/furans based on relative toxicities of the individual chemicals. That composited value is the toxicity equivalent (TEQ), and it can be directly compared with the MCL for dioxin. The highest TEQ dioxin concentration was lower than the MCL, so dioxins/furans were not selected as a COC.

Question/Comment: The Army's compliance level for perchlorate in Harrison Bayou is 26 µg/L, which is TCEQ's groundwater medium specific concentration for residential use (GW-Res). However, the EPA's Health Advisory (HA) level for perchlorate is 15 µg/L. Although the HA is not an enforceable MCL, it is reasonable to assume that when it is finally established, the perchlorate MCL will be similar to the HA. The Army should explain why it did not use the HA level as the cleanup level.

Response: The cleanup level and surface water compliance level for perchlorate is 17 µg/L, which is the TRRP Tier 1 Groundwater Residential PCL. The cleanup level for perchlorate was revised as a result of dispute resolution between the Army and the EPA. If enforceable limits change in the future, or are newly introduced, the difference between the cleanup level and any such new limits will be subject for discussion during the five year reviews.

Question/Comment: The final details of the remedial action will be presented in a Remedial Design (RD). The Army should make the RD available for public review and comment as soon as it is developed. The Army's Proposed Plan does not mention the development of a contingency plan to be invoked if the remedial actions are not performing satisfactorily. A contingency plan should be included in the RD.

Response: The public will be provided with updates on remedial design and remedial action status through the RAB meeting and any concerns can be addressed through this forum. The RD will include performance objectives, schedule and other design criteria and will follow established regulatory guidance for MNA.

The concept of a contingency plan for what to do if the remedy is unsuccessful as implemented is inherent in the process of remediation. The remedy must be determined to be operating properly

and successfully. Other opportunities for implementing contingency plans will occur with each five-year review.

Question/Comment: The Army reported an average groundwater speed in the shallow zone of 36.7 ft/yr. However, groundwater speeds in the shallow zone range from 0.44 ft/yr - 990 ft/yr.

The higher values may be associated with paleochannels, while the lower values may be associated with ancient overbank deposits that border the paleochannels. When evaluating the transport of contaminants in groundwater, we are usually more concerned with the contaminants that flow most rapidly, rather than those that flow at average or lower speeds.

Response: Noted. The groundwater velocity is not directly measured, but is estimated from groundwater gradients and the average of hydraulic conductivities measured in individual wells. There can be considerable variability of hydraulic conductivity from well to well, so using the average hydraulic conductivity is reasonable for calculating the overall groundwater velocity for the entire site.

Question/Comment: Alternative 7 seems to be the path of least resistance rather than a proactive approach. It appears the Army is trying to do as little as possible for a very contaminated site and not fix the problems for LHAAP-16. The relative low cost was based on the Army's 30 year payout and the possible length of time to remediate the landfill is projected to be 280 years. More investigation should be conducted before finalizing the plans for Site 16 Landfill.

Response: More investigation is not considered necessary to understand the contamination and hydrogeology at LHAAP-16. Additional investigations are unlikely to alter the conclusions that have led to the development of remedial alternatives for the site. Delaying implementation of a remedy to perform more investigations would be less protective of human health than proceeding with the preferred remedy. Besides actively treating the more contaminated portions of the groundwater, the preferred remedy will require monitoring, control of groundwater use, and periodic review of the conditions of the site. The components of the remedy that apply to the more contaminated portions of the groundwater would be implemented within a few years – well within the 30 year period of the cost estimate. Due to the future land use, it is reasonable to utilize monitored natural attenuation to address the remaining contamination over a much longer time period. The preferred remedy has been deemed to be protective of the human health and the environment.

Question/Comment: The Army's proposal for dealing with this highly contaminated landfill consist mostly of future monitoring, periodic groundwater water treatment, and implementing some small barrier walls to hopefully slow down the migration of contaminated groundwater into nearby Caddo Lake. Unfortunately, this is already happening, although the Army claims to not

know to what extent. Site 16 landfill remedy has a projected cost of a little less than 2 million dollars for its proposed 30 year clean-up plan. The Army says it will possibly take 280 years to complete the site 16 landfill clean-up; this must indicate that the site is highly contaminated.

Response: A landfill cap and cover system was placed over the site and was completed as part of an early IRA. Landfill cap is a presumptive remedy for municipal landfills (USEPA, 1993) and for military landfills (USEPA, 1996). A landfill cap and cover system eliminated the direct exposure pathway to source area waste material, preventing contaminant transport to surface water via surface runoff, and reducing leaching of contaminants to the groundwater. The IRA was intended to be consistent with the final remedy and is considered a component of the final remedy being proposed for LHAAP-16.

Rather than slowing the migration of the contamination, the proposed biobarriers and bioremediation injections are intended to destroy much of the identified contamination. The active remedies that apply to the more contaminated portions of the groundwater would be implemented first and followed by monitored natural attenuation. Due to the future land use, it is reasonable for the preferred alternative to utilize monitored natural attenuation to address the areas outside of the active remedies over a much longer time period.

Question/Comment: Does the Army have a plan for what it intends to do after the first 30 year segment of the clean-up project has been completed? Could it possibly be the same remedy continued, or a new plan at a much greater cost? Or, could it be that nothing will be done because the sands of time have by then washed away all the records and memory of site 16, leaving it for future generations to unknowingly suffer from and possibly have to deal with?

Response: The expectation at this time is that the remedy would continue. At the five-year reviews, the remedy is evaluated and adjusted or changed if necessary.

Question/Comment: The remediation cost is \$183.00 per day for LHAAP-16 for 'no' removal of many "known" and "unknown" toxic chemicals buried at the site. Site 16 landfill has been determined by the EPA to be so contaminated it is listed as a Federally Funded Military Superfund Clean-up site. There are most likely metal containers of toxic chemicals buried at the site that will eventually rust through and cause additional soil and groundwater contamination beyond what is currently known or detected.

Response: A detailed analysis of several alternatives including landfill removal was conducted in accordance with the evaluation criteria identified in the NCP (40CFR 300.430). Advantages, disadvantages, and trade-offs were considered as part of the evaluation process during the feasibility study (Jacobs, 2002). The selected remedy for LHAAP-16 was preferred over other

alternatives because it provides the best combination of major trade-offs, is protective of human health and the environment and is compliant with regulatory requirements.

Question/Comment: Nearby Caddo Lake may eventually be home to this toxic waste since it is migrating through the soil and groundwater in that direction.

Response: The history of LHAAP-16 indicates the contamination migrates via groundwater flow, not through transport of soil. Contaminated groundwater does exist at LHAAP-16, but is not flowing into Caddo Lake. While sample results for Harrison Bayou surface water indicate that it is within the allowable water quality limits for the contaminants of concern, the groundwater near the bayou has elevated concentrations of those contaminants. The concern for preventing seepage of contaminants to the bayou was a significant factor in proposing a remedial action that includes a biobarrier to intercept that contamination.

3.2 *Technical and Legal Issues*

This section is used to expand on technical and legal issues. However, there are no issues of that nature beyond the technical issues already discussed in **Section 3.1**.

LHAAP-17

3.0 *Responsiveness Summary*

The Responsiveness Summary serves three purposes. First, it provides the U.S. Army, USEPA, and TCEQ with information about community concerns with the preferred alternative at LHAAP-17 as presented in the Proposed Plan. Second, it shows how the public's comments were considered in the decision-making process for selection of the remedy. Third, it provides a formal mechanism for the U.S. Army to respond to public comments.

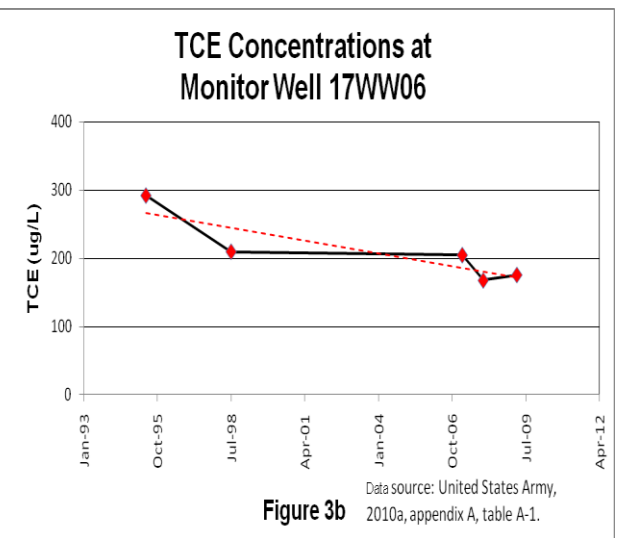
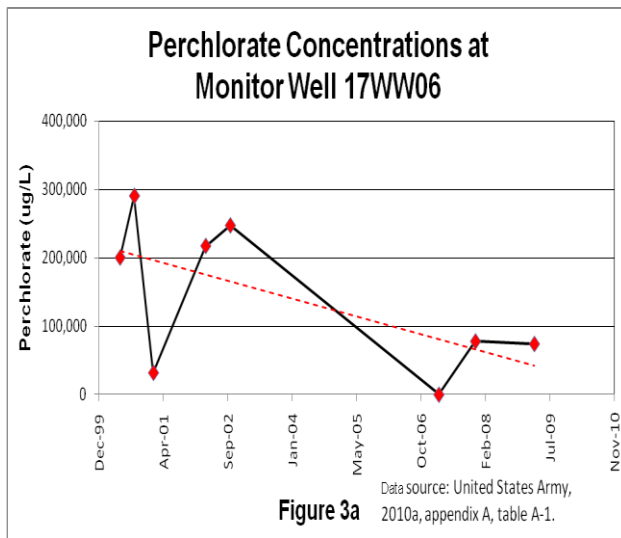
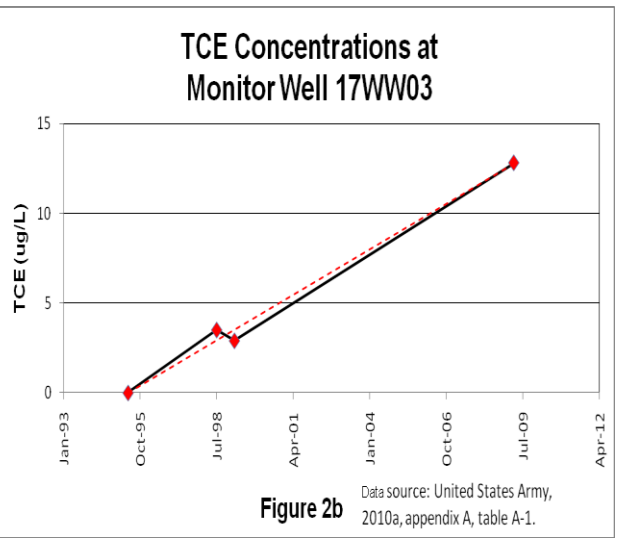
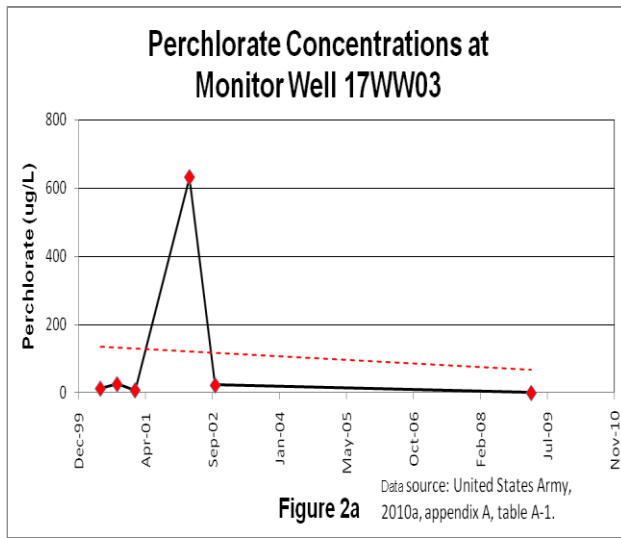
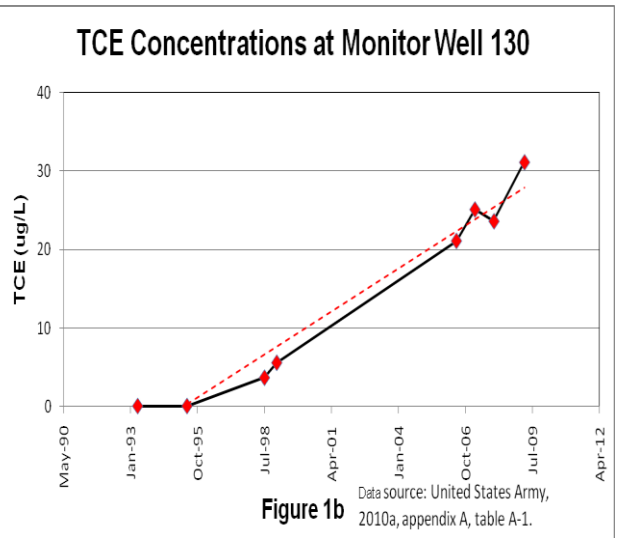
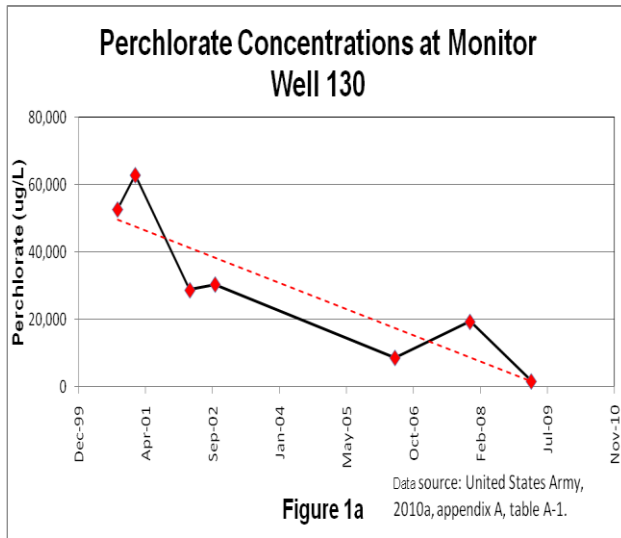
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- Written questions and comments from the public during the public comment period, and the U.S. Army response to those comments dated December 9, 2010.

3.1 *Stakeholder Issues and Lead Agency Responses*

This section responds to significant issues raised by stakeholders including the public and community groups that were received in written or verbal form. The figures that the commenter makes reference to were provided by the commenter.

Question/comment: The Army intends to stop pumping and treating groundwater once average perchlorate concentrations are reduced to 20,000 µg/L. According to the Army, high concentrations of perchlorate inhibit the natural attenuation of TCE. However, the Army has not presented any evidence to show that there are significant differences in the attenuation of TCE when the perchlorate concentration is below 20,000 µg/L. In fact, TCE concentrations are increasing at monitor wells 130 and 17WW03, even though perchlorate concentrations at these wells are well below 20,000 µg/L (see figures 1a, 1b, 2a, and 2b on the next page). On the other hand, perchlorate concentrations in monitor well 17WW06 are much higher than 20,000 µg/L, but TCE concentrations are decreasing (see figures 3a and 3b). Thus, there does not appear to be a strong relationship between perchlorate concentrations and the attenuation of TCE. The Army should not rely on a reduction in perchlorate concentrations to result in the attenuation of TCE.



Response: Studies of natural attenuation and guidance for implementing MNA presume that biologically assisted attenuation proceeds from the most easily reduced compounds to the ones that are most difficult. Perchlorate is more easily reduced than TCE. The microbes that metabolize perchlorate are ubiquitous in the natural environment, and there appears to be no potential “stalling” at daughter products (which can happen with TCE). The perchlorate concentration of 20,000 µg/L was selected based on data from LHAAP-17 and another site at Longhorn. At LHAAP-17, observation of the subsurface conditions is complicated by the perchlorate contaminated soil which may add perchlorate to the groundwater via percolation. The performance of natural attenuation to meet remedial action objectives will be evaluated after soil removal, groundwater pumping, and eight quarterly sampling events. If it is found that the performance objectives are not being met with natural attenuation, a contingent remedy such as in situ bioremediation would be implemented.

Question/comment: It appears that the Army intends to stop pump and treat once the trigger is reached, regardless of the effect that pump and treat is having on contaminant concentrations. This is not a reasonable approach to contaminant clean-up. The Army should evaluate the effectiveness of pump and treat when the trigger is reached. Then, if it is still having a substantial effect on contaminant concentrations, pump and treat should be continued. The pump and treat system should be operated as long as it is causing significant reductions in contaminant concentrations.

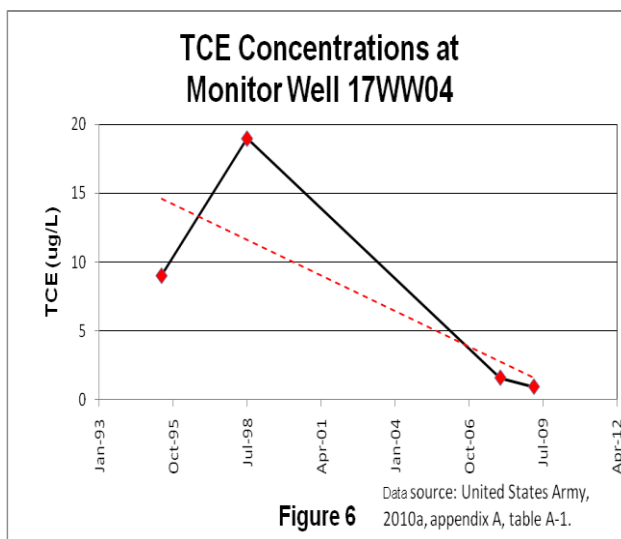
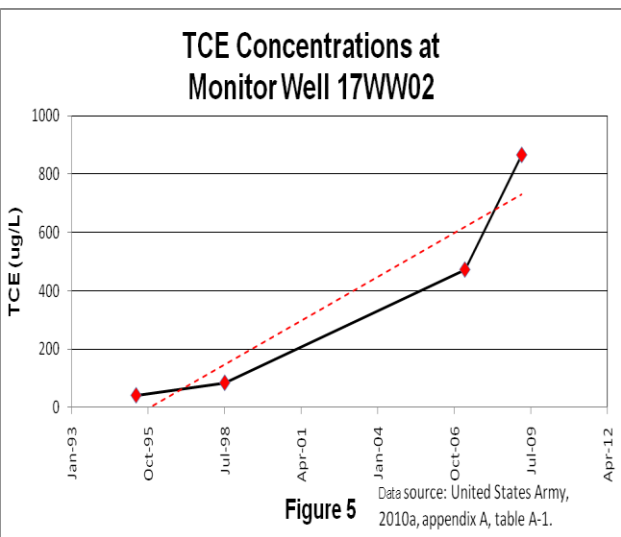
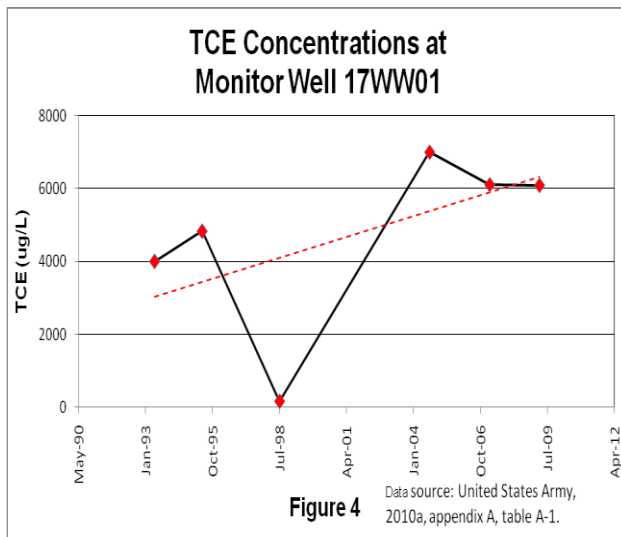
Response: The U.S. Army has chosen to implement pump and treat to reduce the highest contaminant concentrations at LHAAP-17 to make conditions more favorable for MNA. Contaminant removal by pump and treat methods operates with diminishing returns – as concentrations decrease, the mass removal rate also falls. Inevitably, a point is reached at which remediation by pump and treat is no longer cost effective. The pump and treat system in conjunction with the site hydrogeological conditions may also be considered ineffective if the system is incapable of reducing perchlorate concentrations at a rate that would be considered productive. As the wording in the comment implies, “substantial effect” and “significant reductions”, there is some amount of interpretation involved in deciding when to turn off the pumps. However, pump and treat is not the primary remedy selected or evaluated for LHAAP-17. It is used to assist the primary remedy of MNA by reducing the highest contaminant concentrations. If the pump and treat does not effectively reduce the highest contaminant concentrations in the reasonable time allowed, a contingency remedy such as in situ bioremediation will be implemented.

Question/comment: TCE samples have been collected from 11 monitor wells in the shallow zone. TCE concentrations have exceeded the 5 µg/L MCL in six of these wells. Of these six wells TCE concentrations are rising in four, and dropping in two (see figures 1b, 2b, 3b, 4, 5, and 6). The table below shows the most recent TCE concentrations found in the six wells.

Clearly, natural attenuation is not acting to reduce TCE concentrations throughout the site. Although the Army claims that high concentrations of perchlorate are inhibiting the attenuation of TCE, this assertion is not supported by the data (see first comment). The Army should reevaluate its reliance on natural attenuation to reduce TCE concentrations at Site 17.

Most Recent TCE Concentrations in Shallow Zone Monitor Wells

Wells with increasing concentrations of TCE		Wells with decreasing concentrations of TCE	
Well ID	TCE (µg/L)	Well ID	TCE (µg/L)
130	31.1	17WW04	0.9
17WW01	6090	17WW06	176
17WW02	867		
17WW03	12.8		



Response: The most significant increase in TCE concentrations is seen at well 17WW01 between 1998 and 2004. TCE concentrations have declined in this well since 2004. Increases in TCE concentrations at wells 130, 17WW02, and 17WW03 are not as significant and may reflect seasonal variations instead of an overall increase in mass. The groundwater gradient at LHAAP-17 is fairly flat and the diffusion of TCE away from 17WW01 may cause a rise in concentrations in the surrounding wells (i.e., 17WW02 and 17WW03). Even though there are fluctuations in the wells at LHAAP-17, the plume is bounded and there does not appear to be a significant migration of the plume. Additionally, pump and treat will contain the plume and will reduce TCE concentrations (prior to MNA evaluation) as well as the perchlorate.

Under current conditions at LHAAP-17, with the addition of perchlorate from contaminated soil by percolation, natural attenuation cannot be effectively evaluated since the high perchlorate concentrations are inhibiting TCE attenuation. After contaminated soil is removed, groundwater pumping will still disturb natural conditions. It is only after soil is removed and pumping is stopped that an effective MNA evaluation may be made. When that evaluation is complete, and if it is favorable, MNA will continue as the remedy. However, if the evaluation is not favorable, another remedy (e.g., in situ bioremediation) will be implemented to reduce the TCE concentrations.

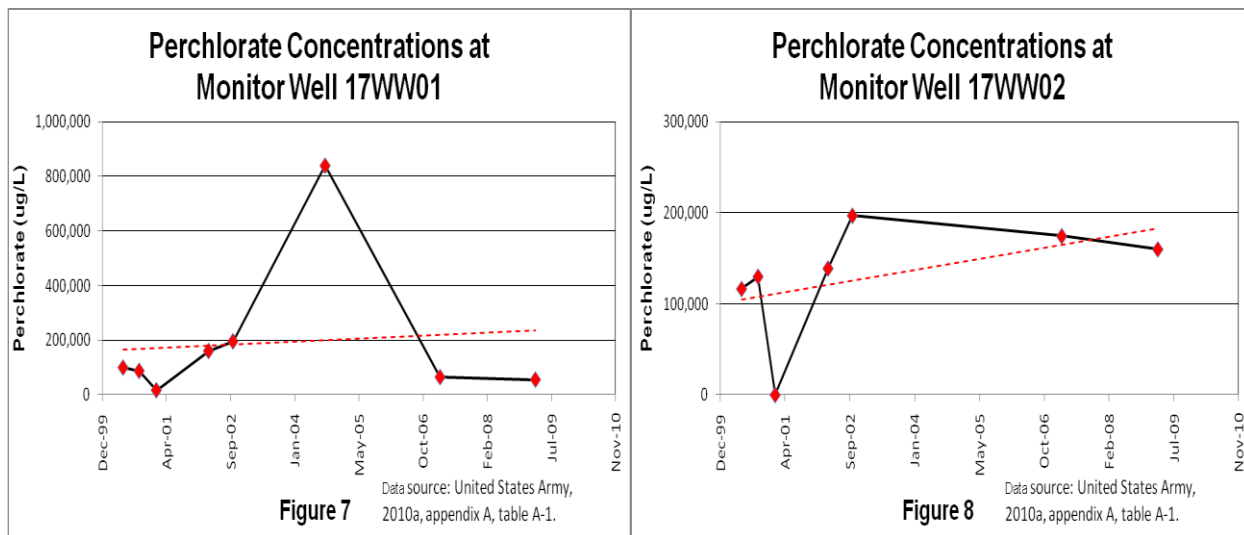
Question/comment: The Army estimates that natural attenuation will reduce TCE concentrations in the shallow groundwater zone to the clean-up level (5 µg/L) in less than 120 years. It is not reasonable to propose a plan that could require the maintenance of LUCs for a century.

Response: The reasonably anticipated future use of the site is as a wildlife refuge (i.e., Caddo Lake National Wildlife Refuge). Once the property is transferred into the refuge system, the property must be kept as a National Wildlife Refuge unless there is an act of Congress which removes the parcel or the land is exchanged in accordance with the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Act Amendments of 1974. This proposed transfer as a national wildlife refuge, which by its very nature includes physical access and use restrictions, is subject to control and continual inspection by Refuge personnel. Also, the property is intended to remain under ownership and management of a federal government agency. The LUC for groundwater will prohibit access to the groundwater except for environmental testing until cleanup levels are met. Maintenance of the LUC for groundwater use prohibition would require minimal effort and would be reasonable for extended lengths of time. Effectiveness of the LUC will be evaluated as part of the statutory five-year reviews and does not pose additional burden. Additionally, access of groundwater through well installations requires a permit from the Texas Department of Licensing and Regulation or Texas Water District authority. The department will be provided a copy of the county recordation that indicates the location of contaminated groundwater at the site and associated prohibitions.

Question/comment: The clean-up time estimate is based on data from monitor well 17WW06, where TCE concentrations are declining (see figure 3b). However, this estimate does not apply to those portions of Site 17 where TCE concentrations are increasing (see third comment). The Army should provide an estimate of clean-up time for the entire site.

Response: Although there is some uncertainty associated with the cleanup time for the entire site because of the inhibitive effects of perchlorate, the data collected during the two year period of natural attenuation monitoring (post pump and treat) will be used to remove some of the uncertainties associated with the estimate of time to achieve MCLs. The statutory five-year reviews will evaluate the effectiveness of the remedy and estimated durations to reach MCLs and would recommend implementation of other measures if needed.

Question/comment: The Army estimates that natural attenuation will reduce perchlorate concentrations to the clean-up level (17 µg/L) within approximately 15 years. This estimate is based on perchlorate degradation rates (half-lives) calculated for eight monitor wells. However, the Army did not calculate degradation rates for two monitor wells that currently contain high perchlorate concentrations: well 17WW01 (56,000 µg/L) and well 17WW02 (160,000 µg/L). Over the entire period of record, perchlorate concentrations in these two wells have increased, although concentrations in both wells are currently decreasing (see figures 7 and 8). Wells 17WW01 and 17WW02 are important data points that the Army has not accounted for in its estimate. The Army should explain why it did not use data from these wells to estimate the clean-up time for perchlorate at Site 17.



Response: Data from wells 17WW01 and 17WW02 were not used because those two wells appear to be receiving additional perchlorate as it leaches into groundwater from the overlying contaminated soil. The removal of contaminated soil will end this influx, and the pump and treat activity will reduce perchlorate concentrations in the groundwater at those two wells (to

20,000 µg/L). As the perchlorate concentration at 17WW06 (74,000 µg/L) is significantly higher, the U.S. Army feels that the cleanup time estimated for perchlorate at 17WW06 by MNA provides a reasonable estimate.

Question/comment: The Army does not consider perchlorate to be a COC in the intermediate groundwater zone. However, high concentrations of perchlorate have been detected in intermediate zone monitor well 17WW11. Therefore, perchlorate should be a COC in the intermediate zone.

Response: Well 17WW11 is considered a shallow-intermediate well. There was no distinct clay layer to separate the shallow and intermediate zones. Boring logs for it and surrounding wells were inspected along with groundwater elevations, and it appears to be more reasonably connected with nearby shallow zone monitoring wells than with nearby intermediate zone monitoring wells. As a result, the well 17WW11 has been included with the shallow wells, and within the defined perchlorate plume. Also, perchlorate concentrations were below the detection limit in the intermediate groundwater zone wells (17WW07, 17WW09, 17WW15, and 17WW17).

Question/comment: The Army will present details of the soil excavation plan, the pump and treat system, the groundwater remediation performance objectives, the plan for implementing and evaluating MNA, and the LUC implementation plan, in the RD. However, the RD has not yet been produced. Given its importance, the Army should make the RD available for public review and comment as soon as practicable.

Response: The public will be provided with updates on remedial design and remedial action status through the RAB meeting and any concerns can be addressed through this forum. The RD will include performance objectives, schedule and other design criteria and will follow established regulatory guidance for MNA.

3.2 Technical and Legal Issues

This section is used to expand on technical and legal issues. However, there are no issues of that nature beyond the technical issues already discussed in **Section 3.1**.

LHAAP-001-R-01 and -003-R-01

3.0 *Responsiveness Summary*

The Responsiveness Summary serves three purposes. First, it provides the U.S. Army, USEPA, and TCEQ with information about community concerns with the remedy at LHAAP-001-R and LHAAP-003-R as presented in the Proposed Plan. Second, it shows how the public's comments were considered in the decision-making process for selection of the remedy. Third, it provides a formal mechanism for the U.S. Army to respond to public comments.

The U.S. Army, USEPA, and TCEQ provide information regarding LHAAP-001-R and LHAAP-003-R through public meetings, the Administrative Record file for the facility, and announcements published in the Shreveport Times and Marshall News Messenger newspapers. **Section 2.3** discusses community participation on LHAAP-001-R and LHAAP-003-R, including the dates for the public comment period, the date, location, and time of the public meetings, and the location of the Administrative Record. The following documents related to community involvement were added to the Administrative Record:

- Transcript of the public meeting on July 21, 2011
- Presentation slides from the July 21, 2011 public meeting
- Questions and comments from the public during the public comment period, and the response to comments from the U.S. Army dated July 27, 2011.

Written comments were received from the general public during the public comment period and Proposed Plan meeting in July 2011 for LHAAP-001-R and LHAAP-003-R. The Proposed Plan was finalized without revision. **Appendix A** contains the public announcement for the Proposed Plan meeting and public comment period.

3.1 *Stakeholder Issues and Lead Agency Responses*

This section responds to significant issues raised by stakeholders including the public and community groups that were received in written or verbal form.

Question/comment: High concentrations (greater than the MCL) of metals have been found in groundwater at both sites since the early 1980s. In the most recent round of groundwater sampling (2009), high concentrations of beryllium and chromium were detected at site 001-R, and high concentrations of arsenic and chromium were detected at site 003-R.

However, the Army does not intend to monitor metals in groundwater at either site. This is despite the fact that the EPA sent the Army a letter that recommended monitoring metals in groundwater. Letters between the EPA and Army are reproduced in appendix 1.

The Army should monitor metals in groundwater at both sites.

Response: Perchlorate and white phosphorus (WP) are the data gap contaminants of concern for LHAAP-001-R and LHAAP-003-R under the Military Munitions Response Program (MMRP). Metals were addressed at sites LHAAP-27 and LHAAP-54, which are co-located with LHAAP-001-R and LHAAP-003-R respectively, under the 1998 Installation Restoration Program (IRP) ROD. Therefore any metals issues/concerns for these two sites must be addressed with respect to the 1998 IRP ROD and would not be included in this Proposed Plan. Army is in the process of reviewing the new metal results and historical results and has committed to respond to EPA and TCEQ under a path separate from the MMRP.

Question/comment: Soils at sites 001-R and 003-R are contaminated with a variety of metals (e.g., arsenic, barium, cadmium, lead). However, the Army does not plan to remove contaminated soil from either site.

According to the Army, the contaminants do not represent a threat to human health. However, there are problems with the Army's human health risk assessment (HHRA).

First, many of the soil analyses are not useful because of high detection limits (see below).

Second, the HHRA was performed in 1997. Therefore, it did not use the most recent data. The more recent data shows that some metal concentrations are significantly higher than those used in the HHRA (**Table 3-1**). Also, perchlorate was not included in the HHRA.

**Table 3-1
Contaminant Concentrations Used in HHRA
Old and New Maximums**

Contaminant/Site	Old Maximum (mg/kg)	New Maximum (mg/kg)
Barium/001-R	123	639
Copper/001-R	18.7	41.1
Lead/001-R	18	26.3
Nickel/001-R	2.41	18.6
Thallium/003-R	-	0.2
Perchlorate/001-R	-	28.9 (µg/kg)

The Army should remove contaminated soils from both sites.

Response: Please see response to the first comment above.

Question/comment: In some cases, the Army used detection limits for metals in soil and sediment that are higher than the standards established to protect human health (see **Table 3-2**). Thus, the Army cannot know whether these contaminants are present in concentrations that threaten human health.

**Table 3-2
Detection Limits for Metals in Soil and Sediment**

Contaminant	Site	Date	Detection Limit (mg/kg)	Standard (TCEQ GWP-Ind, mg/kg)
Antimony	001-R & 003-R	1982	0.76	0.6
	001-R & 003-R	1993	1	0.6
	001-R	1994	1.1-1.3	0.6
	001-R	1996	10.3-10.9	0.6
	003-R	1996/1997	1.1-1.2	0.6
Arsenic	001-R & 003-R	1982	0.3	1
	001-R & 003-R	1993	0.1-1	1
	001-R	1996	2.58-2.74	1
	003-R	1996/1997	0.596-58.7	1
	001-R & 003-R	2003	0.52-0.54	1
Beryllium	001-R & 003-R	1982	0.5	0.4
	001-R	1997	0.62-0.77	0.4
	001-R & 003-R	2003	0.20-0.22	0.4
Cadmium	001-R & 003-R	1982	0.5	0.5
	001-R & 003-R	1993	1	0.5
	001-R	1994	0.56-0.63	0.5
	001-R	1996	2.06-2.19	0.5
	003-R	1996/1997	2.22-2.38	0.5
	001-R & 003-R	2003	0.25-0.27	0.5
Thallium	001-R & 003-R	1982	3	0.2
	001-R & 003-R	1993	0.2	0.2
	001-R	1994	0.55-1.2	0.2
	001-R	1996	15.5-16.4	0.2
	003-R	1996/1997	0.6	0.2

The Army should re-sample soil and sediment at both sites. The samples should be analyzed using detection limits that are lower than the human health-based standards.

Response: Please see response to the first comment above.

Question/comment: The Army does not appear to have done the work required to determine groundwater flow directions at either site. Effective and efficient groundwater monitoring cannot be performed unless groundwater flow directions are known.

The Army should produce maps showing groundwater flow directions at each site.

Response: Hydrogeology was already addressed at sites 001-R and 003-R under the 1998 IRP ROD (see 1997 Remedial Investigation Report). Based on the Hydrogeological Assessment, the groundwater and surface flow direction at LHAAP-003-R are to the northwest and parallel to Sanders Branch and Harrison Bayou and at LHAAP-001-R groundwater flow is northerly. In addition, groundwater surface data from May 2000 (attached) for monitoring wells 127, 128 and 18WW16 at site LHAAP-003-R has been evaluated and confirms a northwest groundwater flow direction. Groundwater surface data from May 2000 for monitoring wells 27WW01, 27WW02, 27WW03, 27WW04, 131 and 132 at site LHAAP-001-R confirm a groundwater flow direction to the northeast. Maps showing groundwater flow direction at each site are attached as **Appendix B**.

Question/comment: There are six monitor wells at site 001-R, and four monitor wells at site 003-R. In addition, one-time grab samples were obtained from borings at each site.

The Army does not know whether there are a sufficient number of monitor wells at each site because it does not know whether the wells are down gradient of contaminated areas (see above comment on groundwater flow directions). The Army should evaluate the need for additional monitor wells after it has determined groundwater flow directions at each site.

Response: Please see the above response. Hydrogeology was already addressed at these sites.

Question/comment: The Army is using a groundwater standard for perchlorate of 72 µg/L. However, the EPA health reference level (HRL) for perchlorate is 15 µg/L. In addition, the EPA has decided to establish a primary drinking water standard (MCL) for perchlorate. When established, the perchlorate MCL will probably be similar to the HRL.

If the Army abandons the monitor wells based on the 72 µg/L standard, it may have to re-install monitor wells when the EPA establishes an MCL for perchlorate.

Until the EPA establishes an MCL for perchlorate, the Army should use a standard that is no greater than 15 µg/L.

Response: The Army is using the TRRP Tier 1 Groundwater Residential PCL of 17 µg/L for comparison of perchlorate in groundwater.

Question/comment: The Army has analyzed soil and water samples for two isomers of dinitrotoluene (DNT): 2,4-DNT and 2,6-DNT. These are the most common isomers in technical grade DNT. However, there are four other isomers of DNT (2,3-DNT; 2,5-DNT; 3,4-DNT; and 3,5-DNT). All of the isomers are toxic.

At the Badger Army Ammunition Plant, high concentrations of the other isomers have been found in groundwater. In some cases, concentrations of the other isomers are significantly higher than the concentrations of 2,4-DNT and 2,6-DNT.

The Army should analyze soil and water samples for all isomers of DNT, not just the 2,4-DNT and 2,6-DNT isomers.

Response: At this time, there are no Federal or State of Texas promulgated screening levels for DNT isomers, other than for 2,4-DNT and 2,6-DNT. However, as part of the CERCLA process, the statutory five-year reviews will evaluate the effectiveness of the remedy, including any changes in ARARs concerning DNT isomers, and would recommend implementation of other measures if needed.

Question/comment: The Army has developed source-receptor conceptual site models for munitions constituents and OE at LHAAP sites 001-R and 003-R. The Army should also develop source-receptor conceptual site models for metals at both sites.

Response: Please see response to the first comment above.

Question/comment: The following documents were listed as primary reference documents in the Final Proposed Plan. However, they do not appear to have been included in the Army Administrative Record.

- CAPE, 2007b, Final Engineering Evaluation/Cost Analysis Action Memorandum Revision 1, Longhorn Army Ammunition Plant, Karnack, Texas, Signed by Thomas Lederle, BRAC Division, ACSIM, United States Army, 5 December.
- Environmental Protection Systems, Inc. (EPS), 1984, Longhorn Army Ammunition Plant Contamination Survey, June.
- EODT Technology, Inc., (EODT), 2009, Final Site Specific Final Report for the MEC Removal Action at the Former Longhorn Army Ammunition Plant, LHAAP-001-R (Site 27) and LHAAP-003-R (Site 54), Karnack, Texas, September.

The Army should ensure that all documents referred to in the Proposed Plan are included in the Administrative Record. If any document has been misfiled or mislabeled in the Administrative Record, the Army should so indicate when referring to that document.

Response: The Final Engineering Evaluation/Cost Analysis Action Memorandum, signed by Thomas Lederle 5 December 2007, is located in the Administrative Record in Volume 9, Year 2008. It is listed out of date in sequence.

The other two references appear to have been overlooked and will be incorporated into the Administrative Record.