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: July 25, 2019, 6:00 PM Central Daylight Time (CDT)

Meeting Participants:

Army BRAC:	Rose M. Zeiler
USACE:	Aaron Williams
USAEC:	Amanda Sherman
USGS:	Kent Becher
Bhate:	Kim Nemmers
APTIM:	Susan Watson
USEPA Region 6:	Dorelle Harrison
TCEQ:	April Palmie
USFWS:	Paul Bruckwicki
RAB:	Present: Judy VanDeventer, Paul Fortune, Carol Fortune, John Fortune, Charles Dixon, Nigel R. Shivers, and Sharron McAvoy Absent: Richard LeTourneau; Terry Britt; John Pollard, Jr.; Tom Walker; and Deon Hall
Public:	Laura-Ashley Overdyke (Executive Director of the Caddo Lake Institute [CLI]), Brad Eskue, Robert Speight, and Vicki Pace

An agenda for the RAB meeting, a color copy of the Bhate Environmental Associates, Inc. (Bhate) slide presentation, and handouts (see list at end of meeting minutes) were provided for meeting attendees.

Welcome and Introduction

Mr. Paul Fortune, RAB Installation Co-Chair, called the RAB meeting to order at 6:05 pm CDT. Mr. Fortune welcomed everyone and asked if there was anyone present that had not attended before. Ms. Amanda Sherman stated that she is with the U.S. Army Environmental Command (USAEC). Ms. Rose Zeiler introduced the new RAB members and presented the RAB agenda.

Ms. Zeiler then reviewed the list of RAB members and asked Ms. Laura-Ashley Overdyke if there was any interest in the RAB from the public outreach. Ms. Overdyke stated that the previous outreach did not result in anyone signing up, but that there are three other events scheduled for August 6 and 7, 2019, in Marshall, Jefferson, and Karnack, where the same handouts will be shared. Ms. Zeiler explained the purpose of the RAB. Ms. Zeiler explained that the meeting is held every 3 months and then presented the mission for the RAB. Ms. Zeiler welcomed anyone that might be interested in joining the RAB to complete an application. Ms. Kim Nemmers explained that the RAB member application is available on the website or can be emailed. Ms. Zeiler then explained what information is available on the LHAAP website, including the Administrative Record (AR) updated through December 2018. Ms. Zeiler stated that the website also has a calendar of activities including field activities ongoing at LHAAP.

Open Items

Ms. Zeiler noted that the April 2019 RAB Meeting minutes had been sent out in May 2019. Ms. Judy VanDeventer made a motion to accept the April 2019 RAB Meeting minutes. Ms. Carol Fortune seconded the motion.

Defense Environmental Restoration

LHAAP-50

Ms. Susan Watson discussed the LHAAP-50 Explanation of Significant Difference (ESD). Ms. Watson explained that the Record of Decision (ROD) selects the remedy and that the ESD describes a change in that selected remedy. Ms. Zeiler pointed to where LHAAP-50 is located within the LHAAP. Ms. Watson explained the site history for LHAAP-50. Ms. Watson explained that the site had a 47,000 gallon aboveground storage tank that received industrial waste water from sumps throughout Longhorn AAP. This process continued from 1955 until 1988. Ms. Watson stated that the water, after solids were filtered, was discharged to Goose Prairie Creek. Ms. Watson stated that investigations were conducted and contamination was identified in the area. Specifically, Ms. Watson stated that the contaminants included chlorinated solvents and perchlorate in the groundwater and also perchlorate in the soil. In 2010, the ROD selected monitored natural attenuation (MNA) for the groundwater, excavation of soil contamination that could leach into the groundwater, and land use controls (LUCs). The ROD also had a contingency remedy of enhanced in-situ bioremediation (EISB) if the MNA was not effective.

Ms. Watson explained that the Remedial Action-Operation [RA (O)] evaluated the remedy beginning in 2013. The RA (O) is conducted to reevaluate the remedy. In 2018, MNA was found to be ineffective based upon lines of evidence in a process developed by the USEPA. Ms. Watson explained that the first line of evidence is contaminant concentrations that evaluate changes in concentrations over time and distance. Ms. Watson explained that the concentrations of trichloroethene (TCE) and perchlorate increased from 2013 to 2018. In addition, Ms. Watson explained that the TCE plume expanded. Ms. Watson noted that the perchlorate plume did not expand. Therefore, Ms. Watson explained that the Army, Texas Commission on Environmental Quality (TCEQ), and United States Environmental Protection Agency (USEPA) agreed that the contingency remedy was needed to enhance MNA and address the site plumes. Ms. Watson stated that initiation of the contingency remedy required an ESD to the ROD. Ms. Watson explained that approval is necessary before implementation of the contingency remedy. The draft ESD proposed EISB as the contingency remedy and was submitted in April 2019 for Regulator review. Ms. Watson stated that comment resolution is ongoing. Ms. Watson stated that the next step is then the Contingency Remedial Action Work Plan (RAWP), which is currently being prepared. Ms. Watson explained that, due to the expansion of the plume, an additional well is being installed. Ms. Watson stated that the RAWP will be finalized after the groundwater data from the new well is received. Ms. Watson stated that the remedy is anticipated to be implemented in the Fall of 2019. Ms. Watson pointed out that the additional monitoring well location is in pink on RAB slide 10. Ms. Watson stated that 18 monitoring wells are currently sampled. Ms. Zeiler stated that the schedule for the remedial implementation will be on the LHAAP website.

Ms. Overdyke asked if the plume data at LHAAP-50 was included in the RAB meeting handouts. Ms. Watson stated that the data to define the extent of the plume has not been collected and was not in the handouts. Ms. Watson said that once the remedial design and RAWP were approved the details would be presented at a RAB meeting. Ms. Zeiler also explained that historic results could be found in the AR within the Annual RA (O) Reports, and then Ms. Watson explained how to search the AR online. Ms. Watson stated that the best way to find a document is to search the index for the site, and then go to the year and volume within the AR based upon the site search. Ms. Watson pointed out that each of the volumes have bookmarks labeled with letters to help find documents.

Overview of Sites

Ms. Watson discussed the field work completed the previous 3 months. Ms. Watson stated that groundwater elevation measurements were completed at LHAAP-16 in May 2019 to evaluate groundwater flow. Ms. Watson stated that RA (O) sampling was completed at several sites in May 2019 (LHAAP-37, LHAAP-50, and LHAAP-67) and that RA (O) sampling was completed at LHAAP-58 and LHAAP-18/24 in June 2019. Ms. Watson stated that some repairs and maintenance were also completed at LHAAP-18/24.

Ms. Watson then discussed the documents in process currently. For LHAAP-03, the remedial design and RAWP for the excavation was approved in July 2019. Ms. Zeiler noted that the excavation at LHAAP-03 was planned for the Fall of 2019. Ms. Watson mentioned the ongoing ESD and Contingency RAWP previously discussed, the annual RA (O) Report for LHAAP-58, and the quarterly evaluation reports for the groundwater treatment plant (GWTP).

Excavation and Injection Field Work

Ms. Watson discussed the field work planned for the fall, which includes injections and excavations. Ms. Watson noted that the work plan for the soil excavation at LHAAP-03 is final. Ms. Watson explained that paperwork needs to be filed with the TCEQ for the EISB injections at LHAAP-04, which is in process. For LHAAP-16, Ms. Watson explained that there are monitoring wells that need to be installed, which have not been installed to date due to wet conditions. Ms. Watson stated that once the monitoring wells at LHAAP-16 are installed, baseline samples will be collected and then the EISB injections will be completed. At LHAAP-17, Ms. Watson explained that the site has an excavation component as well as groundwater extraction system installations. Ms. Watson stated that the contingency EISB injections for LHAAP-50 was also planned for implementation in the fall 2019. Ms. Zeiler noted that the field work is approximately 2 months in duration to which Ms. Watson concurred. Ms. Watson noted that the field work for LHAAP-16, LHAAP-17, and LHAAP-50 is behind schedule due primarily to the wet conditions over the past months. Ms. Zeiler pointed out that both LHAAP-16 and LHAAP-17 were sites under the dispute resolution so these sites are now moving forward with the remedy implementation. Ms. Zeiler also noted that LHAAP-03 and LHAAP-04 were also held up by the dispute, but now the remedies are being implemented at those sites. Mr. Nigel Shivers asked if the rain had held up many of these remedies being implemented. Ms. Zeiler responded that the rainfall had held up work especially at the sites near the creeks. Ms. Overdyke asked if the hope is for August to help dry the sites out to which Ms. Zeiler concurred.

Ms. Nemmers then discussed the 3 month look ahead for LHAAP field work. Ms. Nemmers stated that remedy implementation at LHAAP-03, LHAAP-04, LHAAP-16, LHAAP-17 and LHAAP-50 is the primary focus for the next 3 months along with groundwater monitoring to evaluate performance of remedies in place at sites. Ms. Nemmers stated that monitoring wells are planned for installation the following week to begin the implementation of the remedies. Ms. Nemmers stated that the current schedule is for the excavation work at LHAAP-17 and LHAAP-03 to be completed first followed by the injections in September. Ms. Nemmers stated that the field activities completed in the coming months would be presented at the October 2019 RAB meeting.

Ms. Nemmers stated that the RAWP for LHAAP-50 will be finalized once the new well is installed and the groundwater analytical results are received. Ms. Nemmers stated that the plan is also to complete the injections in the coming month at LHAAP-50. Ms. Nemmers indicated that LHAAP-58 was discussed at RAB meetings last year and that the remedy is in place. Currently, quarterly groundwater sampling of the western plume is ongoing. The RA (O) Report for LHAAP-58 will be prepared to evaluate the past year of sampling but Ms. Nemmers stated that the results look good so far. Ms. Nemmers stated that the quarterly evaluation reports for the GWTP are in process with the fourth quarter 2018 report having been issued. Ms. Nemmers noted that these GWTP reports also include the groundwater analytical results for LHAAP-16 and LHAAP-18/24, which is why they are listed in the site name next to the document on the slides.

Groundwater Treatment Plant

Ms. Nemmers stated that there were handouts with the information on the slides for the GWTP that provide more details. Ms. Nemmers pointed out that the chart depicts discharge of treated water that includes water from the INF Pond so the peaks and valleys of the chart do not necessarily represent problems with the GWTP. The increase in flow in a particular month is typically associated with discharge to the Bayou from the INF pond. Ms. Nemmers stated that there were no major issues with the GWTP since the RAB last met but repairs were made at LHAAP-18/24 for the water conveyance line. In addition, Ms. Nemmers noted that a pump for moving water to the air stripper needed to be repaired.

Surface Water Sampling

Ms. Nemmers presented the five locations sampled for surface water and stated that results are usually non-detect and well below the action level. Ms. Nemmers stated that there were no issues to note this past quarter. Ms. Nemmers stated that this information is also provided in a handout.

LHAAP-18/24, LHAAP-29, and LHAAP-47

Mr. Aaron Williams explained that HDR, Inc., has a separate contract for sites that do not have a ROD and is responsible for selection of the final remedy at three sites (LHAAP-18/24, LHAAP-29, and LHAAP-47). Mr. Williams explained that LHAAP-18/24 is now in the ROD phase. Mr. Williams stated that the draft ROD for LHAAP-18/24 is expected to go to the Regulators in September 2019 as the document is currently in Army review. Mr. Williams stated that the Draft Final ROD for LHAAP-29 was submitted to the Regulators on July 15, 2109. If the Regulators have no further

concerns, Mr. Williams indicated that the LHAAP-29 ROD will be ready for signatures on August 15, 2019. For LHAAP-47, Mr. Williams explained that an Addendum to the Post-Screening Investigation (PSI) Report was completed and submitted to the Regulators on July 1, 2019. Mr. Williams discussed that the four surface water samples, collected as part of the PSI Addendum, showed all results were below standards. Mr. Williams also noted that water levels were collected from monitoring wells sampled nearest the surface water samples to determine if the groundwater was contributing to Goose Prairie Creek, and that only one monitoring well had a groundwater elevation higher than the creek. Mr. Williams stated that the revised Draft ROD is planned for submittal to the Regulators in August 2019.

Mr. Williams stated that the Five Year Review (FYR) was completed in May 2019 and will be added to the AR. Mr. Williams stated that the FYR was completed to determine if the interim and final remedies at 12 LHAAP sites are or remain protective of human health and the environment. Mr. Williams stated that the conclusion of the FYR was that all of the remedies are protective or short-term protective. For sites that were short-term protective, recommendations were noted in the FYR. Mr. Williams stated that the recommendations are either being implemented or are in the process of being implemented. More specifically, Mr. Williams stated that the final remedy for LHAAP-16 is being implemented and the final ROD for LHAAP-18/24 is in process. Mr. Williams stated that many of the monitoring wells at LHAAP-46 are dry, but that the contractor is going to the site during heavy rain periods to determine if groundwater is present in the monitoring wells and sample, if so. This data collected, if able, will be used to evaluate declining trends during high recharge periods. Mr. Williams stated that the contingency remedy for LHAAP-50 is being implemented as discussed earlier in the meeting, and that the EISB remedy and performance monitoring at LHAAP-58 has already been completed. Mr. Williams stated that additional wells are being installed at LHAAP-12, LHAAP-50, and LHAAP-67 the following week if the sites remain dry. Mr. Williams pointed out the location for the new monitoring well at LHAAP-12, which is where monitoring well 12WW10 was previously located. The FYR pointed out that no well is located downgradient of the plume to evaluate if the plume is moving. Mr. Williams pointed out the two new monitoring well locations planned at LHAAP-67 to confine the plume boundary based upon 1,1-dichlorothene detections.

Mr. Shivers asked if the draft final ROD for LHAAP-29 had been submitted. Ms. April Palmie explained that the USEPA and TCEQ had issued comments and that if those comments were addressed satisfactorily, then the ROD will be routed for signature. Ms. Palmie explained that the ROD is within the middle of the 30-day review time frame for the regulators because the ROD was submitted on July 15, 2019. Mr. Shivers asked if there was a schedule for the signatures. Ms. Palmie explained that Ms. Zeiler usually obtains the signatures relatively quickly and that the USEPA is hoping the ROD will be finalized by September 30, 2019.

Next RAB Meeting Schedule and Closing Remarks

Ms. Zeiler then discussed the next meeting with the RAB members. It was decided that the next RAB Meeting will be held on **October 17, 2019,** with the **meeting starting at 6:00 pm CDT** at the Karnack Community Center. Ms. Zeiler requested public questions or topics to be discussed at the next RAB meeting.

Adjourn

Ms. VanDeventer made the motion to adjourn and Mr. Paul Fortune seconded the motion. The meeting adjourned at 5:41 pm CDT.

July 2019 Meeting Attachments and Handouts:

- Meeting Agenda
- Color Copy of Bhate Presentation Slides
- GWTP – Processed Groundwater Volumes Handout
- Surface Water Sampling Handout

Longhorn Army Ammunition Plant Quarterly Restoration Advisory Board Meeting

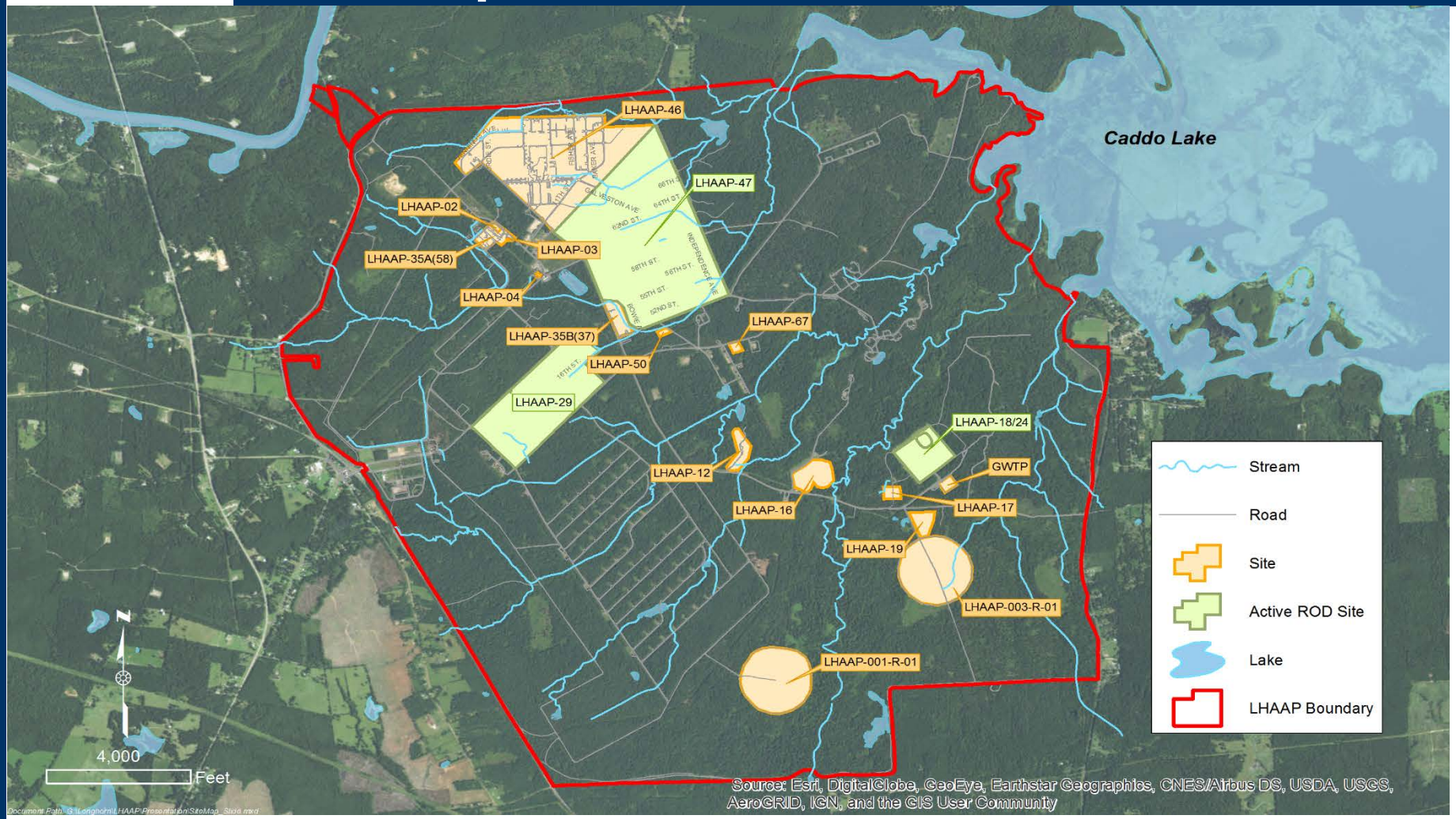
Karnack Community Center
July 25, 2019
6:00 PM CDT

APTIM

bhate

Restoration Advisory Board Meeting

Site Map



Abbreviations and Acronyms

µg/L	Micrograms per liter
DERP	Defense Environmental Restoration Program
ECP	Environmental Condition of Property
EISB	Enhanced In Situ Bioremediation
ESD	Explanation of Significant Differences
ft bgs	Feet below ground surface
GPW	Goose Prairie Creek Water Sample
GW-Res	Residential Groundwater
GWTP	Groundwater Treatment Plant
HBW	Harrison Bayou Water Sample
ISB	In-Situ Bioremediation
LHAAP	Longhorn Army Ammunition Plant
MNA	Monitored natural attenuation
PCL	Protective Concentration Level
PDI	Pre-Design Investigation
PSI	Pre-Screening Investigation
RAB	Restoration Advisory Board
RA(O)	Remedial Action Operation
RAWP	Remedial Action Work Plan
ROD	Record of Decision
TCE	Trichloroethylene
TCEQ	Texas Commission on Environmental Quality
TRRP	Texas Risk Reduction Program
USEPA	U.S. Environmental Protection Agency

Restoration Advisory Board Meeting

Agenda

06:00 Welcome and Introduction
06:05 Open Items {RMZ}
- Purpose of the RAB Meeting
- Ongoing Outreach/Website
- RAB Administrative Issues
  - o Minutes (April 2019 RAB Meeting)

06:15 Defense Environmental Restoration Program (DERP) Update {Bhate}
- LHAAP-50 ESD to the September 2010 ROD
- Documents and Field Work Completed since last RAB
- Upcoming Excavation and Injection Field Work
- Three Month Look ahead
- Groundwater Treatment Plant (GWTP) Update

06:45 Other Defense Environmental Restoration Program (DERP) Update {RMZ}
- LHAAP-18/24 Record of Decision and Responsiveness Summary
- LHAAP-29 Record of Decision and Responsiveness Summary
- LHAAP-47 Record of Decision and Responsiveness Summary
- Five Year Review Update – Recommendations for Sites 12, 50 and 67

06:55 Next RAB Meeting Schedule and Closing Remarks {RMZ}

Purpose of the RAB Meeting

- Held every 3 months
- The mission of the Longhorn Army Ammunition Plant (LHAAP) RAB is to promote community awareness and obtain constructive community review and comments on environmental restoration activities at the former LHAAP

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
    - Website is regularly updated to indicate the upcoming field events at each site including groundwater sampling, monitoring well installations, soil sampling, or remediation activities
  - Make suggestions for improving communication – the Army welcomes and appreciates community feedback

RAB Administrative Issues

- Welcome our newest RAB Members
  - Sharron McAvoy
  - Deon Hall
  - John R. Fortune
- Current RAB Members
  - Judy VanDeventer
  - Tom Walker
  - Charles Dixon
  - Carol Fortune
  - Sharron McAvoy
  - Deon Hall
  - John R. Fortune
  - Paul Fortune
  - John Pollard, Jr.
  - Richard LeTourneau
  - Terry Britt
  - Nigel Shivers
- Discussion of April 2019 RAB Meeting minutes/motion to accept

Restoration Advisory Board Meeting

LHAAP-50 ESD to September 2010 ROD

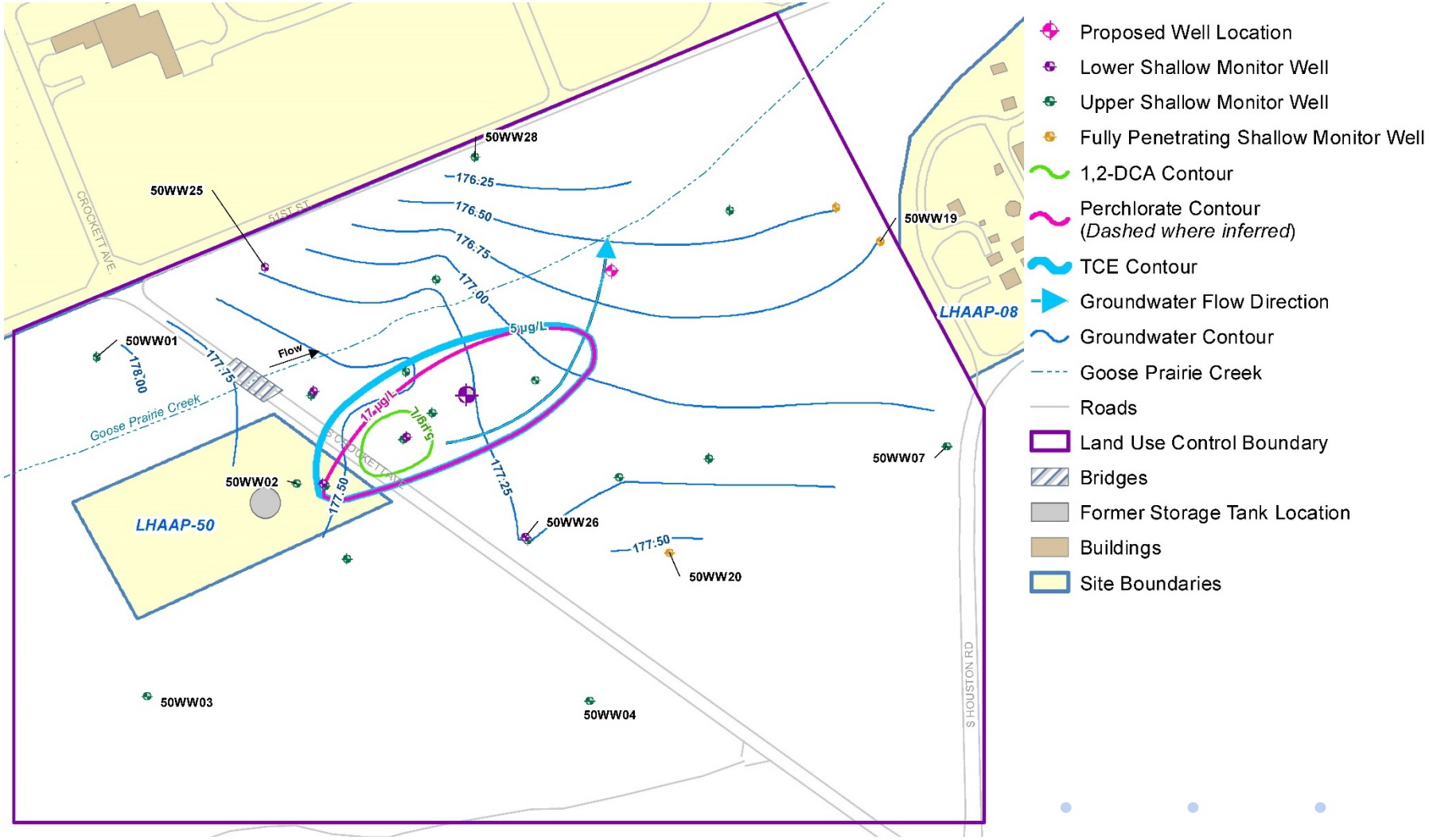
- **Site Background**
  - LHAAP-50 had a 47,000-gallon aboveground storage tank receiving industrial wastewater from various production sumps throughout LHAAP between 1955 and 1988
  - After solids were filtered, the water was discharged to Goose Prairie Creek
  - Constituents of concern at LHAAP-50 were chlorinated solvents and perchlorate in groundwater and perchlorate in soil
  - The selected remedy in the 2010 Record of Decision (ROD) was monitored natural attenuation (MNA), excavation of soil to eliminate groundwater contamination from contaminated soil, and land use controls as the remedy for groundwater. The ROD also included a contingency remedy for groundwater if MNA was not effective.
- **Groundwater Remedial Action Operation (RA[O]) Monitoring**
  - RA(O) groundwater Monitoring began in 2013
  - In 2018, MNA was found to be ineffective based on evaluation of several lines of evidence
  - The first line of evidence is based on contaminant concentrations
  - Concentrations of trichloroethylene (TCE) and perchlorate increased from 2013 to 2018, and the TCE plume has expanded beyond its baseline footprint

LHAAP-50 ESD to September 2010 ROD

- **Explanation of Significant Differences**
  - The Army, USEPA, and TCEQ agree that the contaminant plume has expanded in groundwater at LHAAP-50 and that a contingency remedy to enhance MNA is needed to address the chlorinated solvents and perchlorate in groundwater
  - To initiate the contingency remedy, an ESD to the approved ROD is required
  - The Draft ESD, proposing in situ bioremediation as a contingency remedy, was submitted for regulatory review in April 2018 and comment resolution is ongoing
  - A Contingency Remedial Action Work Plan (RAWP) is being prepared for the implementation of the contingency remedy
  - One additional shallow zone groundwater monitoring well is proposed to better define the plume as part of the contingency remedial action
  - Implementation of the Contingency RAWP is anticipated in Fall 2019

Restoration Advisory Board Meeting

LHAAP-50 New Well Location



Completed Field Work Since Last RAB Meeting

Site	Activity
LHAAP-16	Groundwater Elevation Measurements – May 2019
LHAAP-37	RA(O) Sampling – May 2019
LHAAP-50	RA(O) Sampling – May 2019
LHAAP-58	RA(O) Sampling –June 2019
LHAAP-67	RA(O) Sampling – May 2019
LHAAP-18/24	RA(O) Sampling – June 2019 and maintenance/repairs

Documents in Process

Site	Document
LHAAP-03	Remedial Design and RAWP (Approved July 2019)
LHAAP-50	ESD Contingency RAWP
LHAAP-58	Annual RA(O) Report
GWTP	Quarterly Evaluation 4th Quarter (October - December 2018) Quarterly Evaluation 1st Quarter (January – March 2019) Quarterly Evaluation 2nd Quarter (April – June 2019)

Excavation and Injection Field Work

- Planned Major Remedial Field Work Activities for Summer/Fall 2019
  - LHAAP-03 Soil Excavation
  - LHAAP-04 ISB Injections
  - LHAAP-16 Well Installations and In Situ Bioremediation (ISB) Injections
  - LHAAP-17 Excavation and Groundwater Extraction System Installation
  - LHAAP-50 Contingency ISB Injections
- Challenges
  - Key LHAAP-16 well installations delayed by wet conditions along Harrison Bayou
  - LHAAP-17 excavation area requires dryer conditions to allow large trucks and equipment to access site
  - LHAAP-50 injection plan is dependent upon data from a new well, which cannot be installed until the site dries out

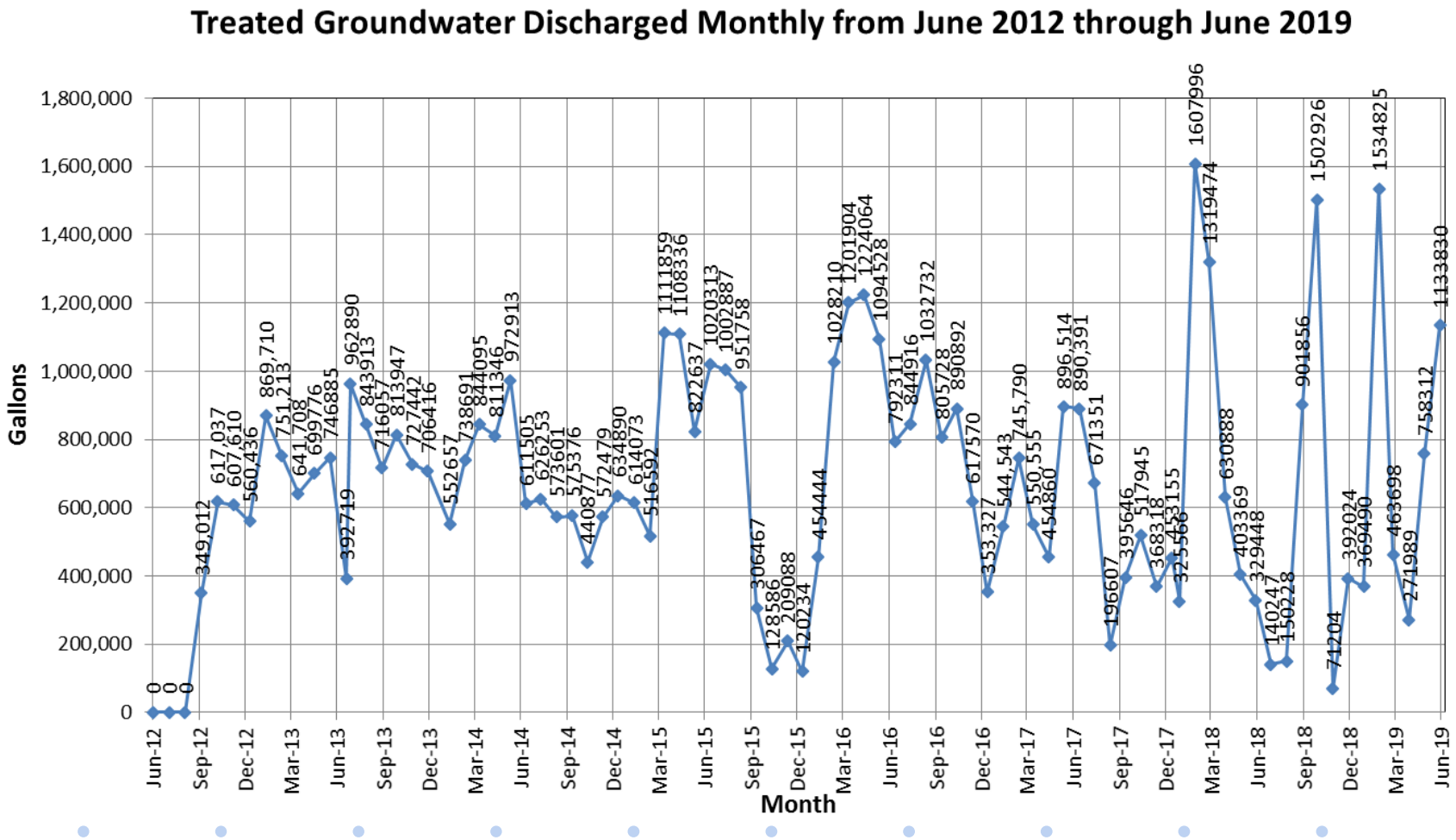
3 Month Look Ahead - Field Work by Bhate Team

Site	Activity
LHAAP-03	Complete soil excavation
LHAAP-04	Complete ISB injections
LHAAP-16	Complete well installations and ISB injections
LHAAP-17	Complete soil excavation and extraction system installation
LHAAP-37	RA(O) Sampling – August 2019
LHAAP-58	RA(O) Sampling – September 2019

3 Month Look Ahead – Documents by Bhate Team

Site	Document
LHAAP-50	Explanation of Significant Differences Remedial Action Work Plan
LHAAP-58	RA(O) Report
GWTP, LHAAP-16, and LHAAP-18/24	Quarterly Evaluation Report: Fourth Quarter (October – December) 2018 Quarterly Evaluation Report: First Quarter (January – March 2019) Quarterly Evaluation Report: Second Quarter (April – June 2019)

GWTP Update


Treated Groundwater Discharged Monthly from June 2012 through June 2019
Gallons
Month
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
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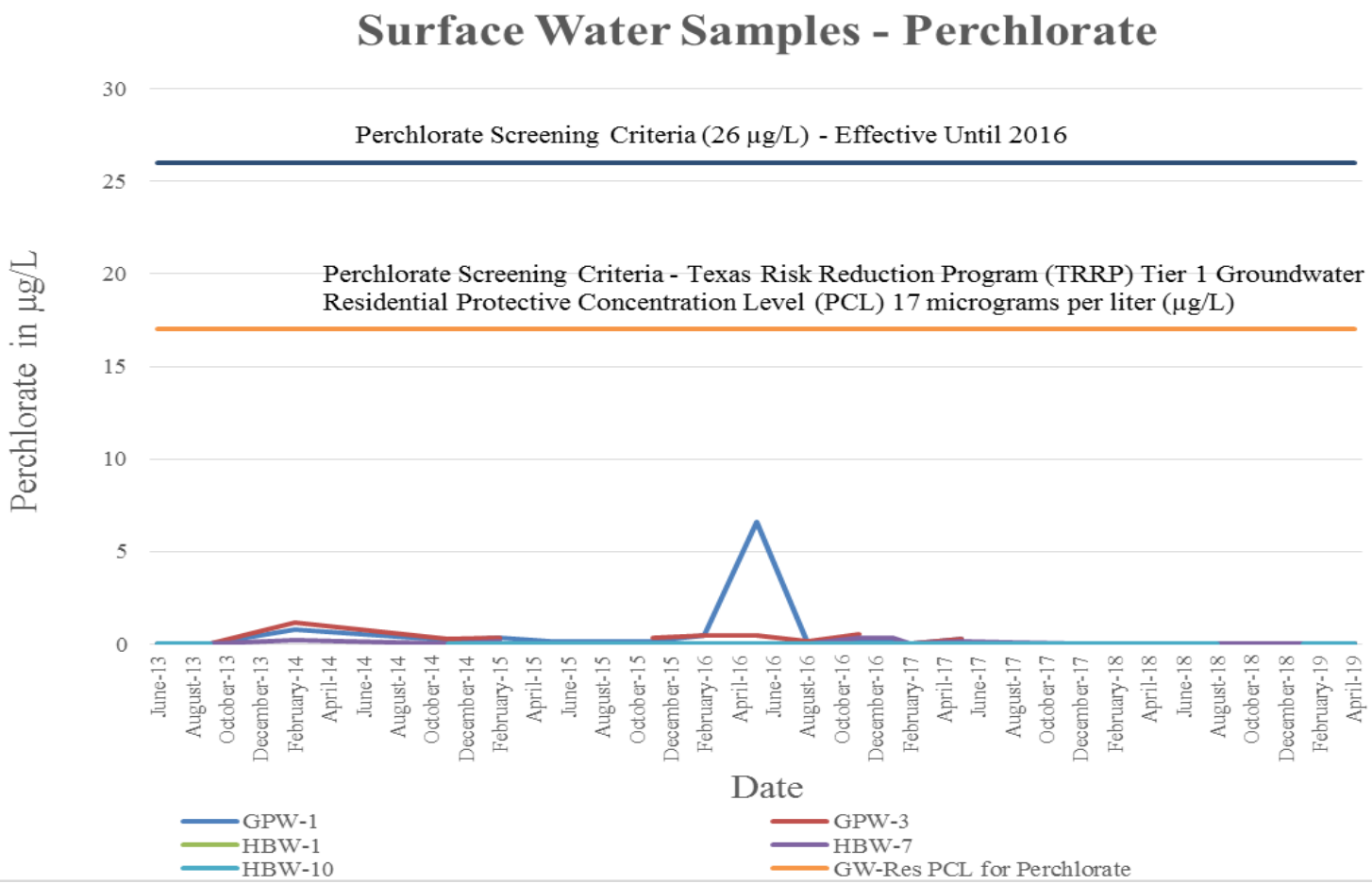
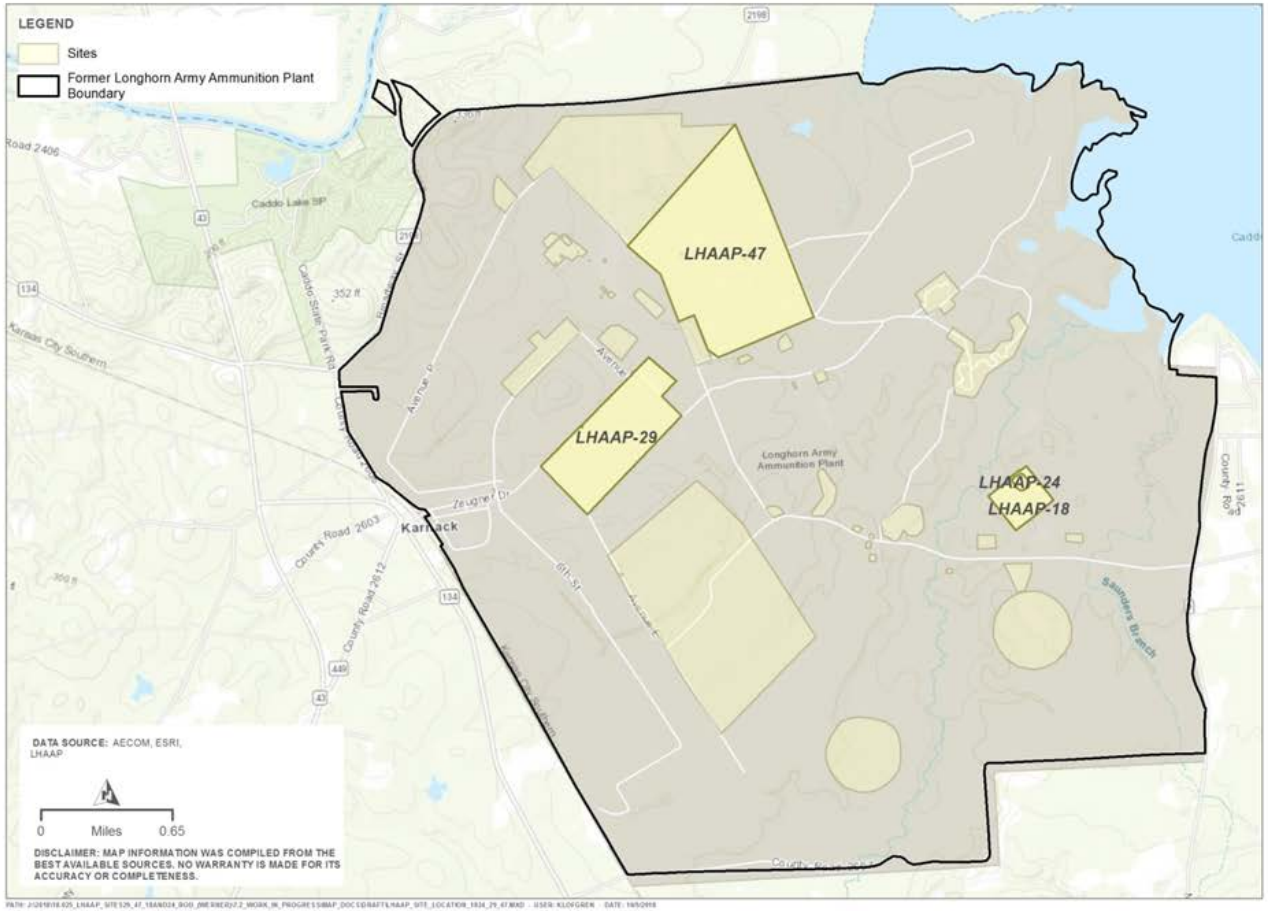
1133830

Surface Water Sample Results

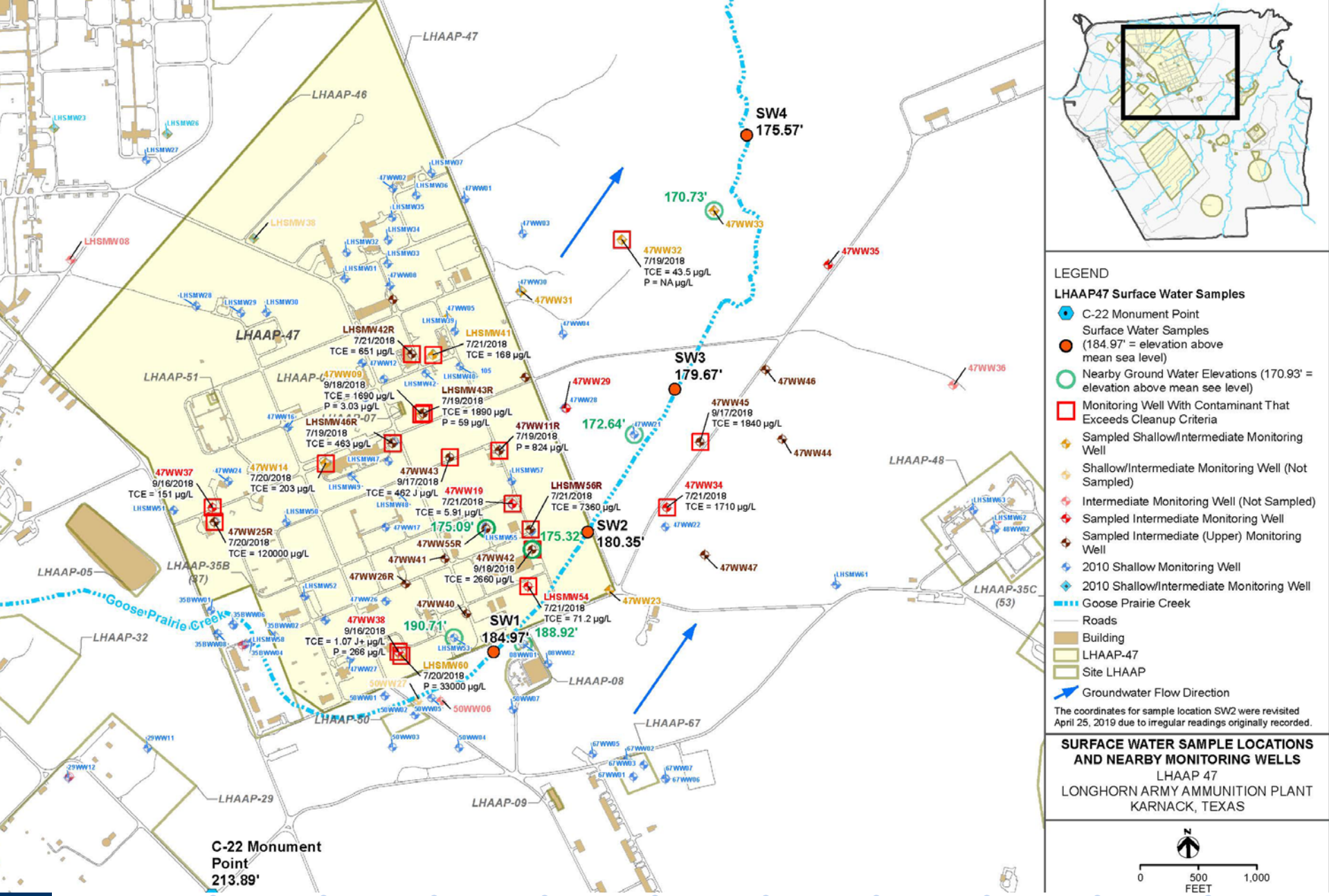


LHAAP-18/24, 29, 47 Status Update



LHAAP-18/24, 29 & 47 HDR Document Status

- **LHAAP-18/24**
  - **Draft Record of Decision submittal planned for September 2019**
- **LHAAP-29**
  - **Draft Final Record of Decision submitted to Regulators on July 15, 2019**
- **LHAAP-47**
  - **Draft Addendum Post Screening Investigation Report submitted to regulators on July 1, 2019**
  - **Revised Draft Final Record of Decision planned for August 2019**


LHAAP-47
LHAAP-46
LHAAP-51
LHAAP-07
LHAAP-48
LHAAP-05
LHAAP-35B (37)
LHAAP-35C (53)
LHAAP-32
LHAAP-50
LHAAP-08
LHAAP-67
LHAAP-29
LHAAP-09
Goose Prairie Creek
SW4
175.57'
170.73'
47WW33
47WW32
7/19/2018
TCE = 43.5 µg/L
P = NA µg/L
47WW35
47WW31
SW3
179.67'
47WW46
47WW45
9/17/2018
TCE = 1840 µg/L
47WW44
47WW36
47WW29
172.64'
LHSMW42R
7/21/2018
TCE = 651 µg/L
LHSMW41
7/21/2018
TCE = 168 µg/L
47WW09
9/18/2018
TCE = 1690 µg/L
P = 3.03 µg/L
LHSMW43R
7/19/2018
TCE = 1890 µg/L
P = 59 µg/L
LHSMW46R
7/19/2018
TCE = 463 µg/L
47WW11R
7/19/2018
P = 824 µg/L
47WW37
9/16/2018
TCE = 151 µg/L
47WW14
7/20/2018
TCE = 203 µg/L
47WW43
9/17/2018
TCE = 462 J µg/L
47WW19
7/21/2018
TCE = 5.91 µg/L
LHSMW56R
7/21/2018
TCE = 7360 µg/L
47WW34
7/21/2018
TCE = 1710 µg/L
47WW25R
7/20/2018
TCE = 120000 µg/L
175.09'
47WW55R
175.32'
SW2
180.35'
47WW41
47WW42
9/18/2018
TCE = 2660 µg/L
47WW47
47WW26R
LHSMW54
7/21/2018
TCE = 71.2 µg/L
47WW23
47WW40
190.71'
SW1
184.97'
188.92'
47WW38
9/16/2018
TCE = 1.07 J+ µg/L
P = 266 µg/L
LHSMW60
7/20/2018
P = 33000 µg/L
50WW06
C-22 Monument Point
213.89'
LHSMW08
LHSMW38
LHSMW23
LHSMW26
LHSMW27
LHSMW61
LHSMW62
LHSMW63
LEGEND
LHAAP47 Surface Water Samples
C-22 Monument Point
Surface Water Samples (184.97' = elevation above mean sea level)
Nearby Ground Water Elevations (170.93' = elevation above mean see level)
Monitoring Well With Contaminant That Exceeds Cleanup Criteria
Sampled Shallow/Intermediate Monitoring Well
Shallow/Intermediate Monitoring Well (Not Sampled)
Intermediate Monitoring Well (Not Sampled)
Sampled Intermediate Monitoring Well
Sampled Intermediate (Upper) Monitoring Well
2010 Shallow Monitoring Well
2010 Shallow/Intermediate Monitoring Well
Goose Prairie Creek
Roads
Building
LHAAP-47
Site LHAAP
Groundwater Flow Direction
The coordinates for sample location SW2 were revisited April 25, 2019 due to irregular readings originally recorded.
SURFACE WATER SAMPLE LOCATIONS AND NEARBY MONITORING WELLS
LHAAP 47
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
N
0
500
1,000
FEET

LHAAP 2019 Five Year Review Summary

Purpose: Evaluate whether the Interim Remedial Action or Final Remedial Actions implemented at twelve LHAAP sites are or remain protective of human health and the environment

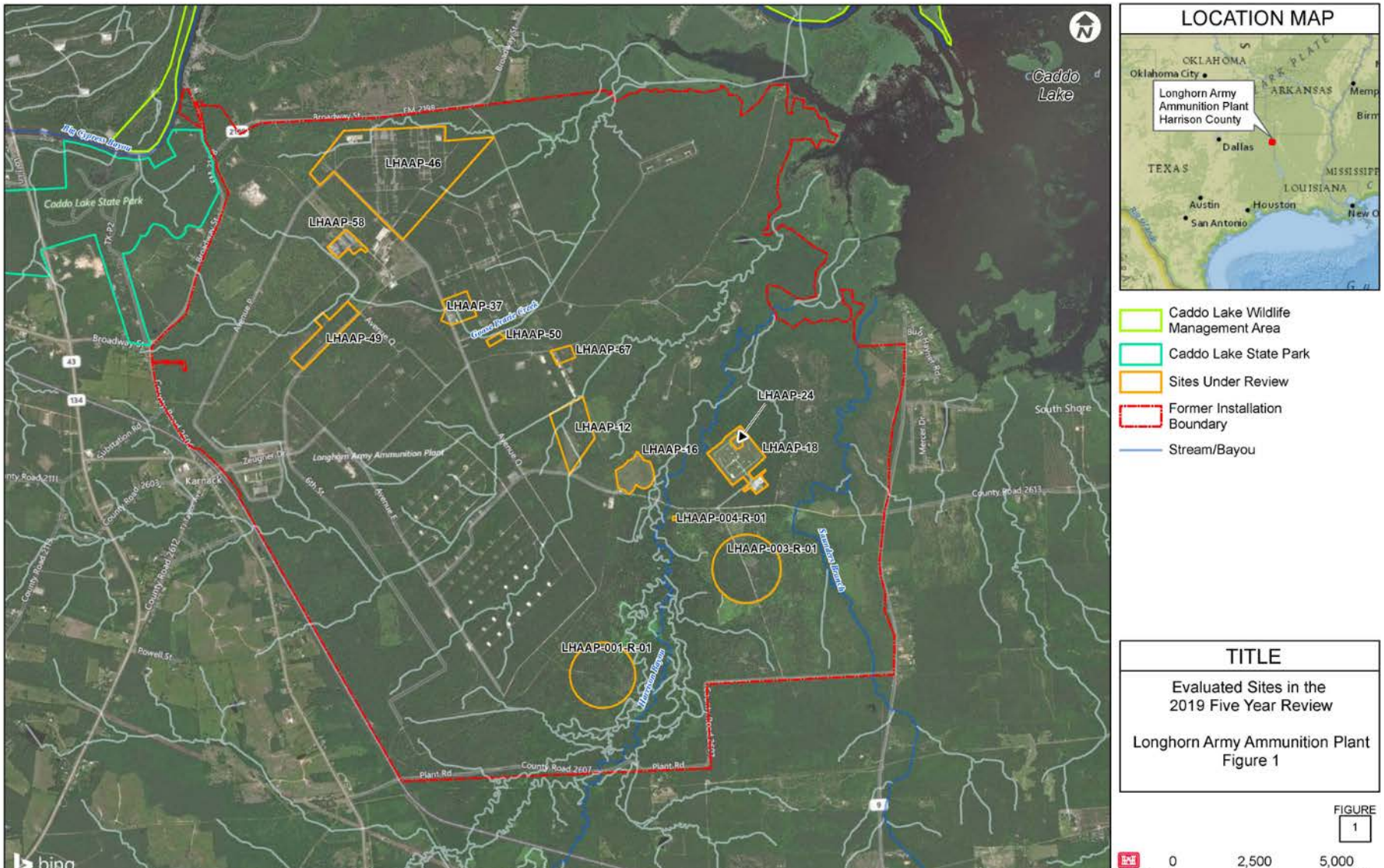
Sites Evaluated: LHAAP-12, LHAAP-16, LHAAP-18/24, LHAAP-37, LHAAP-46, LHAAP-49, LHAAP-50, LHAAP-58, LHAAP-67, LHAAP-001-R-01, LHAAP-003-R-01 and LHAAP-004-R-01

Conclusions: The remedial actions for all sites are either protective or short-term protective

For sites that were found to be short-term protective, issues were identified that could affect future protectiveness

Recommendations to address issues include: implement the final remedy (LHAAP-16 and LHAAP-18/24), evaluate declining trends during high recharge periods (LHAAP-46), implement contingency remedy (LHAAP-50), implement EISB performance monitoring (LHAAP-58), install additional well/wells (LHAAP-12 and LHAAP-67)

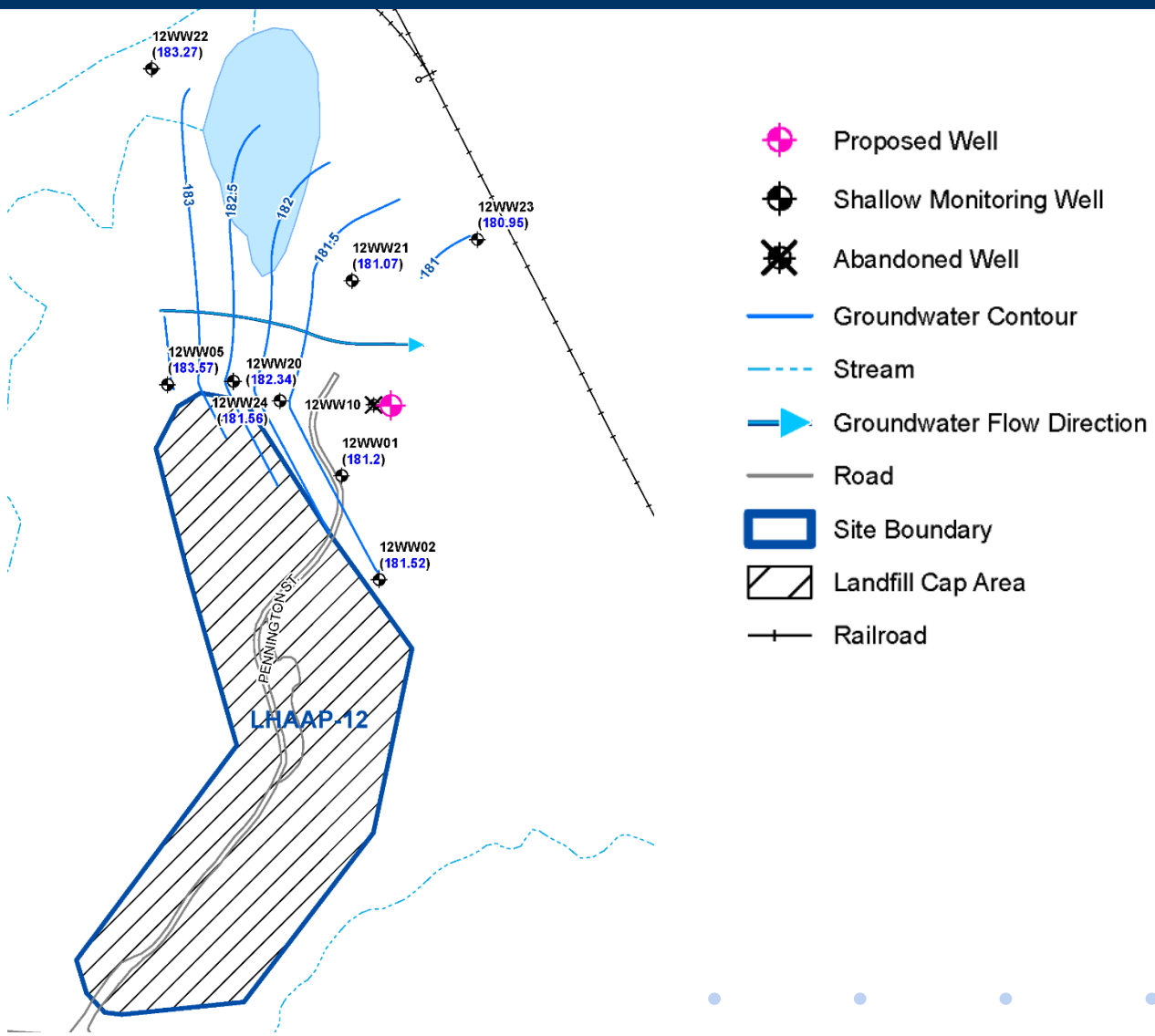
LHAAP Five Year Review Summary



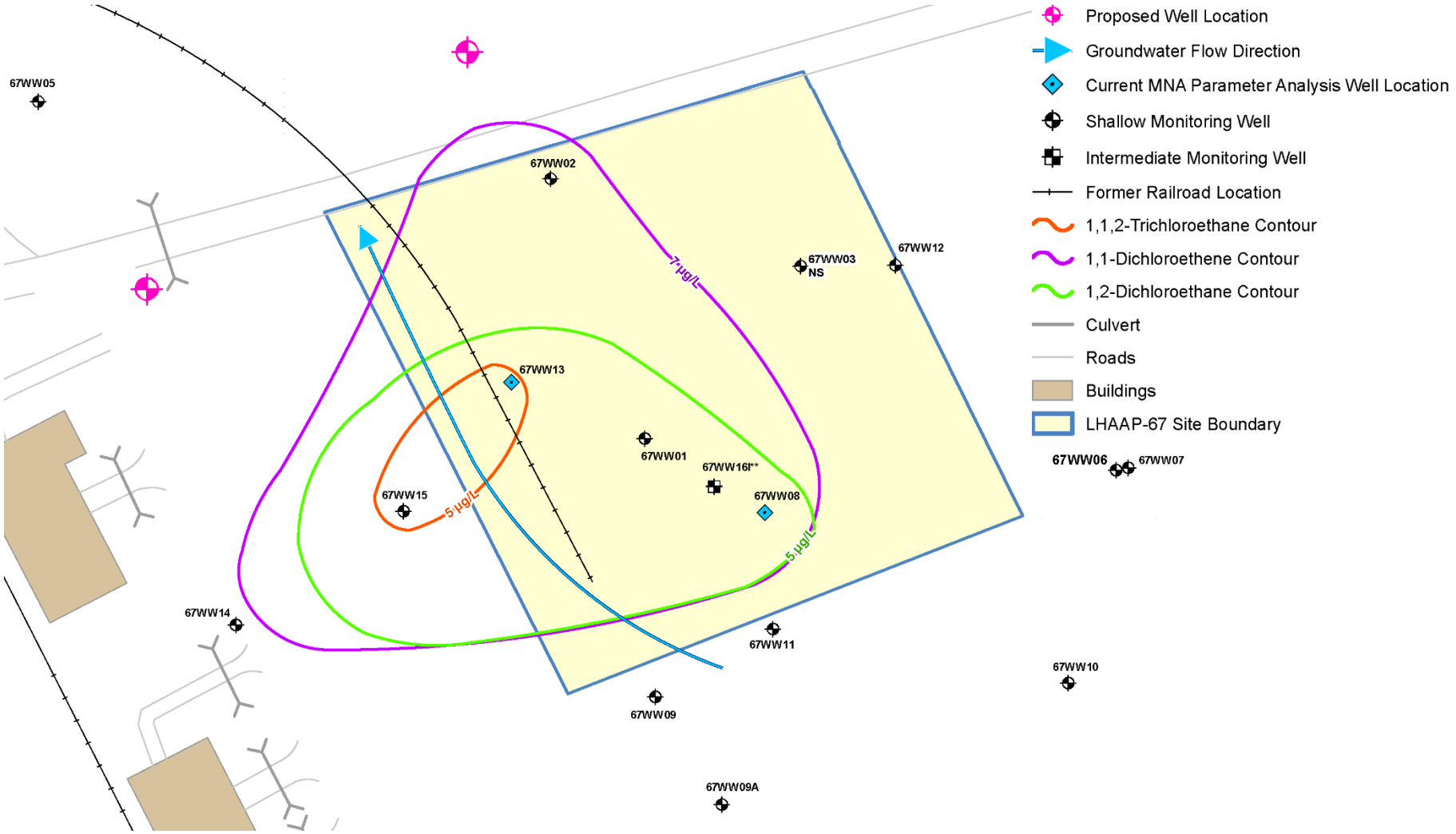
LHAAP-12, -50, and -67 Recommendations

- LHAAP-12 FYR Recommendation:
  - Establish a well network that captures seasonal and spatial variations in Chemical of Concern-impacted groundwater flow direction by adding a well to the southeast.
- LHAAP-50 FYR Recommendation:
  - Implement Enhanced In Situ Bioremediation (EISB) performance monitoring and assess if additional monitoring wells are required to delineate the plume to the south and southwest.
- LHAAP-67 Recommendation:
  - Evaluate data in the north area of the plume to determine if temporary exceedances indicate plume migration or require extension of the plume boundary well monitoring system

LHAAP-12 New Monitoring Well Location



LHAAP-67 New Monitoring Well Locations



Next RAB Meeting Schedule & Closing Remarks

- Schedule October 2019 RAB Meeting
- Other Issues/Remarks
- Thank you for coming

Groundwater Treatment Plant - Processed Groundwater Volumes

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

Processed Water Discharged 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

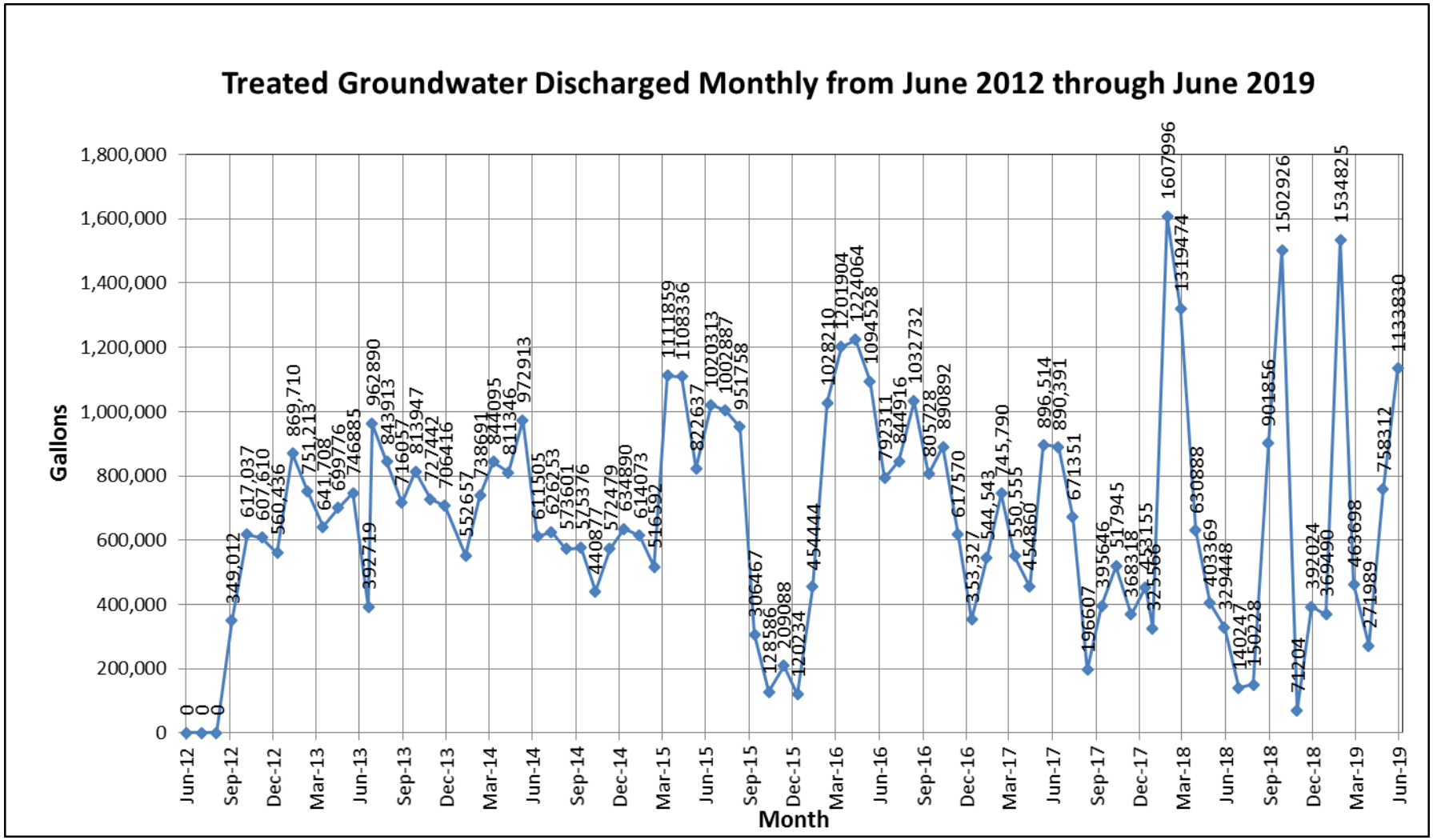
Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
128,586	209,088	120,234	454,444	1,028,210	1,201,904	1,224,064	1,094,528	792,311	844,916	1,032,732	805,728

Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
890,892	617,570	353,327	544,543	745,790	550,555	454,860	896,514	890,391	528,538	195,198	961,324

Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul - 18	Aug-18	Sep-18
517,945	368,318	453,155	325,566	1,607,996	1,319,474	630,888	403,369	329,448	140,247	150,228	901,856

Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	June-19
1,502,926	71,204	392,024	369,490	1,534,825	463,698	271,989	758,312	1,133,830

*Indicates Estimate


Treated Groundwater Discharged Monthly from June 2012 through June 2019
Gallons
Month
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Dec-18
Mar-19
Jun-19
0
0
0
349,012
617,037
607,610
560,436
869,710
751,213
641,708
699,776
746,885
392,719
962,890
843,913
716,057
813,947
727,442
706,416
552,657
738,691
844,095
811,346
972,913
611,505
626,253
573,601
575,376
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
128,586
209,088
120,234
454,444
1,028,210
1,201,904
1,224,064
1,094,528
792,311
844,916
1,032,732
805,728
890,892
617,570
353,327
544,543
745,790
550,555
454,860
896,514
890,391
671,351
196,607
395,646
517,945
368,318
453,155
325,566
1,607,996
1,319,474
630,888
403,369
329,448
140,247
150,228
901,856
1,502,926
71,204
392,024
369,490
1,534,825
463,698
271,989
758,312
1,133,830

Water Discharge Location and Volume (Gallons)

Month	Total Combined to Harrison Bayou	LHAAP-18/24 Sprinklers	GWTP To INF Pond	INF Pond to Harrison Bayou	Contract Hauled Off-Site
Dec-16	0	236,688	0	0	0
Jan-17	0	0	0	0	0
Feb-17	0	0	0	0	14,355
Mar-17	127,242	0	0	0	14,400
Apr-17	113,038	0	236,821	0	0
May-17	0	0	534,155	0	0
Jun-17	958,404	0	294,550	490,574	0
Jul-17	0	0	528,538	0	0
Aug-17	0	0	195,197	0	0
Sep-17	651,434	0	309,980	651,434	0
Oct-17	0	0	517,945	0	0
Nov-17	0	0	368,318	0	0
Dec-17	560,350	0	453,155	560,350	0
Jan-18	325,566	0	253,177	325,566	0
Feb-18	1,607,996	0	62,017	1,430,634	0
Mar-18	1,319,474	0	0	870,816	0
Apr-18	630,888	0	0	630,888	0
May-18	403,369	0	0	403,369	0
Jun-18	193,669	0	135,779	0	0
Jul -18	0	0	140,247	0	0
Aug -18	49,409	0	100,819	0	0
Sep-18	585,397	0	316,459	524,484	0
Oct-18	1,409,106	0	93,820	1,016,285	0
Nov-18	71,204	0	0	0	0
Dec-18	392,024	0	0	0	0
Jan-19	369,490	0	0	369,490	0
Feb-19	1,534,825	0	0	1,326,485	0
Mar-19	463,698	0	0	83,250	0
Apr-19	271,989	0	0	0	0
May-19	758,312	0	0	253,817	0

Month	Total Combined to Harrison Bayou	LHAAP-18/24 Sprinklers	GWTP To INF Pond	INF Pond to Harrison Bayou	Contract Hauled Off-Site
Jun-19	1,133,830	0	0	847,918	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	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
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	2nd	3rd	4th	1st	2nd	3rd	3rd	4th	2nd	3rd	4th
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	1st	2nd	3rd	4th	2nd	3rd	3rd	3rd	4th	1st	2nd
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	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
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

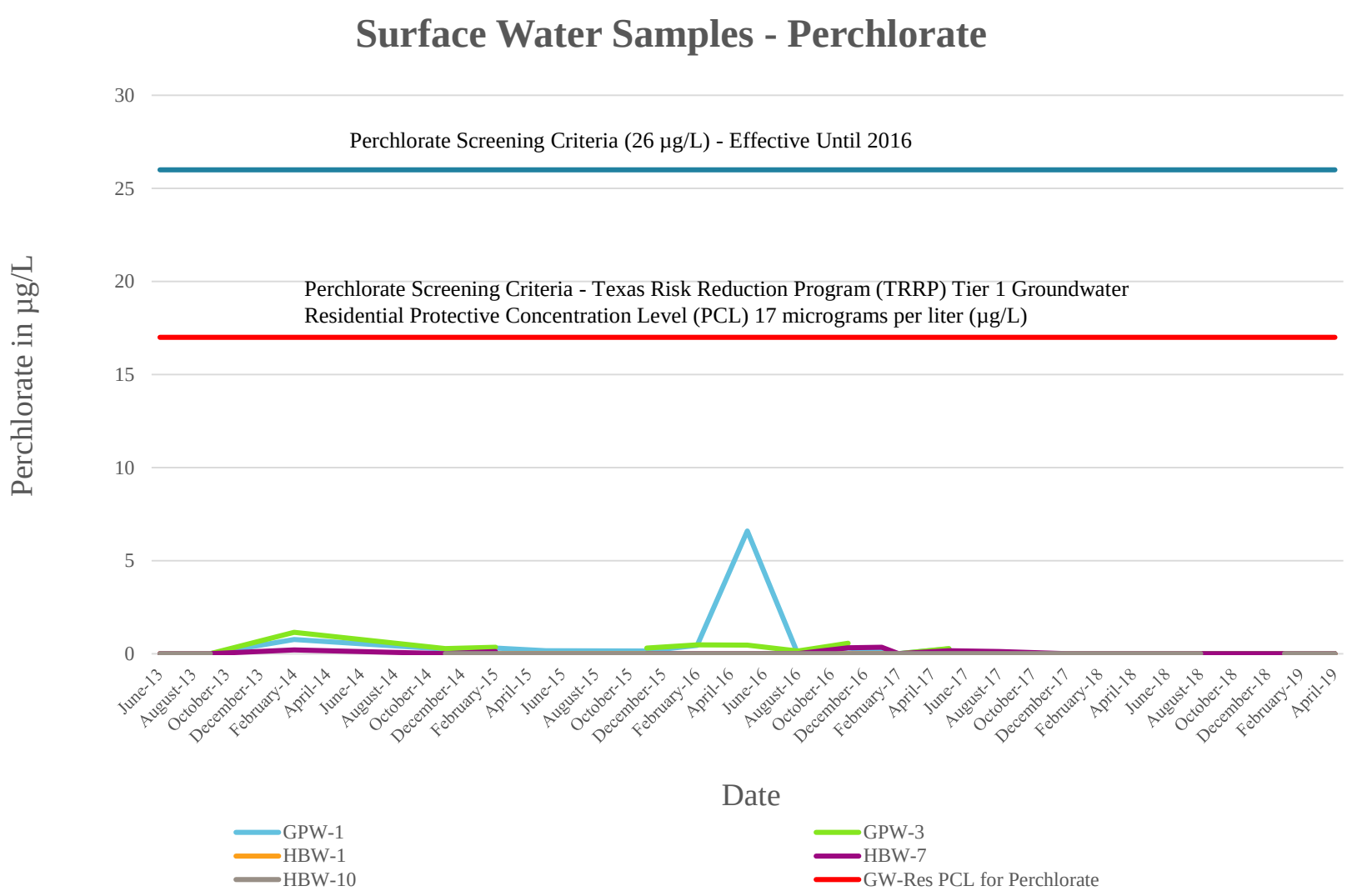
Quarter	2nd	3rd	4th	1st	2nd	3nd	4th	1st	2nd	3rd	4th
Creek Sample ID	**Jun 2013**	**Sept 2013**	**Dec 2013**	**Feb 2014**	**May 2014**	**Aug 2014**	**Nov 2014**	**Feb 2015**	**May 2015**	**Aug 2015**	**Nov 2015**
GPW-1	dry	<0.2 U	dry	0.766	dry	dry	0.244 J	0.311 J	0.156J	dry	0.142 J
GPW-3	dry	<0.2 U	dry	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	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd
Creek Sample ID	**Feb 2016**	**May 2016**	**Aug 2016**	**Nov 2016**	**Feb 2017**	**May 2017**	**Aug 2017**	**Dec 2017**	**Mar 2018**	**June 2018**	**August 2018**
GPW-1	0.447	6.59	<0.2 U	0.301 J	<1 U	0.263	dry	<4.0 U	<4.0 U	dry	<2.0 U
GPW-3	0.474	0.457	0.141	0.563	<1 U	0.274	dry	<4.0 U	<4.0 U	dry	<2.0 U
HBW-1	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	<0.2 U	1.1 J	<4.0 U	dry	<2.0 U
HBW-7	<0.2 U	<0.2 U	<0.2 U	0.318 J	<1 U	0.155	<0.2 U	<4.0 U	<4.0 U	dry	<2.0 U
HBW-10	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	0.111J	<4.0 U	<4.0 U	dry	<2.0 U

NS – not sampled U – non-detect J – Estimated Dry – no surface water

Quarter	4th	1st	2nd
Creek Sample ID	Oct 2018	Jan 2019	April 2019
GPW-1	<2.0 U	<2.0 U	<2.0 U
GPW-3	<2.0 U	<2.0 U	<2.0 U
HBW-1	<2.0 U	<2.0 U	<2.0 U
HBW-7	<2.0 U	<2.0 U	<2.0 U
HBW-10	<2.0 U	<2.0 U	<2.0 U

NS – not sampled U – non-detect J – Estimated Dry – no surface water


Surface Water Samples - Perchlorate
Perchlorate in µg/L
30
25
20
15
10
5
0
Perchlorate Screening Criteria (26 µg/L) - Effective Until 2016
Perchlorate Screening Criteria - Texas Risk Reduction Program (TRRP) Tier 1 Groundwater
Residential Protective Concentration Level (PCL) 17 micrograms per liter (µg/L)
June-13
August-13
October-13
December-13
February-14
April-14
June-14
August-14
October-14
December-14
February-15
April-15
June-15
August-15
October-15
December-15
February-16
April-16
June-16
August-16
October-16
December-16
February-17
April-17
June-17
August-17
October-17
December-17
February-18
April-18
June-18
August-18
October-18
December-18
February-19
April-19
Date
GPW-1
GPW-3
HBW-1
HBW-7
HBW-10
GW-Res PCL for Perchlorate

Longhorn Army Ammuntion Plant Creek Sampling Locations