



**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 19, 2017, 6:00 – 7:00 PM**

Meeting Participants:

LHAAP/BRAC: Rose M. Zeiler
USACE: Aaron Williams, Richard Smith
USAEC: Cathy Kropp
Bhate: Kim Nemmers
APTIM: Susan Watson
USEPA Region 6: Rich Mayer, Janetta Coats
TCEQ: April Palmie
USFWS: Paul Bruckwicki
RAB: **Present:** Carol Fortune; Paul Fortune; Judy VanDeventer;
Richard Le Tourneau; John Pollard, Jr.; Tom Walker; Nigel R. Shivers
Absent: Ken Burkhalter, Lee Guice, Ted Kurz, Terry Britt, Charles Dixon,
James Lambright
Public: Dan Murphy, Laura-Ashley Overdyke, Wendy Ledbetter, Richard Dunn,
John Fortune

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. Additionally, 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. Paul Fortune noted a new person present, and Ms. Wendy Ledbetter introduced herself as a Program Manager for the Texas Nature Conservancy.

Open Items

July 2017 RAB Meeting minutes were approved by Ms. Carol Fortune first, and then two RAB members (Mr. Paul Fortune and Mr. Nigel Shivers) provided a second motion. Dr. Rose Zeiler then stated that the sign-in sheet would be passed around again for each person to mark “yes” if they want to receive emails regarding website updates. Dr. Rose Zeiler also asked about the website and what improvements could be made to make it easier to use. Ms. Carol Fortune stated that she was surprised how easy it was to use. Dr. Rose Zeiler discussed recruiting or interest in the RAB by the public, and reminded everyone that the RAB membership application form is on the website.

Community Relations Plan (CRP)/Community Involvement Plan (CIP)

Ms. Cathy Kropp discussed the survey that was released to assess and improve the public information and RAB. Based upon this survey, the CRP is being revised. Ms. Cathy Kropp said that they had hoped to have a draft CRP available to share but all comments were not received.



However, the comments by the U.S. Environmental Protection Agency (USEPA) Technical Assistance Grant (TAG) and responses were provided at tonight's meeting. Dr. Rose Zeiler asked who wanted a hard copy of the RAB presentation in addition to the emailed copies. Ms. Janetta Coats and Mr. John Pollard, Jr. indicated they would like to see hard copies.

Ms. Cathy Kropp discussed the ongoing outreach activities listed on Slide 3. Ms. Laura-Ashely Overdyke stated that she ran into a Bhate employee who was putting up the flyers the other day and was told that the Family Dollar Store was no longer allowing the fliers to be posted. The question was raised whether the post office would allow posting. Ms. Susan Watson stated that Bhate would check to see if posting fliers at the post office would now be allowed though it has not been allowed in the past. Ms. Judy VanDeventer also indicated the U.S. Post Office would not allow postings. Also, Ms. Judy VanDeventer indicated that the slide incorrectly listed the convenience store location as there is a "9" missing from FM199. It should read "FM1999".

Ms. Judy VanDeventer stated that she had a correction to the TAG comment/response handed out for the Mayor of Uncertain. Mayor Greg Jones was pro-tem mayor. Mr. Mike Fox is the new Mayor of Uncertain. The change will be made to the CRP/CIP but was not included in the response to comments handed out.

Defense Environmental Restoration

Mr. Aaron Williams discussed an overview of the environmental work to be performed under the new contract awarded to Bhate. Dr. Rose Zeiler discussed a second contract to be awarded for sites that do not have decision documents. Ms. Judy VanDeventer asked about the two contracts and whether the next RAB will have the other contractor present.

Overview of Sites

Ms. Kim Nemmers presented the sites under the contract awarded to Bhate and general approaches for each site. Ms. Kim Nemmers stated that Bhate was implementing existing approaches or remedies to advance the sites towards closure. The performance objectives presented were established by the Army within the contract. Ms. Susan Watson pointed out the sites on a map as Ms. Kim Nemmers discussed each site. Ms. Kim Nemmers gave LHAAP-02 as an example of a site that will be able to move quickly to closure following additional groundwater sampling. LHAAP-03 will be advanced by completing an excavation for the soils and then moving the groundwater impacts to be addressed under the LHAAP-58 groundwater remediation. LHAAP-04 was discussed as having had a prior excavation and in-situ bioremediation is planned to be implemented for perchlorate in the groundwater.

LHAAP-12 and LHAAP-16 will continue to have groundwater monitoring. Dr. Rose Zeiler explained that Bhate will develop a remedial action work plan for LHAAP-16 as one of their first actions. The work plan will allow for the completion of in-situ bioremediation and eventually phase-out of the existing pump and treat system. Ms. Kim Nemmers pointed out that LHAAP-16 was presented in detail in the previous July 2017 RAB slides. Ms. Kim Nemmers skipped discussion on LHAAP-17 and stated that Ms. Susan Watson would be discussing it in detail shortly. LHAAP-19 will continue post closure care to confirm that site closure is reasonable.



Scope for LHAAP-37 and LHAAP-67 includes remedial action-operation (RA-O). Sites LHAAP-46, LHAAP-50 and LHAAP-58 will have groundwater remediation in addition to RA-O. LHAAP-58 will involve implementation of additional in-situ bioremediation which requires finalization of the Explanation of Significant Difference (ESD). Dr. Rose Zeiler mentioned that LHAAP-58 is an example where monitored natural attenuation (MNA) was selected in the Record of Decision (ROD), and a contingency remedy was included in the ROD as a plan if MNA was not working. Based on the groundwater monitoring data, the plume may be migrating, and MNA is not considered to be working effectively. The LHAAP-58 ROD allows for implementation of a contingent remedy, and the ESD is being prepared for the implementation of the contingent remedy. The two Military Munitions Response Program (MMRP) sites, LHAAP-001-R-01 and LHAAP-003-R-01, will have land use control (LUC) remedial designs to advance the sites to closure.

Ms. Kim Nemmers explained that the groundwater treatment plant and Site LHAAP-18/24 work together as the operating interim remedial action. Operations of the plant will continue without interruption or changes. Bhate has hired the existing groundwater treatment plant operators. Ms. Kim Nemmers stated that Bhate was working to get out in the field quickly.

Ms. Kim Nemmers presented the slide of the map with the sites included in Bhate's contract. Ms. Kim Nemmers discussed the documents that will be prepared and the field work that is planned over the next 3 months and how that tied to the site objectives previously discussed.

LHAAP-17

Ms. Susan Watson presented the LHAAP-17 Pre-Design Investigation (PDI) plans. A remedy has been selected to address both soil and groundwater contamination at this site for both ecological and human receptors. The remedy for soil is excavation. There will be an interim remedy of groundwater extraction to reduce the high perchlorate concentrations to allow for MNA of the chlorinated solvents and perchlorate in groundwater to occur. To complete the remedy design, additional data will be gathered. A pre-approved PDI Work Plan is in place and will be implemented which includes soil sampling, groundwater sampling, and water level measurements to assess groundwater flow. Groundwater level data will also include data from LHAAP-18/24 due to proximity. Current cleanup standards will be used to determine the plume extent which may require installation of additional wells. A pump test will also be completed to develop the design of the interim pump and treat groundwater remedy.

Ms. Susan Watson directed the RAB participants to the LHAAP-17 PDI handouts as she discussed the soil sampling plan as well as the monitoring wells to be sampled. Ms. Judy VanDeventer asked why we are having to do so much more sampling. Dr. Rose Zeiler explained that the previous analytical results are older, and the detection limits are no longer low enough to ensure that the soil and groundwater meets the current cleanup levels. Ms. Susan Watson also indicated that the soil will be excavated and the data will allow for determination of the amount of soil to be removed. Mr. Richard Le Tourneau asked if the laboratory methods had changed to allow for this improved resolution. Dr. Rose Zeiler explained that the methods had not changed but the



resolution had improved over time as driven by the regulatory requirements for the lower detection limits. Mr. Paul Fortune asked what the worst-case scenario volume of soil removal at LHAAP-17. Dr. Rose Zeiler referenced the LHAAP-17 figure and indicated the maximum area could be almost the entire site. The excavated quantity would be to a certain depth over a specific area, that would then be multiplied by the “fluff” factor to determine the volume. Ms. Susan Watson also pointed out that the depth and extent of excavation could vary across the site depending upon if ecological receptor criteria apply. Mr. Tom Walker asked where the soil would be disposed. Dr. Rose Zeiler stated that the soil would be disposed of at a licensed landfill based on the waste characterization. The question was asked where the soil would come from for backfilling. Dr. Rose Zeiler indicated it would likely come from off site and that the backfill material must be tested prior to acceptance as backfill material. Mr. Paul Fortune asked how deep is the deepest well at LHAAP-17. Ms. Susan Watson indicated she was not sure exactly but generally wells in the deep zone should be screened deeper than 50 feet below ground surface.

Ms. Susan Watson then presented the proposed extraction system at LHAAP-17 that may include three extraction wells piped to a holding tank. From the holding tank, the extracted groundwater will be pumped to the existing groundwater treatment plant by tying into existing piping. The exact location and configuration of wells will depend on the groundwater results. Dr. Rose Zeiler stated that additional data might be presented on the LHAAP-17 PDI at the next RAB. Ms. Susan Watson stated that potentially groundwater analytical results and a potentiometric map (groundwater flow) might be available. However, soil data will not likely be available for the January 2018 RAB meeting.

Groundwater Treatment Plant

Ms. Kim Nemmers then discussed the groundwater treatment plant operations. The August 2017 dip in the groundwater treated was explained by Ms. Kim Nemmers as a transformer issue. A faulty circuit was identified in the transformer, which was hit by lightning during the hurricane event (Hurricane Harvey). However, the system was put back online and is running. Ms. Kim Nemmers discussed improvements to the groundwater system to minimize downtime, including a new Programmable Logic Controller (PLC) and transformer.

Surface Water Sampling

Ms. Kim Nemmers presented the surface water sample locations and perchlorate sample result slides. Many of the surface water sample locations are dry currently due to drought conditions. Ms. Susan Watson pointed out that handouts are available for the groundwater treatment plant and the surface water sampling.

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

Dr. Rose Zeiler discussed that information presented during the RAB are primarily sites that are towards the end of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) processes. However, Sites LHAAP-18/24, -29, and -47 are lagging behind because no Final RODs are in-place. Draft RODs were prepared for Site LHAAP-29 and -47 but additional data is being collected. LHAAP-29 has had recent work that was previously discussed with the RAB. Dr. Rose Zeiler explained that these sites will be in the new contract to be awarded. LHAAP-



18/24 is in the Feasibility Study phase. These sites will move through the ROD phase and then a different contract will be awarded to implement the selected remedy since the remedy has not been finalized for them yet.

Next RAB Meeting Schedule and Closing Remarks

The next RAB meeting will be held on **January 18, 2018**, at the same time (**6:00 – 7:00 p.m.**) at the Karnack Community Center.

Questions were asked about Bhate and the relationship between Bhate and APTIM Federal Services, LLC (APTIM). Mr. Aaron Williams explained that Bhate was the prime contractor on the contract and that APTIM was their subcontractor. Ms. Kim Nemmers provided a brief synopsis of Bhate, a company based in Birmingham, AL. Bhate is named for Mr. Sam Bhate, who is one of the owners along with Mr. Johnny Roberts. Bhate does several types of work including performance-based remediation projects for the Air Force in nearby southern states. Ms. Kim Nemmers explained that APTIM is part of the contract support to Bhate. Ms. Susan Watson explained that APTIM is a new company that was recently formed by a private equity firm that purchased a portion of Chicago Bridge and Iron (CB&I).

Adjourn

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

October 2017 Meeting Attachments and Handouts:

- Meeting Agenda
- Color Copy of Bhate Presentation Slides
- Groundwater Treatment Plant (GWTP) – Processed Groundwater Volumes Handout
- Harrison Bayou and Goose Prairie Creek – Surface Water Perchlorate Data Handout
- Longhorn Army Ammunition Plant Creek Sampling Locations Map
- Response to September 25, 2017, TAG Comments on Draft Final Community Involvement Plan
- Figure 3-1 Proposed Soil Sample Locations Pre-Design Investigation Work Plan LHAAP-17
- Figure 3-2 Wells Proposed Pumping Test Pre-Design Investigation Work Plan LHAAP-17
- Restoration Advisory Board Membership Application



LONGHORN ARMY AMMUNITION PLANT
RESTORATION ADVISORY BOARD

Karnack, Texas
(479) 635-0110

AGENDA

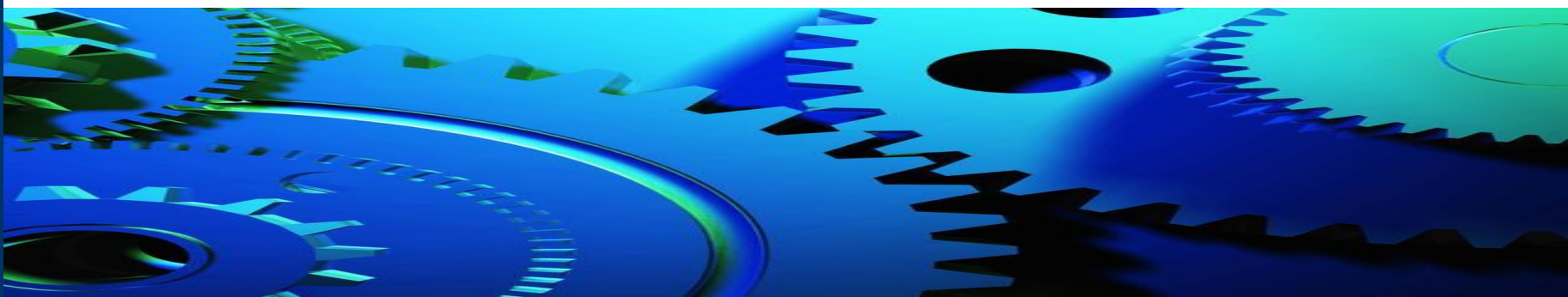
DATE: Thursday, October 19, 2017
TIME: 6:00 – 7:00 PM
PLACE: Karnack Community Center, Karnack, Texas

- 06:00** Welcome and Introduction
- 06:05** Open Items {RMZ}
- RAB Administrative Issues
 - Minutes (July 2017 RAB Meeting)
 - Ongoing Outreach/Website (2017 Volumes 1-6 loaded)
- 06:15** Community Relations Plan/Community Involvement Plan Update
{Cathy Kropp (AEC PAO)}
- 06:25** Sitewide Environmental Restoration Issues {RMZ}
- New Environmental contract awarded September 29, 2017
 - Surface Water Sampling Update
- 06:35** Defense Environmental Restoration Program (DERP) Update {Bhate}
- Introduction of Team
 - Work at LHAAP under the new contract
 - Synopsis of first three month activities
 - Groundwater Treatment Plant (GWTP) Update
- Next RAB Meeting Schedule and Closing Remarks
- 07:00** Adjourn {RMZ}



**Longhorn Army
Ammunition Plant
Quarterly Restoration Advisory
Board Meeting**

**Karnack Community Center
October 19, 2017
6:00 PM CDT**



Restoration Advisory Board (RAB) Meeting

Agenda

- 06:00** Welcome and Introduction
- 06:05** Open Items {RMZ}
 - RAB Administrative Issues
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- Next RAB Meeting Schedule and Closing Remarks
- 07:00** Adjourn {RMZ}

Restoration Advisory Board Meeting

Ongoing Outreach – Notification for October RAB Meeting

- Published RAB announcements in Marshall News Messenger on October 12, 2017
- Requested the following radio stations to air October 2017 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, KTAL Channel 6 TV, KSLA Channel 12 Community/Local Events Calendar
- Sent RAB announcement/agenda by email and United States Postal Service (USPS) to individual RAB members and other interested parties
- Mailed RAB announcement to churches in Karnack on October 10, 2017
- 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

Restoration Advisory Board Meeting

Minutes from Past RAB Meetings

Discussion of July 2017 RAB Meeting minutes/motion to accept

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

New Environmental Contract

Awarded on September 29, 2017 to Bhate Environmental Associates Inc. (Bhate), with APTIM Federal Services (APTIM) as subcontractor

- **Fixed Price Performance Based Remediation contract**
- **Period of Performance – September 29, 2017 to September 30, 2022**
- **Scope includes:**
 - **Remedial Action and Remedial Action - Operation (RA-O) at 14 sites**
 - **GWTP Operations and Maintenance (O&M)**
 - **LHAAP-18/24 Compliance Sampling/Reporting**
 - **Surface water sampling**
 - **Administrative Record management**
 - **RAB and Monthly Managers Meeting support**
 - **Website and SmartMap management**
 - **Land Use Control Management Plan**
 - **Well Plugging/Abandonment**

Restoration Advisory Board Meeting

New Environmental Contract

Task	Site Identification (ID)/Name	Performance Objective
2	LHAAP-02: Vacuum Truck Overnight Parking Lot	Groundwater Sampling; Response Complete (RC)
3	LHAAP-03: Building 722 Paint Shop	Remedial Action; RC
4	LHAAP-04: Pilot Wastewater Treatment Plant	Remedial Action Remedial Action - Operation (RA-O)
5	LHAAP-12: Landfill 12 (SWMU 12)	RA-O
6	LHAAP-16: Old Landfill (SWMU 16)	Remedial Action; RA-O
7	LHAAP-17: No. 2 Flashing Area/Burning Ground (SWMU 17)	Remedial Action; RA-O
8	LHAAP-19: Construction Materials Landfill	Landfill O&M; RC

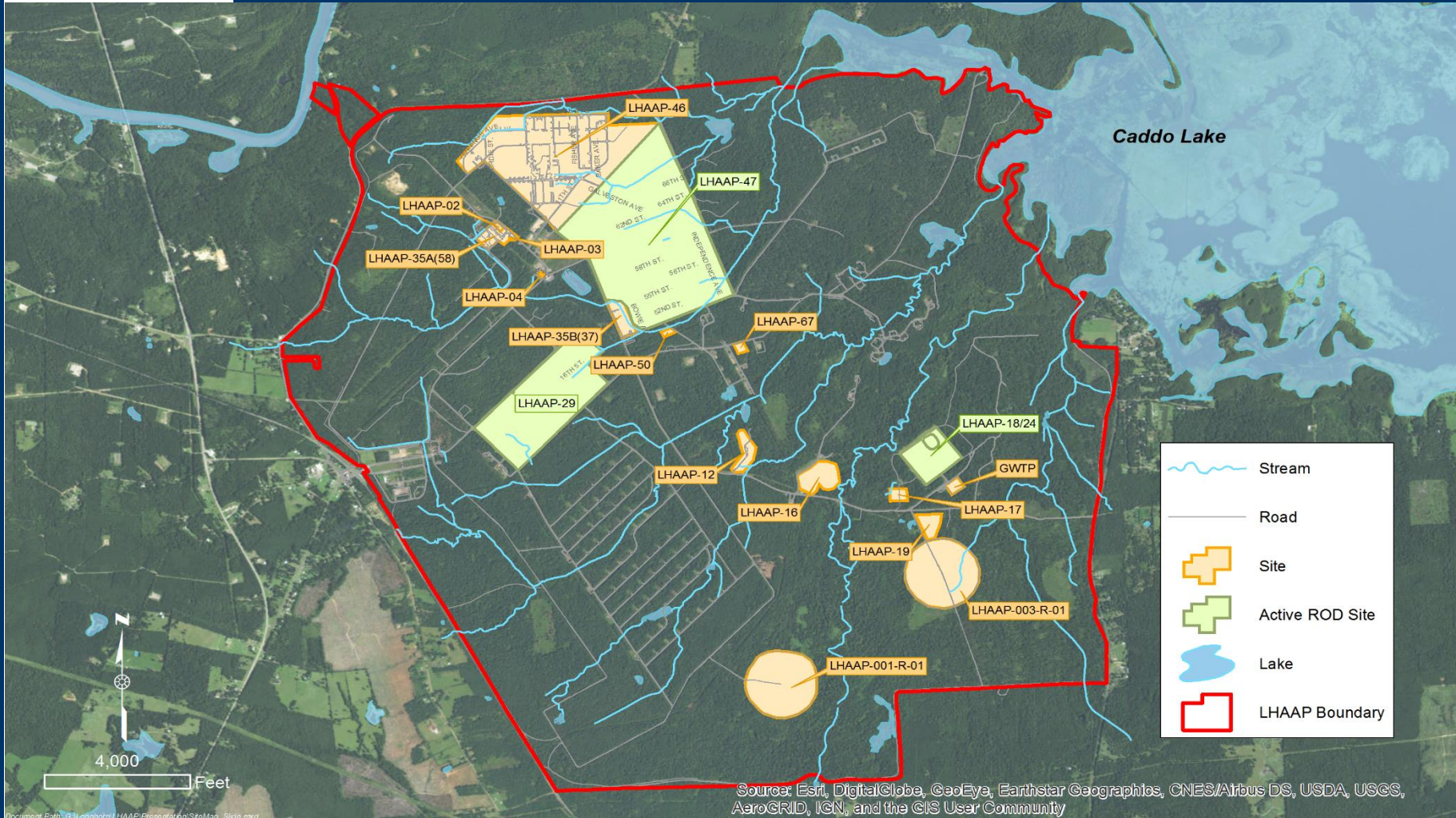
Restoration Advisory Board Meeting

New Environmental Contract

Task	Site Identification (ID)/Name	Performance Objective
9	LHAAP-37: Chemical Laboratory Waste Pad	RA-O
10	LHAAP-46: Plant 2/Pyrotechnic Operation	RA-O
11	LHAAP-50: Former Waste Disposal Facility	RA-O
12	LHAAP-58: Maintenance Complex	RA-O
13	LHAAP-67: Above Ground Storage Tank	RA-O
14	LHAAP-001-R-01: South Test Area/Bomb Test Area	Long Term Monitoring (LTM)
15	LHAAP-003-R-01; Ground Signal Test Area	LTM
16	Groundwater Treatment Plant (GWTP)	RA-O and O&M
17	LHAAP-18/24: Burning Ground/Washout Pad/UEP	Continue Interim RA-O

Restoration Advisory Board Meeting

Site Map



Restoration Advisory Board Meeting

FIRST 3 MONTHS' ACTIVITIES - Documents

Site	Document
LHAAP-03	Response to Comment (RTC) – Draft Final (DF) Record of Decision (ROD)
LHAAP-03	Explanation of Significant Difference (ESD)
LHAAP-04	Remedial Design (RD)
LHAAP-16	Remedial Action Work Plan (RAWP)
LHAAP-50	Year 3 RA-O Report
LHAAP-58	RTC - Draft ESD
LHAAP001-R-01	Land Use Control (LUC) RD
LHAAP003-R-01	LUC RD
GWTP	O&M Plan
Base wide	LUC Management Plan

Restoration Advisory Board Meeting

FIRST 3 MONTHS' ACTIVITIES-Field Work

Site	Activity
LHAAP-02	Groundwater Sampling
LHAAP-04	Install wells/sample
LHAAP-12	RA-O Sampling
LHAAP-17	Pre-Design Investigation (PDI) – Sample Soil & Groundwater, install wells, conduct pump tests
LHAAP-37	RA-O Sampling
LHAAP-50	RA-O Sampling
LHAAP-58	RA-O Sampling
LHAAP-67	RA-O Sampling
LHAAP001-R-01	2nd Annual monitoring
Surface Water	Collect Surface Water samples

Restoration Advisory Board Meeting

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

Constituents of Concern (COCs)

- Soil: Explosives (2,4-DNT, 2,6-DNT, and 2,4,6-TNT), barium, and dioxins
- Groundwater: Perchlorate, chlorinated solvents (TCE, 1,2-DCE, VC)

Proposed Remedy:

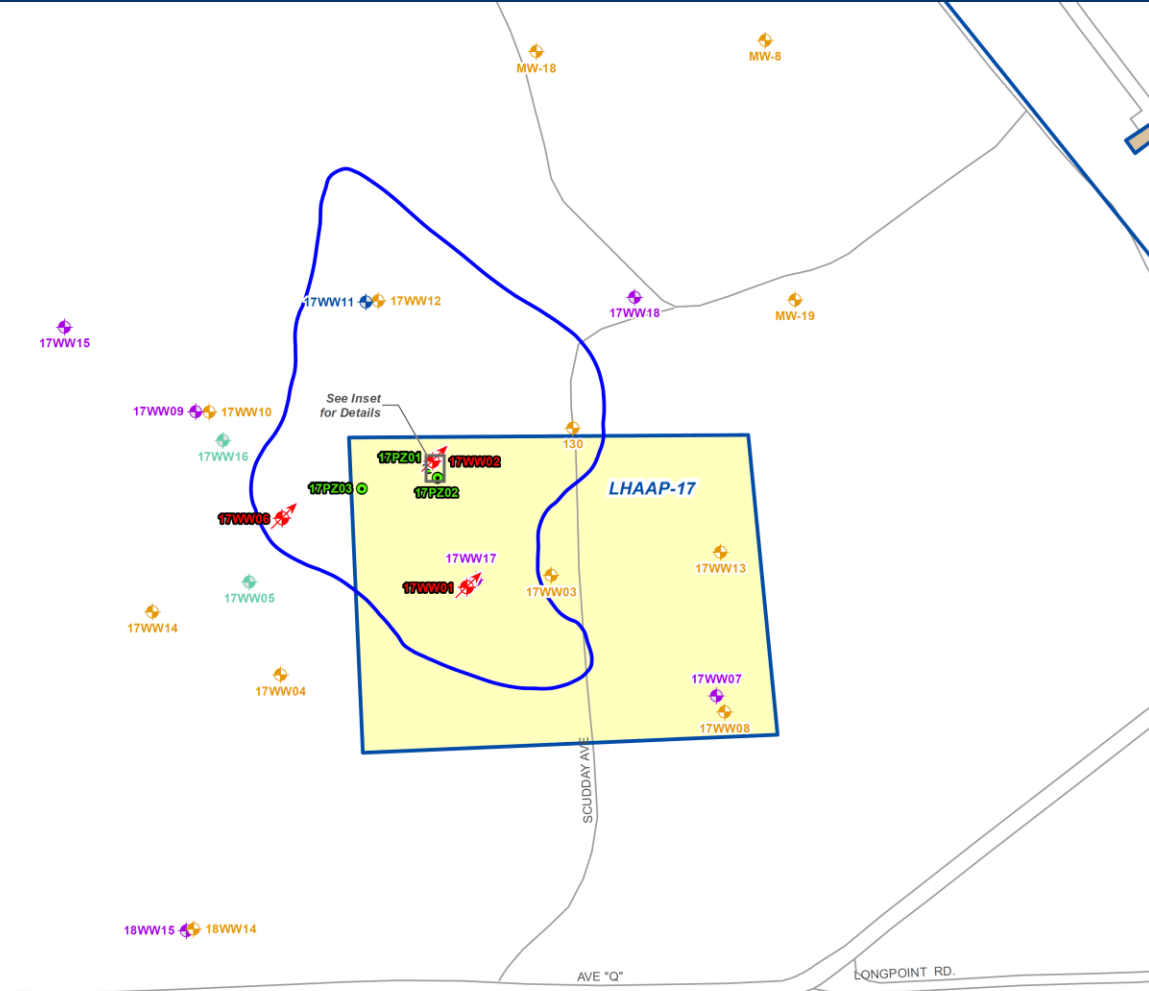
- Soil excavation
- Groundwater extraction to reduce perchlorate concentrations to less than 20,000 micrograms per liter ($\mu\text{g/L}$), an interim cleanup level. Once level is reached, the remedial action will transition from extraction to monitored natural attenuation (MNA).

Scope of PDI:

- Conduct groundwater gauging and sampling and install up to 3 monitoring wells to define current groundwater plumes
- Conduct soil sampling to define soil contamination to design excavation
- Conduct aquifer pumping tests to collect data to design the extraction system

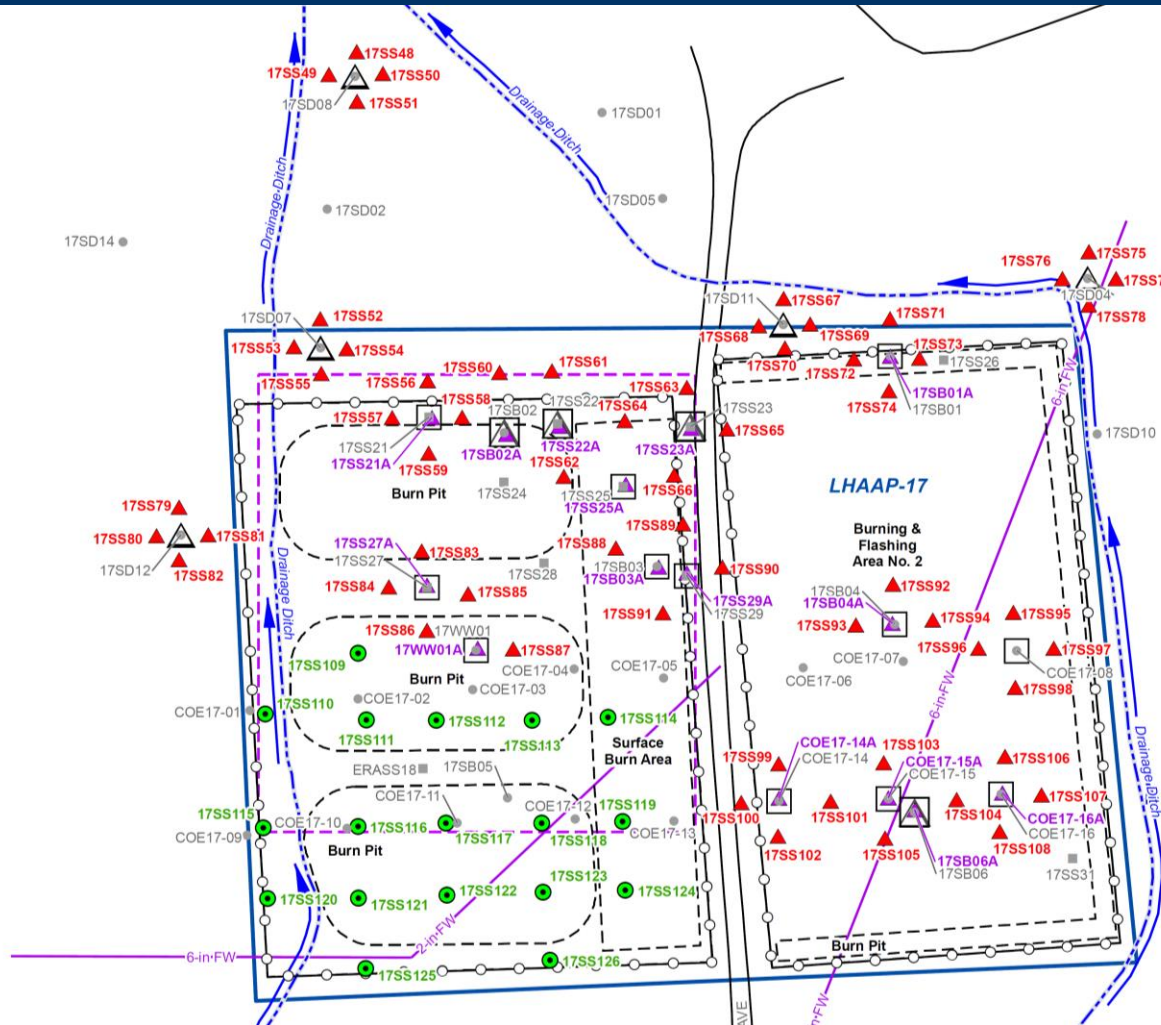
Restoration Advisory Board Meeting

LHAAP-17: Site Map (Groundwater Wells)



Restoration Advisory Board Meeting

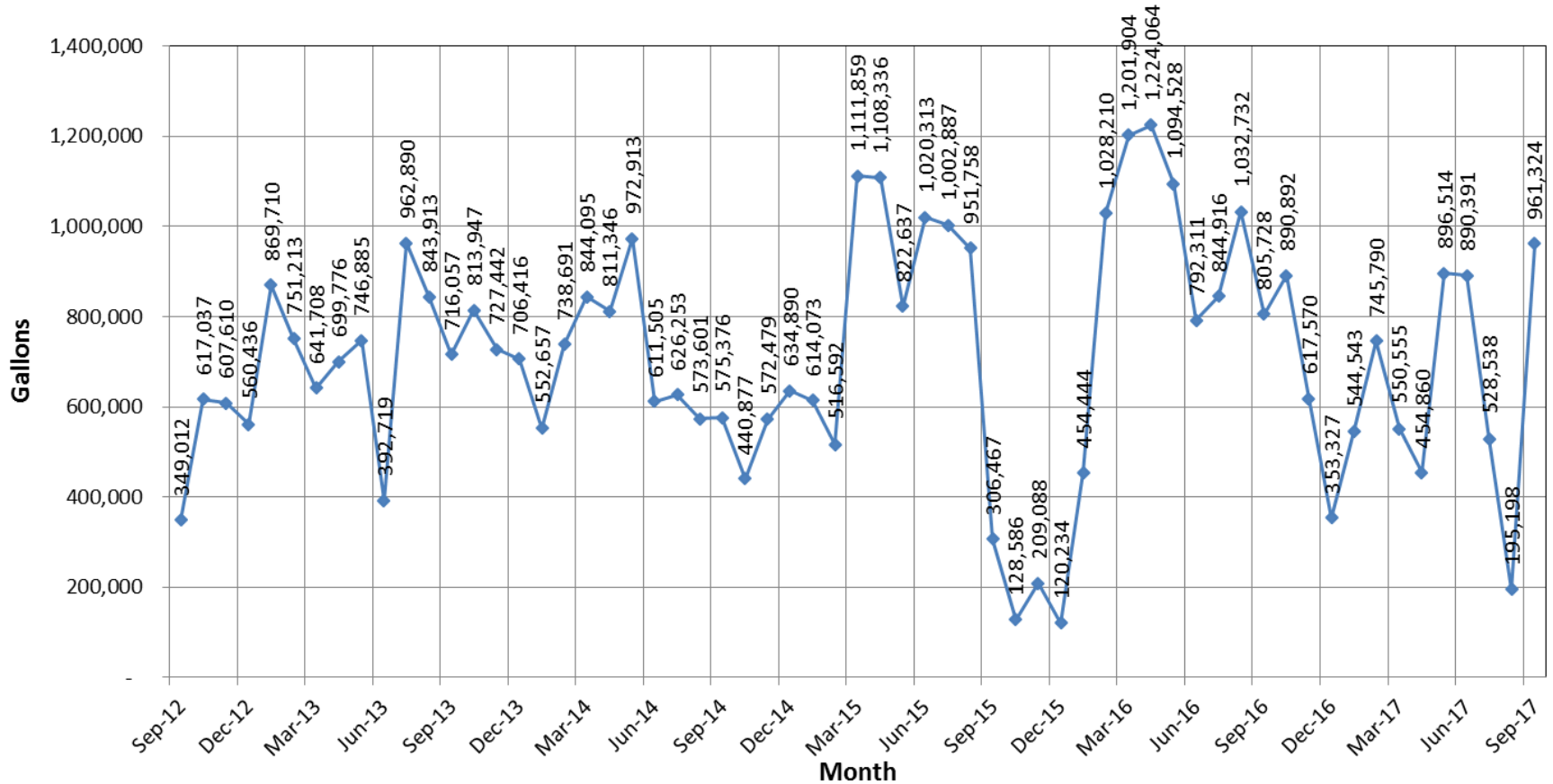
LHAAP-17: Soil Sampling



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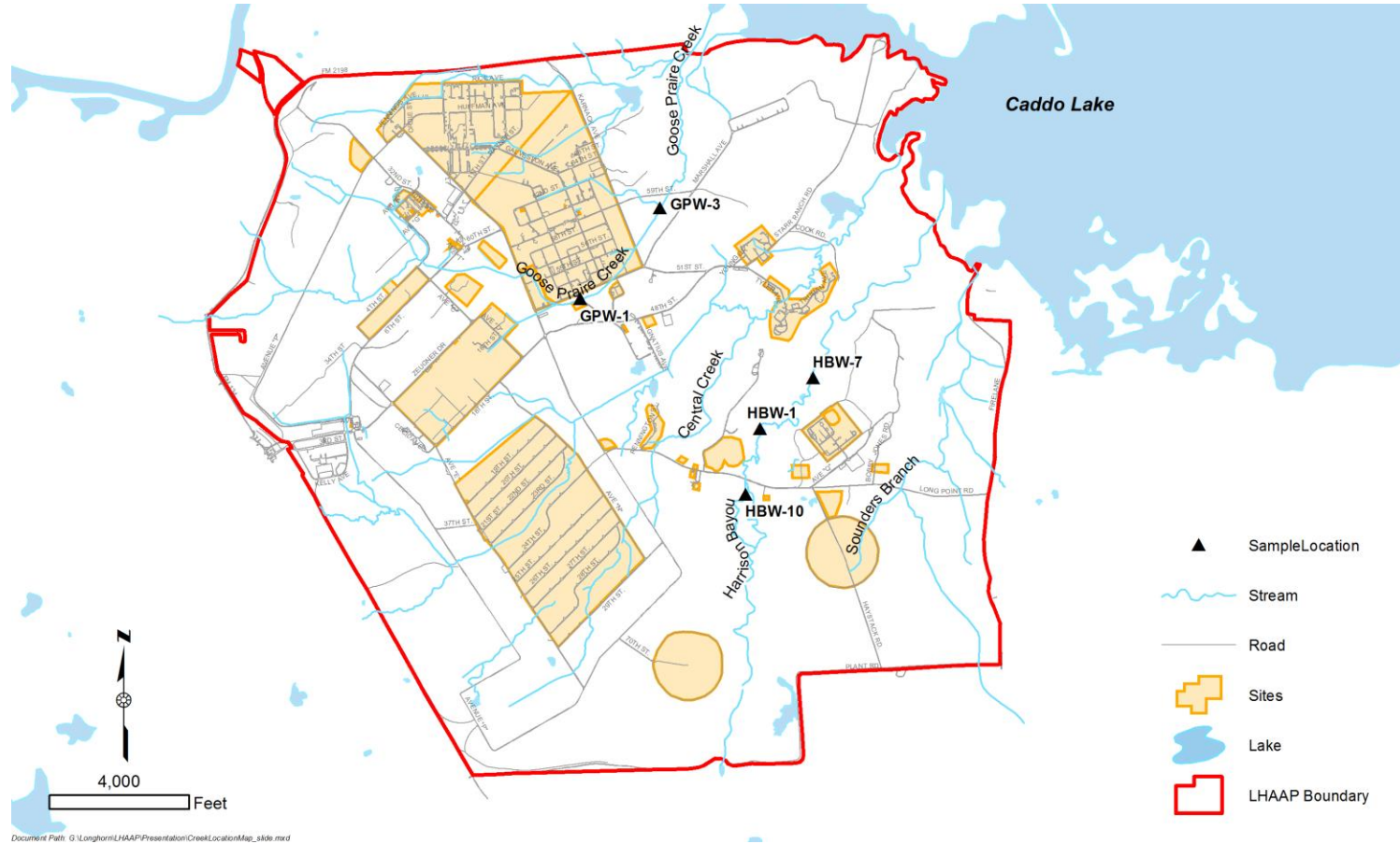
GWTP UPDATE

Water Treated Monthly from September 2012 through September 2017



Restoration Advisory Board Meeting

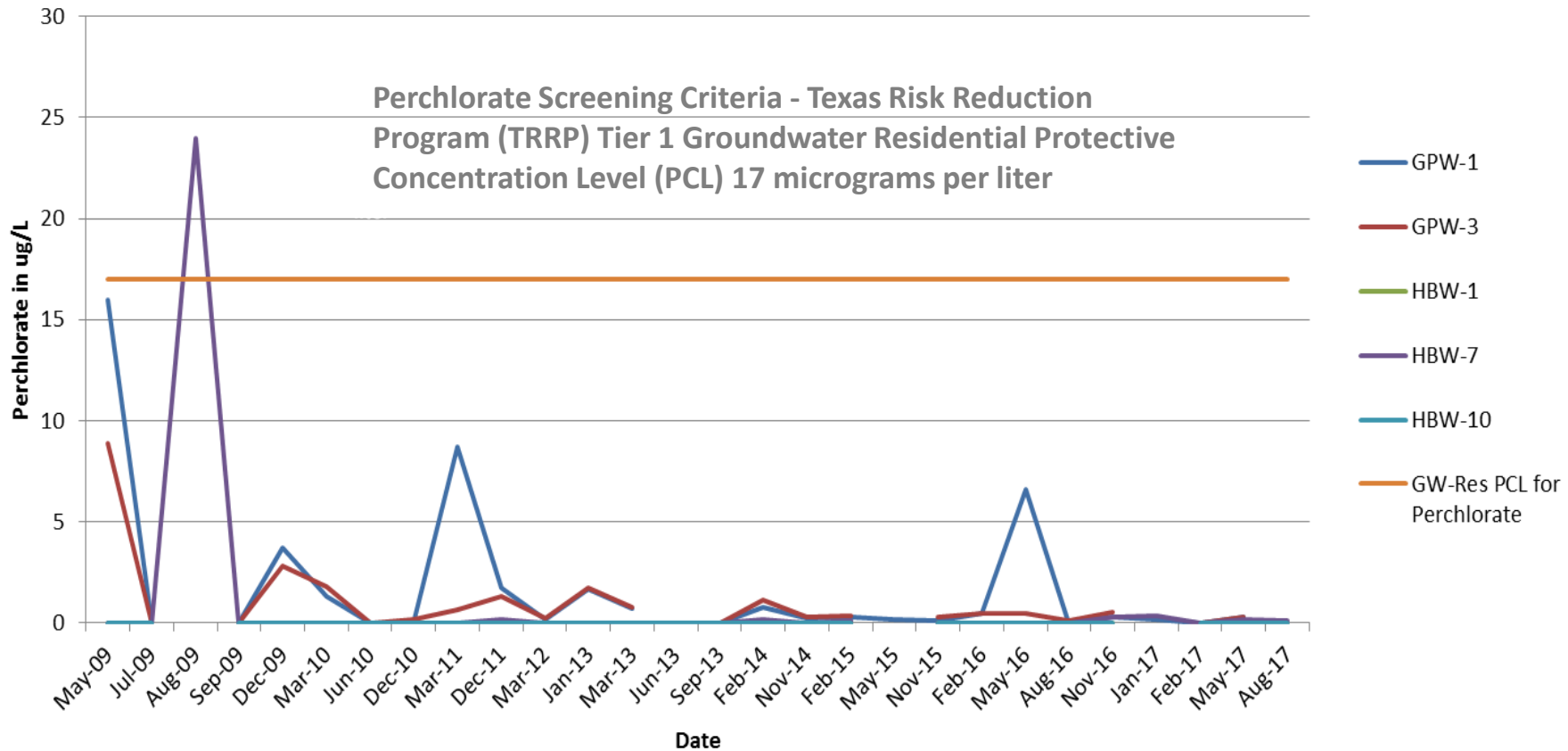
Surface Water Sample Locations



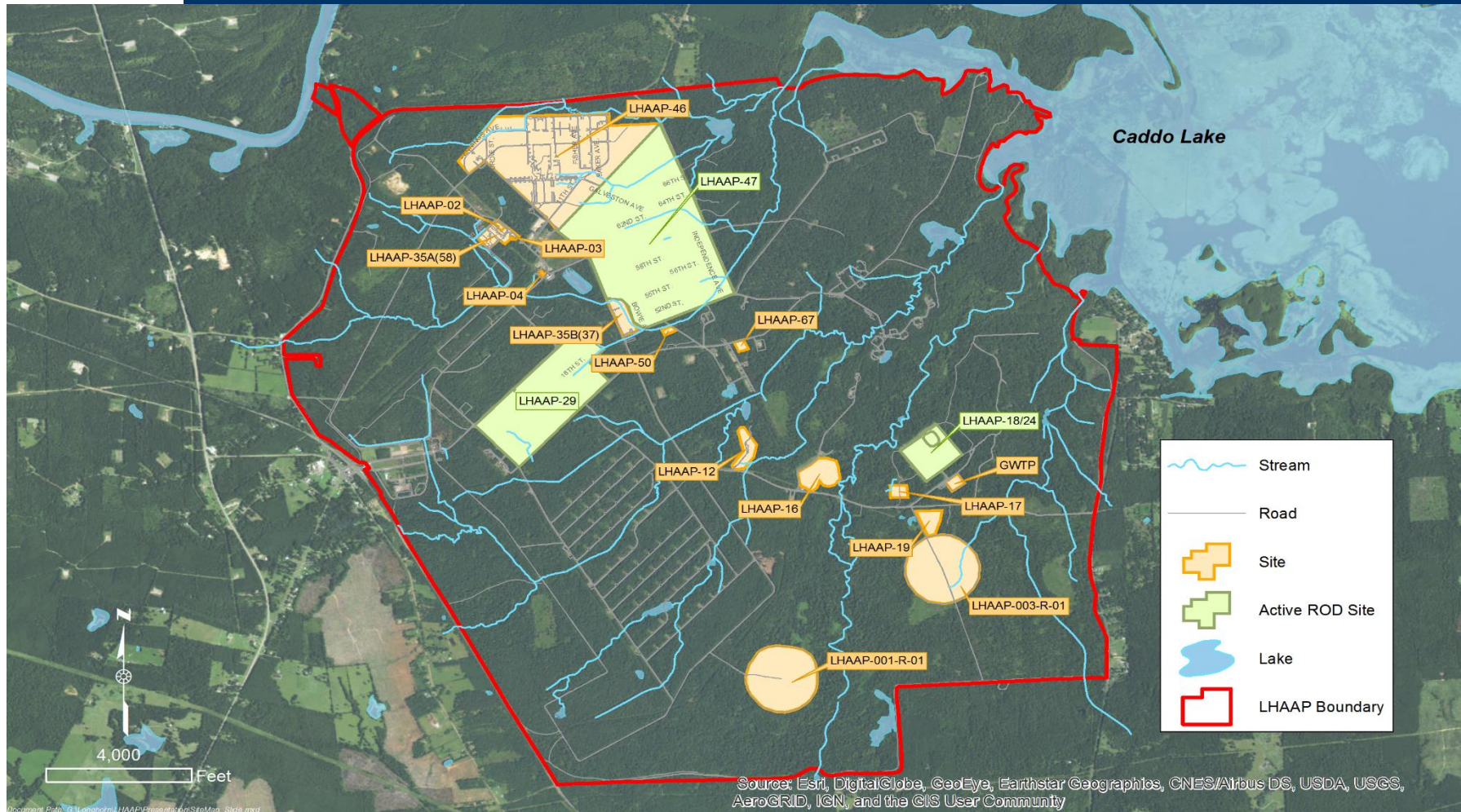
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Surface Water Sample Results

Surface Water Samples - Perchlorate



Environmental Sites Under Separate Contract



Restoration Advisory Board Meeting

Abbreviations and Acronyms

µg/L	micrograms per liter
AEC	Army Environmental Command
CDT	central daylight time
COC	constituents of concern
DCE	dichloroethene
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DF	Draft Final
ESD	explanation of significant difference
GW	groundwater
GWTP	groundwater treatment plant
LHAAP	Longhorn Army Ammunition Plant
LTM	long term monitoring
LUC	land use controls
MNA	monitored natural attenuation
MW	monitoring well
O&M	Operation and Maintenance

PAO	public affairs officer
PDI	pre-design investigation
PSA	public service announcement
RAB	Restoration Advisory Board
RA-O	Remedial Action - Operation
RAWP	Remedial Action Work Plan
RD	remedial design
ROD	Record of Decision
RTC	response to comment
RC	Response complete
SW	surface water
SWMU	solid waste management unit
TCE	trichloroethene
TNT	trinitrotoluene
UEP	unlined evaporation pond
USPS	U.S. Postal Service
VC	vinyl chloride

Next RAB Meeting Schedule & Closing Remarks

- Schedule January 2018 RAB Meeting
- Other Issues/Remarks

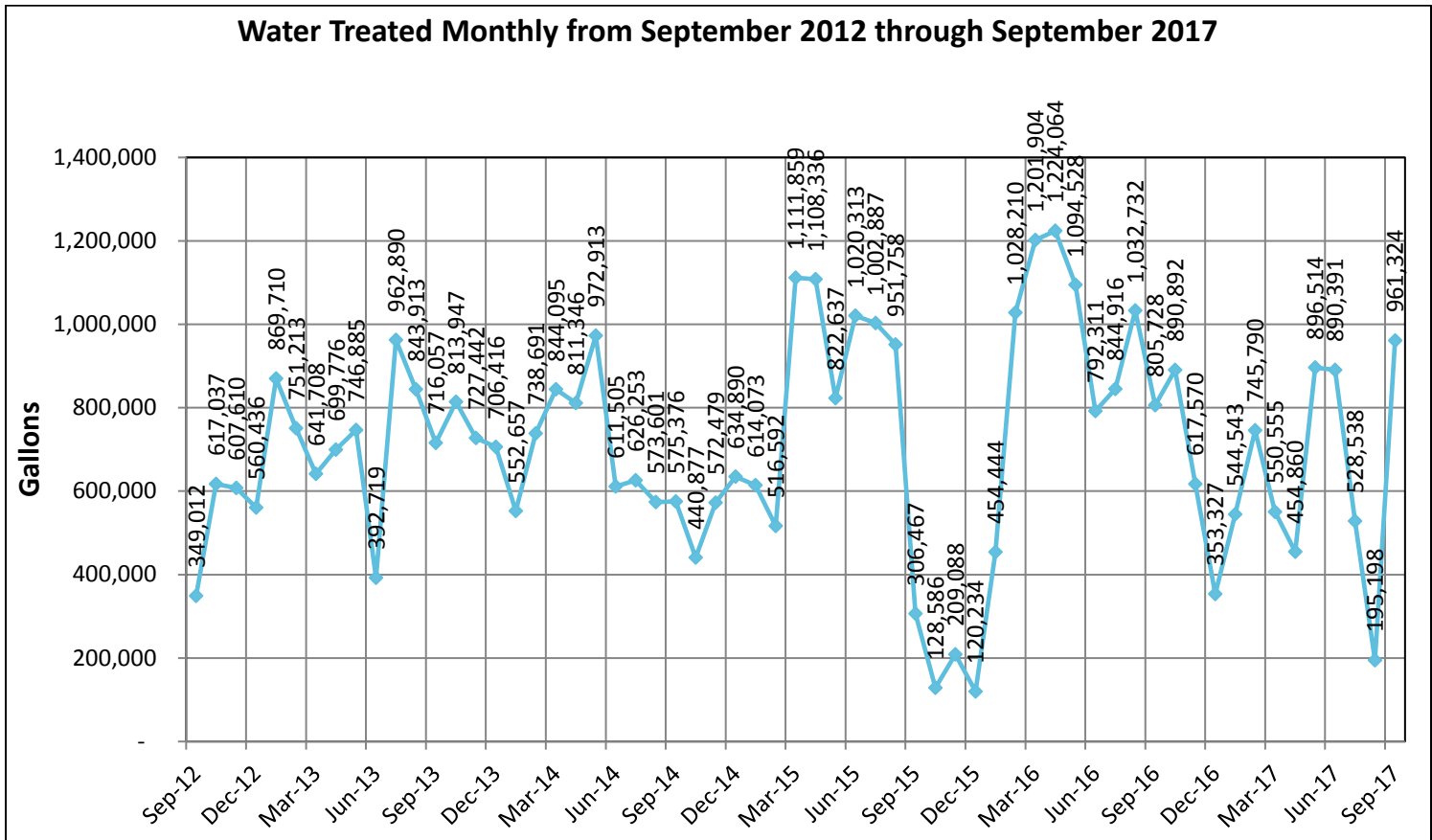
Groundwater Treatment Plant - Processed Groundwater Volumes

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	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

*Indicates Estimate



Water Discharge Location and Volume (Gallons)

Month	Harrison Bayou	LHAAP-18/24 Sprinklers	INF Pond	INF Pond to Harrison Bayou	Contract Hauled Off-Site
Oct-16	0	642,876	0	0	0
Nov-16	0	576,898	0	0	0
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	205,665	0	534,155	0	0
Jun-17	467,830	0	294,550	490,574	0
Jul-17	0	0	528,538	0	0
Aug-17	0	0	195,197	0	0
Sep-17	0	0	309,980	651,434	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

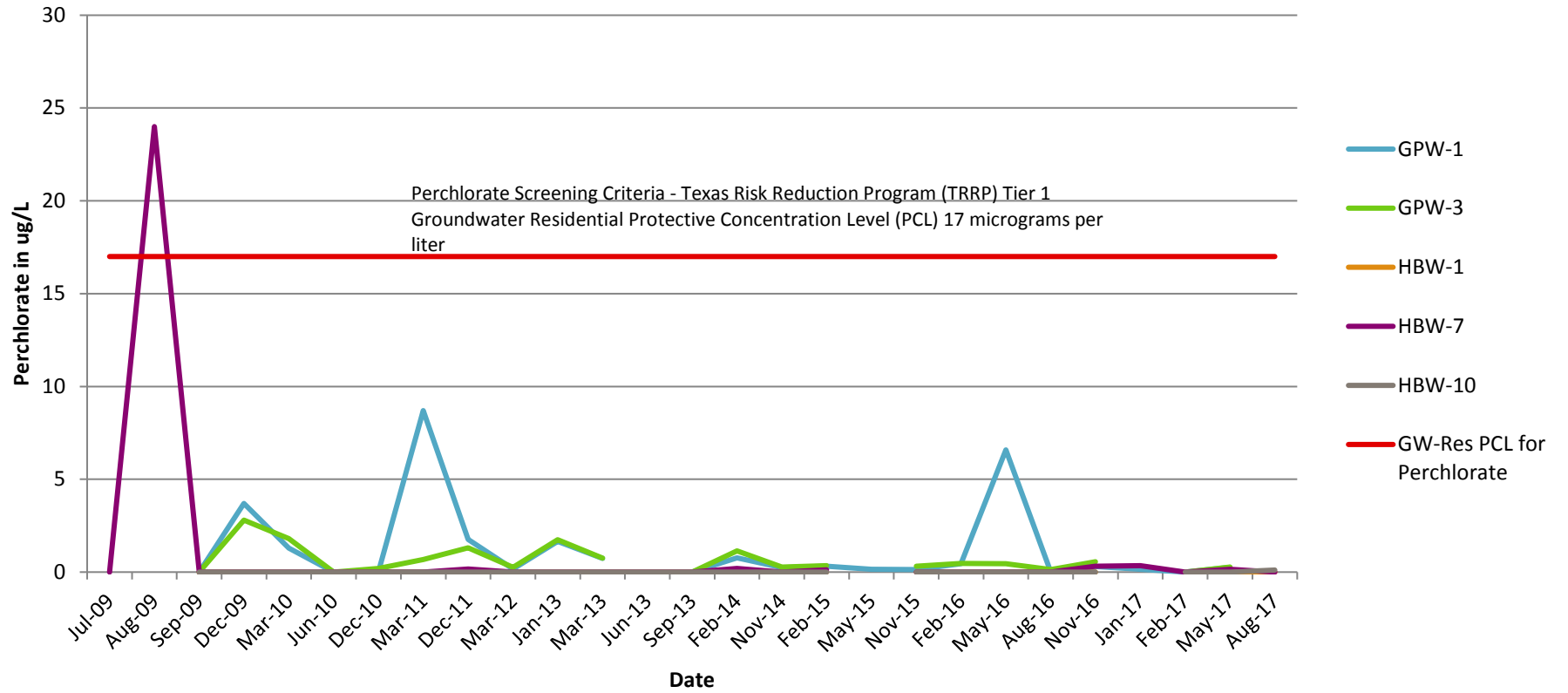
Quarter	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd	4 th	1 st
Creek Sample ID	Sep 2010	Dec 2010	Mar 2011	Jun 2011	Sep 2011	Dec 2011	Mar 2012	Jun 2012	Not Applicable	Jan & Feb 2013	Mar 2013
GPW-1	dry	<0.1U	8.7	dry	dry	1.76	0.163J	dry	NS	1.65	0.735
GPW-3	dry	0.199J	0.673	dry	dry	1.31	0.261	dry	NS	1.74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

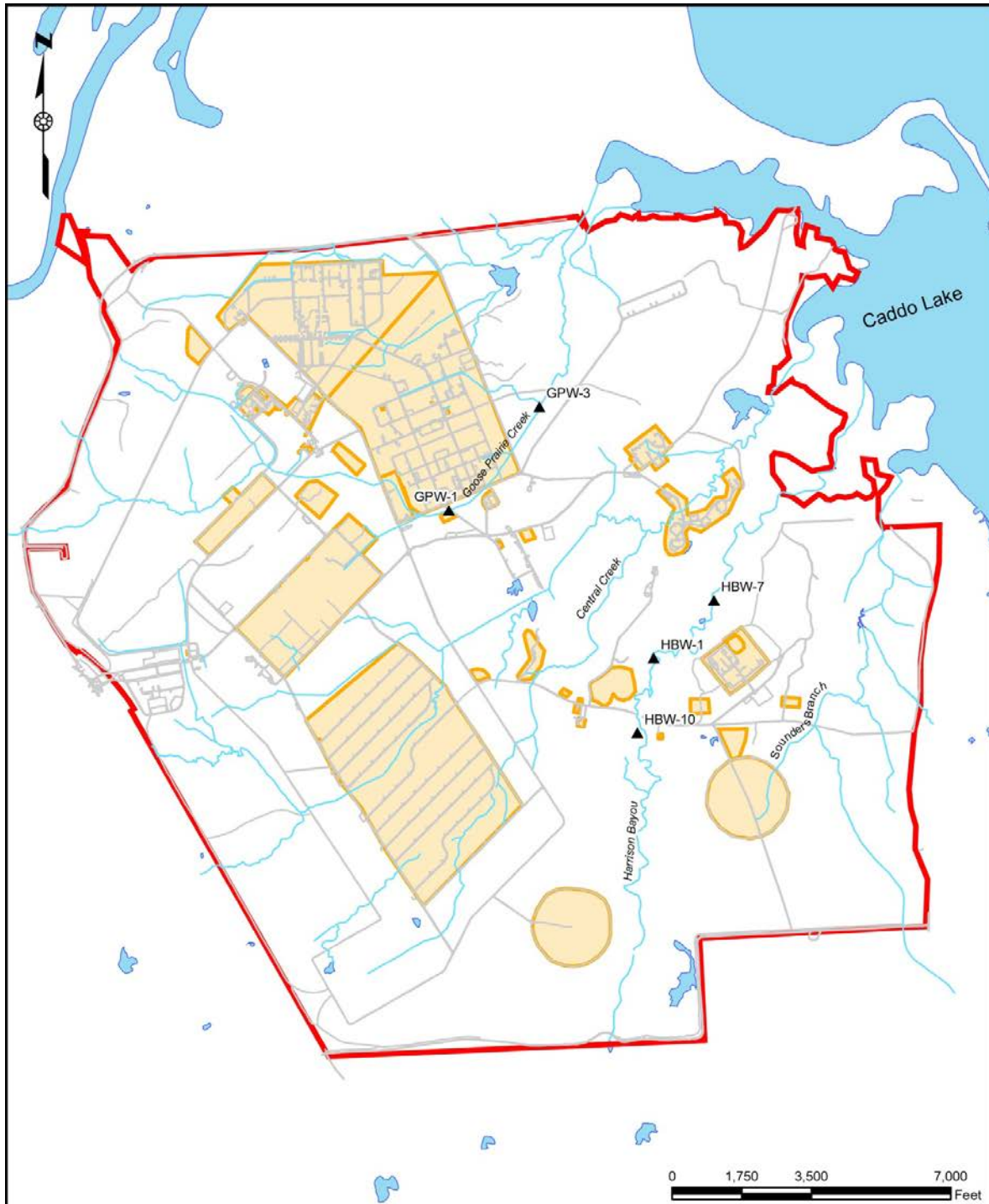
Quarter	1 st	2 nd	3 rd	4 th	1 st	2 nd	3 rd
Creek Sample ID	Feb 2016	May 2016	Aug 2016	Nov 2016	Feb 2017	May 2017	Aug 2017
GPW-1	0.447	6.59	<0.2 U	0.301 J	<1 U	0.263	dry
GPW-3	0.474	0.457	0.141	0.563	<1 U	0.274	dry
HBW-1	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	<0.2 U
HBW-7	<0.2 U	<0.2 U	<0.2 U	0.318 J	<1 U	0.155	<0.2 U
HBW-10	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	0.111J

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

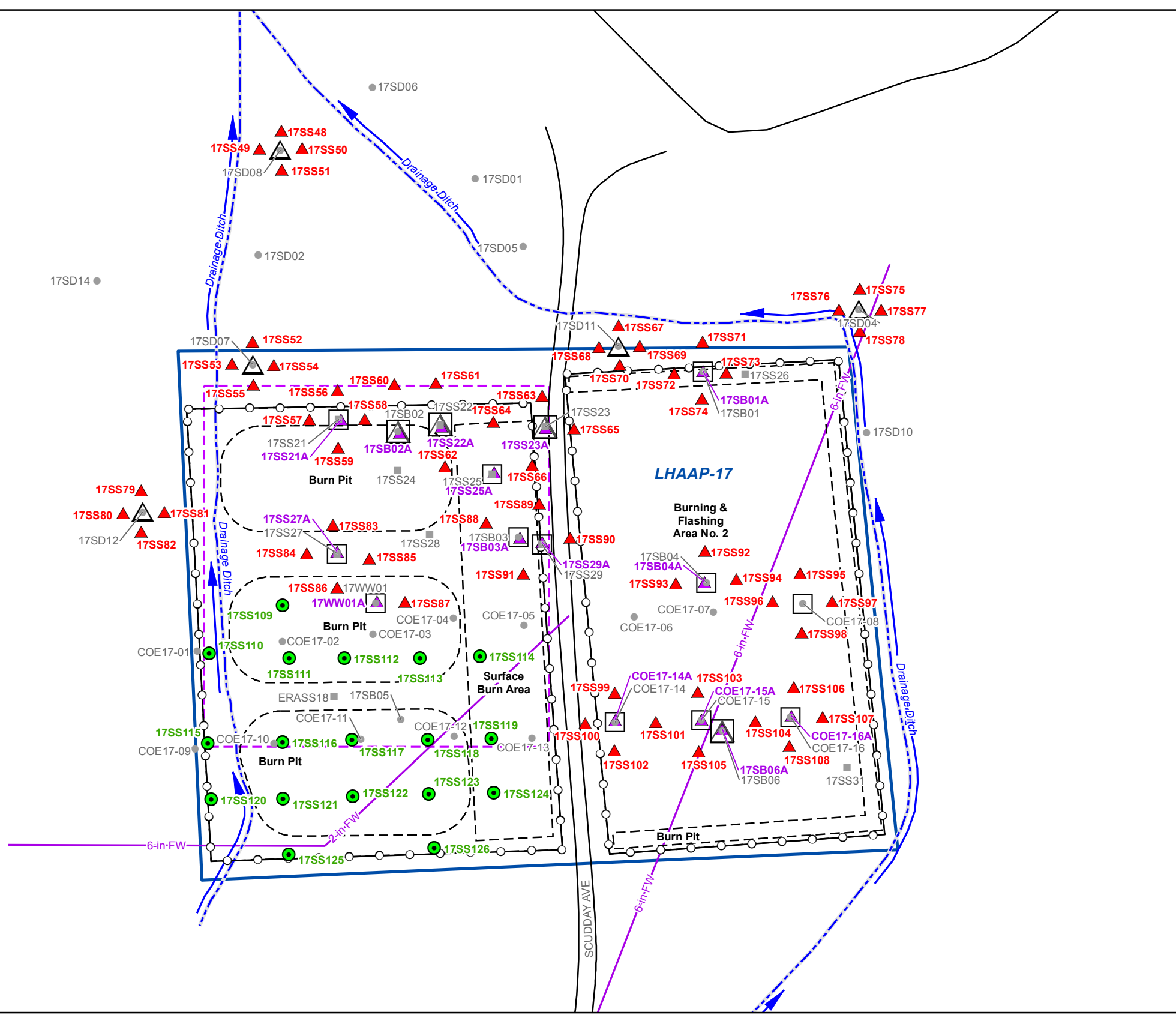
Surface Water Samples - Perchlorate



Longhorn Army Ammunition Plant Creek Sampling Locations



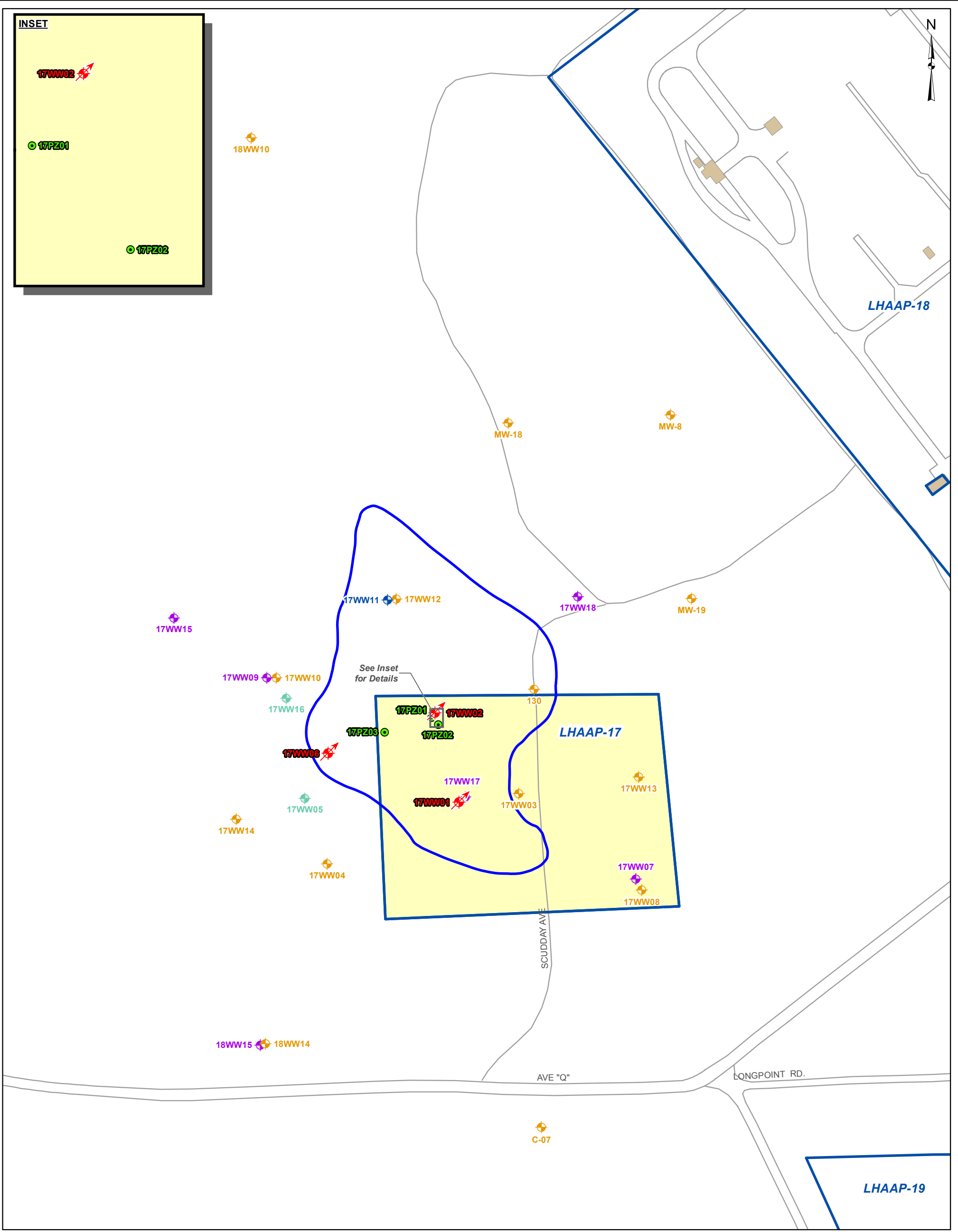
Legend <ul style="list-style-type: none">▲ Surface Water Sampling Location— Stream— Road■ Site■ Lake	U.S. ARMY CORPS OF ENGINEERS TULSA DISTRICT TULSA, OKLAHOMA
SURFACE WATER SAMPLING LOCATION LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS	



- Legend**
- ▲ Proposed Soil Sample Location
 - ▲ Re-Sample Previous Location at Deeper Interval
 - Proposed Shallow Soil Sample Location in Area Lacking Historical Data
 - △ Existing Sample location with contamination that poses Ecological Risk.
 - Existing Sample location with contamination that poses Human Health Risk (for soil to groundwater).
 - Existing Soil Sample Location
 - Existing Surface Soil/Sediment Location
 - Fence Line
 - 2 inch (in) and 6 inch Diameter Fire Water (FW) Line (Respectively)
 - - - Drainage Ditch
 - Surface Water Flow Direction
 - ▭ LHAAP-17 Site Boundary
 - - - Approximate Boundary of Treatability Demonstration Study (PEC, 2004)



Figure 3-1
 Proposed Soil Sample Locations
 Pre-Design Investigation Work Plan
 LHAAP-17
 Longhorn Army Ammunition Plant
 Karnack, Texas



Legend

	Existing Shallow Monitoring Well		Proposed Piezometer Location
	Existing Shallow/Intermediate Monitoring Well		Perchlorate Plume (PCL = 17 µg/L)
	Existing Intermediate Monitoring Well		LHAAP-17 Site Boundary
	Existing Deep Monitoring Well		Other Site Boundary
	Existing Shallow Monitoring Well for Proposed Pumping Test	Note: PCL - Protective Concentration Level for residential groundwater	

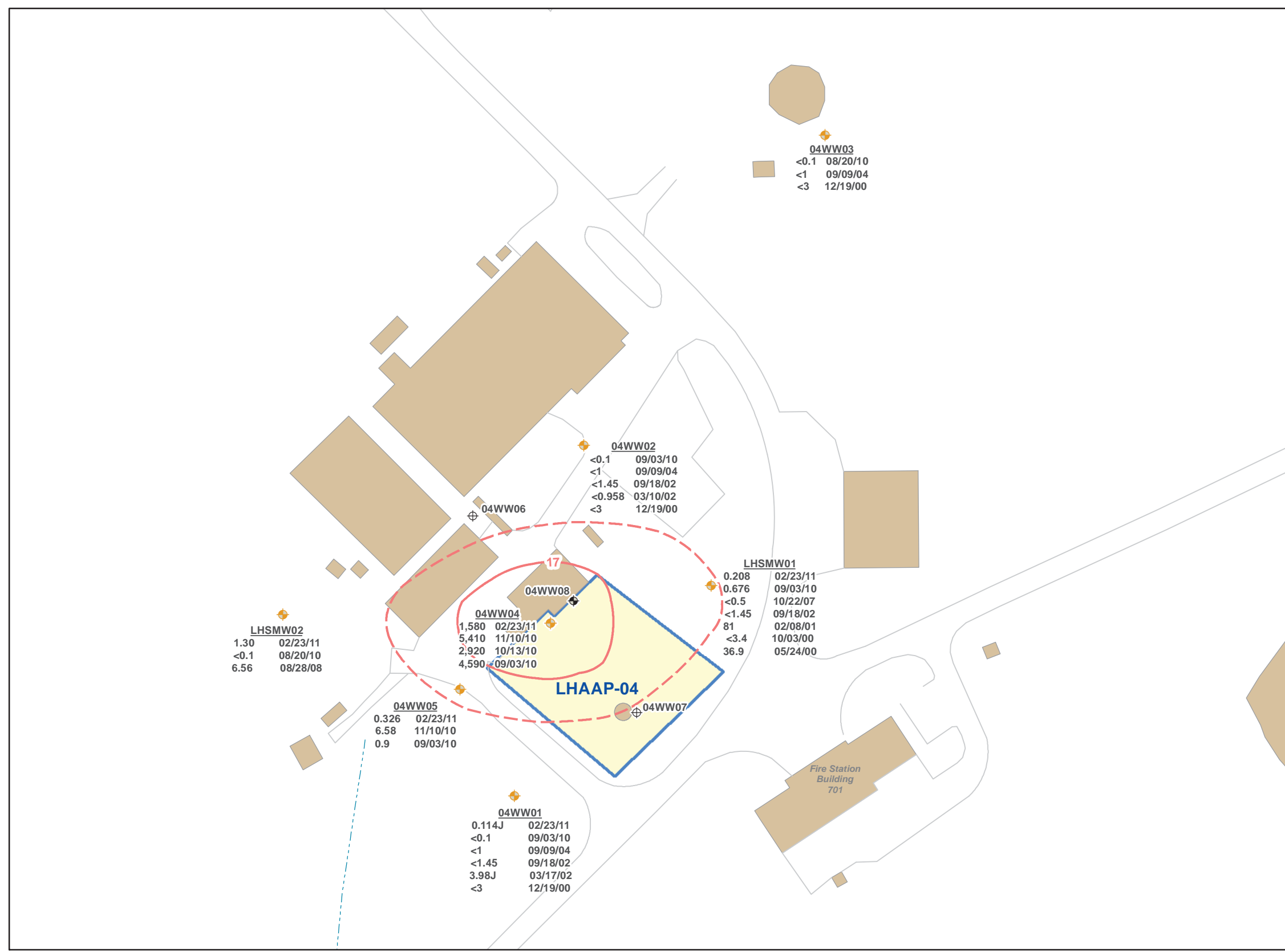
0 75 150 300 Feet



Figure 3-2
Wells for Proposed Pumping Test
Pre-Design Investigation Work Plan
LHAAP-17



Path: L:\AGE\GIS\IAUS GIS\GIS Projects\Longhorn AAP\01 Reports\LHAAP-04\Record of Decision\Figure 2-6 LHAAP-04 Perchlorate Concentrations in GW.mxd



Legend

- Proposed Shallow Monitoring Well
- Proposed Intermediate Monitoring Well
- Shallow Monitoring Well
- Perchlorate Plume Extent (PCL - 17 µg/L)
- Possible Past Extent of Perchlorate
- Stream
- Road
- Building
- LHAAP-04 Site Boundary

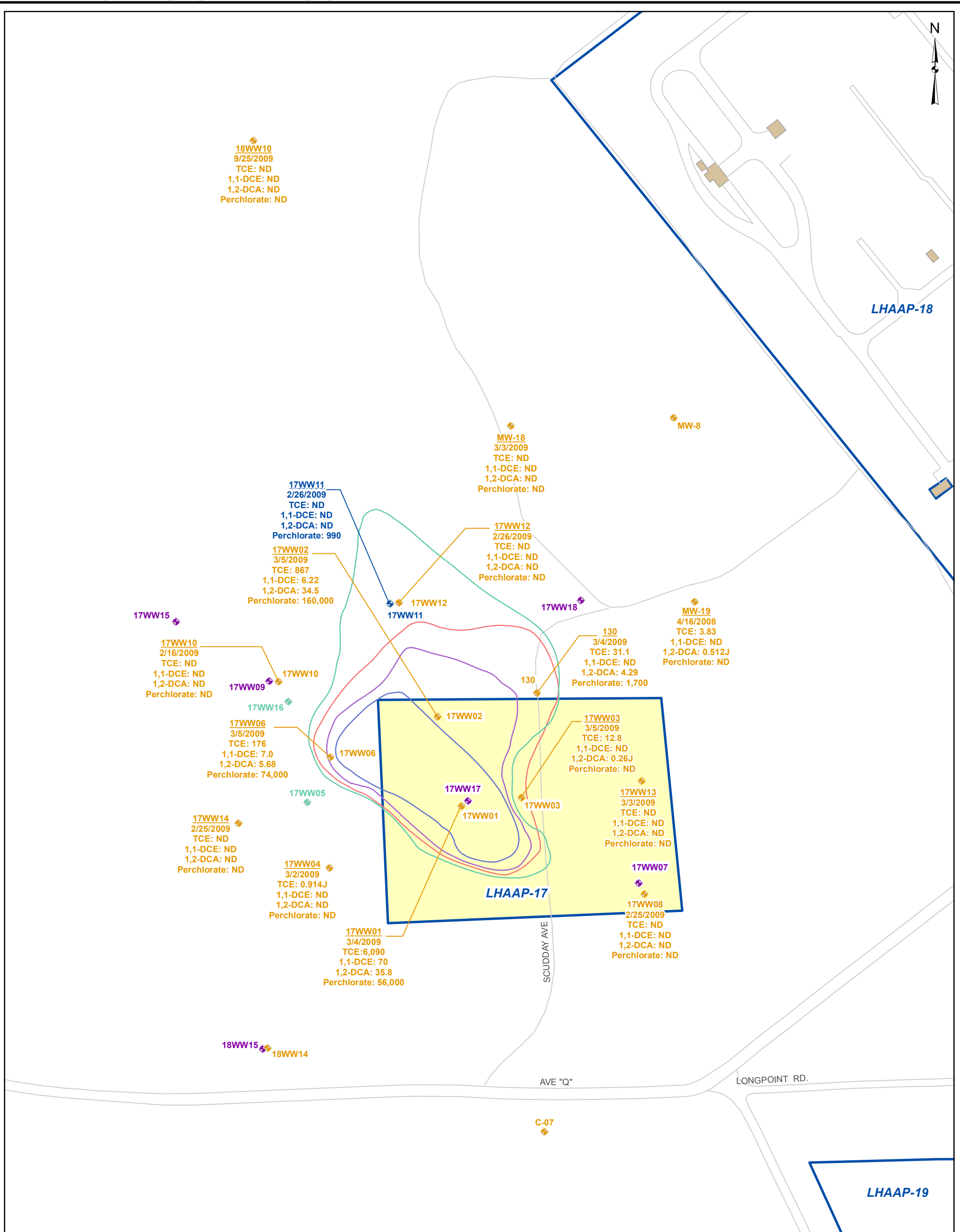
Source: Modified from Shaw 2012, LHAAP-04 Feasibility Study Report

- Notes:**
1. Perchlorate concentrations reported in micrograms per liter (µg/L).
 2. Plume boundaries based on most recent results available at each well (2011).
 3. The wells 04WW06, 04WW07, and 04WW08 are proposed and will be installed as part of the Remedial Design activities. Locations shown are approximate and will be adjusted in the field based on site conditions and any additional data that may be available at that time.
 4. PCL - Texas Risk Reduction Program Protective Concentration Level for Residential Groundwater.



Figure 2-6
 Perchlorate Concentrations in Groundwater
 LHAAP-04 Record of Decision
 Longhorn Army Ammunition Plant
 Karnack, Texas

60274185 October 2016



Legend

- ◆ Shallow Monitoring Well
- ◆ Shallow/Intermediate Monitoring Well
- ◆ Intermediate Monitoring Well
- ◆ Deep Monitoring Well
- TCE Plume (MCL = 5 µg/L)
- 1,1-DCE Plume (MCL = 7 µg/L)
- 1,2-DCA Plume (MCL = 5 µg/L)
- Perchlorate Plume (PCL = 17 µg/L)
- Road
- ▭ LHAAP-17 Site Boundary
- ▭ Other Site Boundary

Notes:

1. All concentrations are reported in microgram per liter (µg/L).
2. ND - non detect
3. GW-Ind - groundwater TCEQ MSC for industrial use
4. MCL - Maximum Contaminant Level
5. PCL - Protective Concentration Level for residential groundwater
6. TCE - trichloroethene
7. 1,1-DCE - 1,1-dichloroethene
8. 1,2-DCA - 1,2-dichloroethane



Figure 2-2
COC Plumes in Shallow Groundwater
Data Gap Investigation Work Plan
LHAAP-17

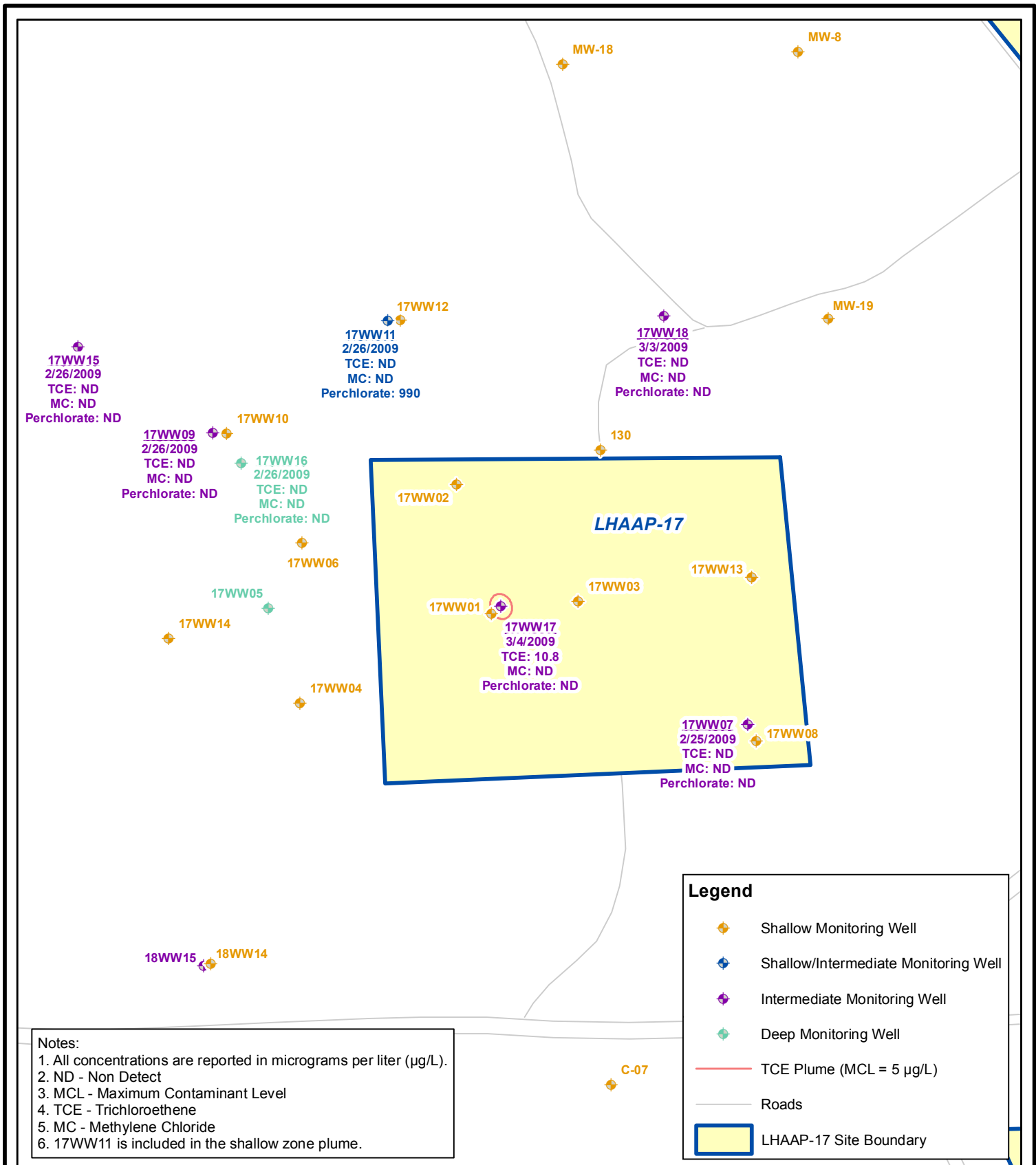
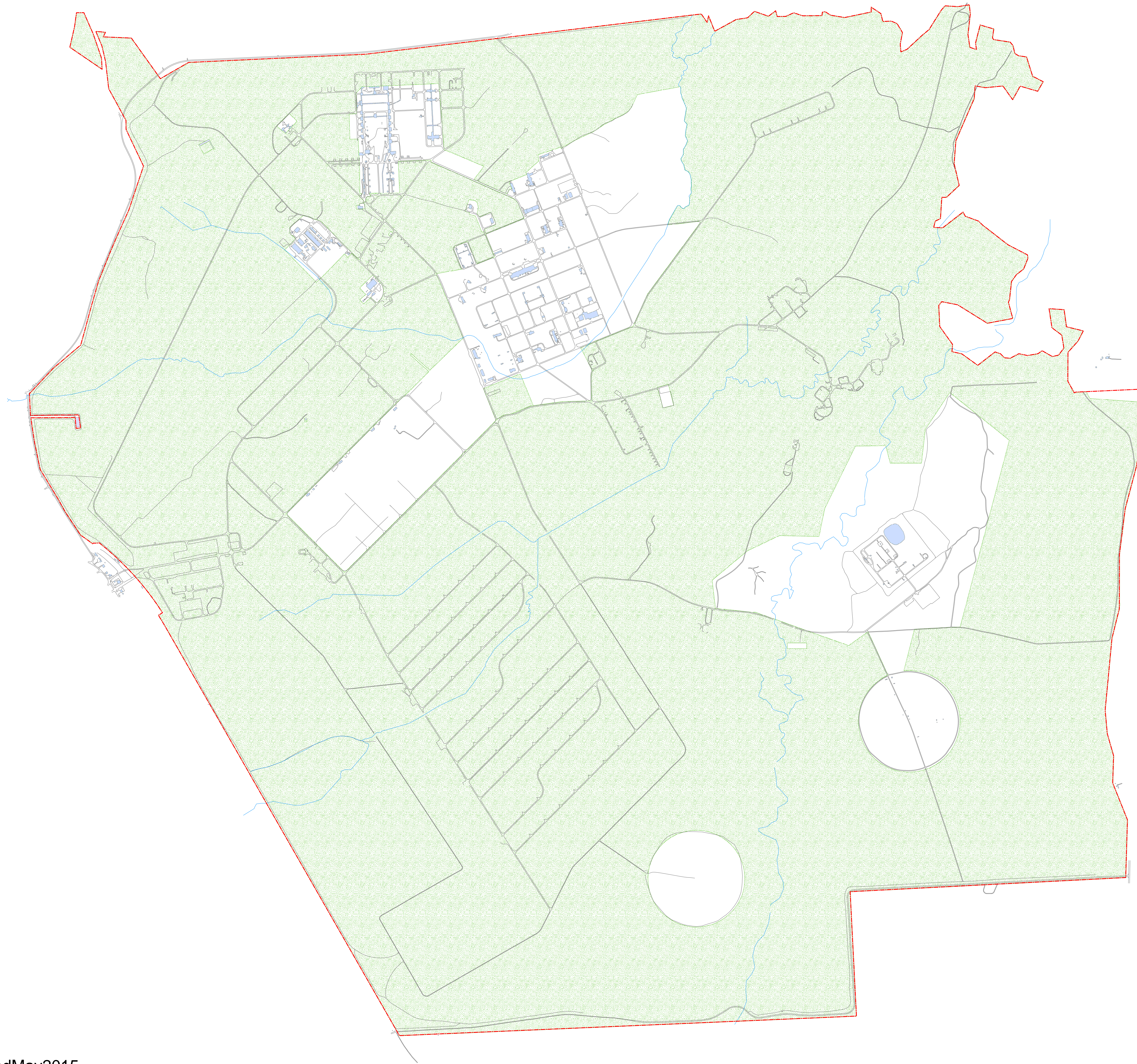
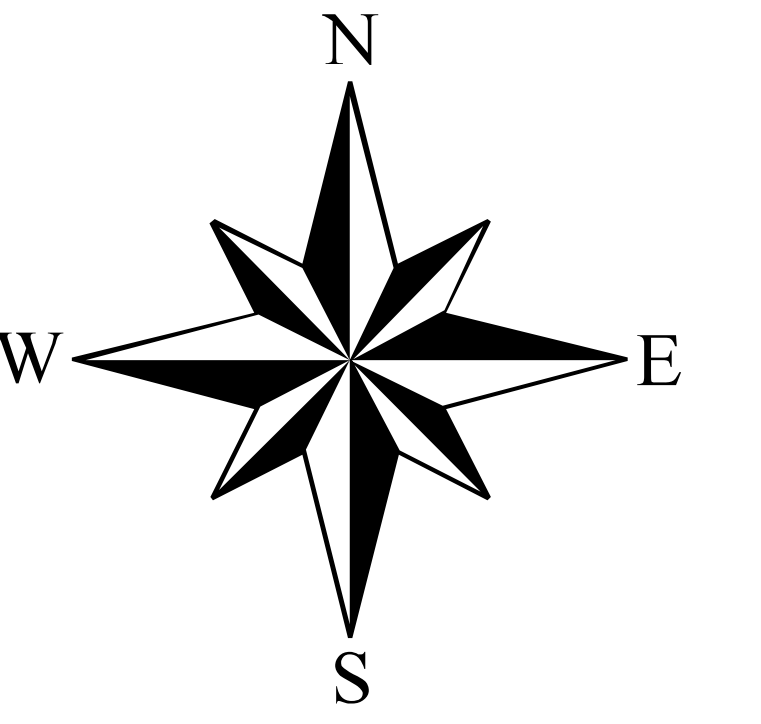
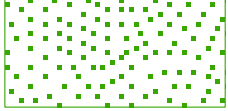



Figure 2-3
COC Plumes in Intermediate Groundwater
LHAAP-17
 Longhorn Army Ammunition Plant
 Karnack, Texas

**LONGHORN ARMY AMMUNITION PLANT
CADDO LAKE NATIONAL WILDLIFE REFUGE PROPERTIES
HARRISON COUNTY, TEXAS**



Legend

-  CLNWR Property_RevisedMay2015
-  LHAAP Surveyed Boundary from FWS

