Final

Remedial Design
LHAAP-50
Former Sump Water Tank, Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers – Tulsa District
1645 South 101st East Avenue
Tulsa, Oklahoma 74128

Prepared by Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Contract No. W912QR-04-D-0027, Task Order No. DS02
Project No. 117591
Rev 0
September 2011

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Shaw® Shaw Environmental, Inc.

Date: ***September 30, 2011***

Project No.:117591

TRANSMITTAL LETTER:

To: Mr. Aaron Williams

Address: US Army Corps of Engineers - Tulsa
CESWT-PP-M
1645 South 101st East Ave
Tulsa, Oklahoma 74128

Re: ***Final Remedial Design for LHAAP-50***
Contract No. W912QR-04-D-0027/DS02

For: Review x As Requested ____ Approval ____ Corrections ____ Submittal ____ Other ____

Item No:	***No. of Copies***	***Date:***	***Document Title***
1	2	September 2011	**Final Remedial Design LHAAP-50, Former Sump Water Tank, Group 4 Longhorn Army Ammunition Plant, Karnack, Texas**

Aaron– Enclosed are two copies of Shaw's final version of the above-named document. Copies have been distributed as indicated at the end of this message.

Please call with any questions or comments.

Sincerely:

For Praveen Srivastav
Project Manager

Distribution:
M. Plitnik, USAEC (1)
R. Zeiler, BRAC (1)
S. Tzhone, EPA (2)
F. Duke (2)/ D. Vodak, TCEQ (1)
P. Bruckwicki, FWS (1)

1401 Enclave Parkway, Suite 250, Houston, Texas 77077 ***Phone: (281) 531-3100/Fax: (281) 531-3136***

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

September 30, 2011

DAIM-ODB-LO

Mr. Stephen Tzhone
U.S. Environmental Protection Agency
Superfund Division (6SF-AT)
1445 Ross Avenue
Dallas, Texas 75202-2733

Re: Final Remedial Design, LHAAP-50, Former Sump Water Tank, Group 4, Longhorn Army Ammunition Plant, Karnack, Texas, September 2011

Dear Mr. Tzhone,

The above-referenced document is being transmitted to you in hard copy as follow-up to the electronic version sent earlier today. The document has been prepared by Shaw Environmental, Inc. (Shaw) on behalf of the Army as part of Shaw's performance based contract for the facility.

The point of contact for this action is the undersigned. I ask that Praveen Srivastav, Shaw's Project Manager be copied on any communications related to the project. I may be contacted at 479-635-0110, or by email at rose.zeiler@us.army.mil.

Sincerely,

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

Copies furnished:
F. Duke, TCEQ, Austin, TX
D. Vodak, TCEQ, Tyler, TX
P. Bruckwicki, Caddo Lake NWR, TX
J. Lambert, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
M. Plitnik, USAEC, San Antonio, TX
P. Srivastav, Shaw, Houston, TX (for project files)

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

September 30, 2011

DAIM-ODB-LO

Ms. Fay Duke (MC-136)
SSDAT/Superfund Section
Remediation Division
Texas Commission on Environmental Quality
12100 Park 35 Circle, Bldg D
Austin, Texas 78753

Re: Final Remedial Design, LHAAP-50, Former Sump Water Tank, Group 4
Longhorn Army Ammunition Plant, Karnack, Texas, September 2011

Dear Ms. Duke,

The above-referenced document is being transmitted to you in hard copy as follow-up to the electronic version sent earlier today. The document has been prepared by Shaw Environmental, Inc. (Shaw) on behalf of the Army as part of Shaw's performance based contract for the facility.

The point of contact for this action is the undersigned. I ask that Praveen Srivastav, Shaw's Project Manager be copied on any communications related to the project. I may be contacted at 479-635-0110, or by email at rose.zeiler@us.army.mil.

Sincerely,

Rose M. Zeiler

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

Copies furnished:
S. Tzhone, USEPA Region 6, Dallas, TX
D. Vodak, TCEQ, Tyler, TX
P. Bruckwicki, Caddo Lake NWR, TX
J. Lambert, USACE, Tulsa District, OK
A. Williams, USACE, Tulsa District, OK
M. Plitnik, USAEC, San Antonio, TX
P. Srivastav, Shaw, Houston, TX (for project files)

From: Tzhone.Stephen@epamail.epa.gov
Sent: Friday, September 30, 2011 4:54 PM
To: Zeiler, Rose Ms CIV USA OSA; Lambert, John R SWT; Williams, Aaron K SWT
Cc: Fay Duke; Srivastav, Praveen; Everett, Kay; Duffield, Robert; Watson, Susan; Sanchez.Carlos@epamail.epa.gov
Subject: Longhorn: EPA Approval of DF LHAAP-50 RD
Attachments: 09 11 Draft Final RD LHAAP-50.pdf

Hi Rose,

The EPA has reviewed the Draft Final Remedial Design for LHAAP-50 and has no further comments. Please proceed with finalization.

Thanks,

Stephen L. Tzhone
Superfund Remedial Project Manager
USEPA Region 6 (6SF-RA)
214.665.8409
tzhone.stephen@epa.gov

From: "Srivastav, Praveen" <Praveen.Srivastav@shawgrp.com>
To: Stephen Tzhone/R6/USEPA/US@EPA, Fay Duke <Fay.Duke@tceq.texas.gov>
Cc: "Williams, Aaron K SWT" <Aaron.K.Williams@usace.army.mil>, "Lambert, John R SWT" <John.R.Lambert@SWT03.usace.army.mil>, "Zeiler, Rose Ms CIV USA OSA" <rose.zeiler@us.army.mil>, "Watson, Susan" <Susan.Watson@shawgrp.com>, "Everett, Kay" <Kay.Everett@shawgrp.com>, "Suryanarayanan, Sowmya" <Sowmya.Suryanarayanan@shawgrp.com>
Date: 09/30/2011 04:30 PM
Subject: Draft Final LHAAP-50 RD

Steve/Fay:

The Draft Final Remedial Design for LHAAP-50 is attached. The file contains the main text and figures to keep the size of the file within manageable limits for e-mail. The files for the entire document are being uploaded to the Longhorn Stakeholder portal. We are also shipping out hard copies today.

Thank you,

Praveen Srivastav, PhD, PG, PMP
Project Manager
Federal Division/Project Management
Shaw Environmental & Infrastructure
1401 Enclave Parkway, Suite 250
Houston, TX 77077
281.531.3188 direct
281.639.8743 cell
praveen.srivastav@shawgrp.com

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Acronyms and Abbreviations

µg/L	micrograms per liter
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
bgs	below ground surface
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	constituents of concern
CQCP	Contractor Quality Control Plan
CQCSM	Contractor Quality Control System Manager
DCA	dichloroethane
DCE	dichloroethene
DHC	*Dehalococcoides* sp.
DO	dissolved oxygen
DPT	direct-push technology
ECP	Environmental Condition of Property
FS	Feasibility Study
GW-Ind	TCEQ groundwater MSC for industrial use
GWP-Ind	TCEQ soil MSC for industrial use based on groundwater protection
GW-Res	TCEQ groundwater MSC for residential use
GWTP	groundwater treatment plant
HASP	Health and Safety Plan
LHAAP	Longhorn Army Ammunition Plant
LTM	long-term monitoring
LUC	land use control
LUC O&M	land use control operations and maintenance
MARC	Multiple Award Remediation Contract
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
MSC	medium-specific concentration
NCP	National Contingency Plan
ORP	oxidation-reduction potential
PPE	personal protective equipment
QA	quality assurance
QC	quality control

Acronyms and Abbreviations *(continued)*

RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
ROD	Record of Decision
Shaw	Shaw Environmental, Inc.
STEP	Solutions to Environmental Problems, Inc.
TAC	Texas Administrative Code
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TOC	total organic carbon
U.S. Army	U.S. Department of the Army
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds

Contract No. W912QR-04-D-0027, Task Order No. DS02• Final • Rev 0 • September 2011

1.0 INTRODUCTION

Shaw Environmental, Inc. (Shaw) has been contracted by the U.S. Army Corps of Engineers (USACE) Tulsa District to complete the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response at LHAAP-50, Former Sump Water Tank, at the former Longhorn Army Ammunition Plant (LHAAP) near Karnack, Texas. This Remedial Design (RD) for LHAAP-50 is a part of the response. Subsequent work plans will be prepared to provide more details of the implementation of this RD (i.e., well installation details). This work is being performed under the Louisville District's Multiple Award Remediation Contract (MARC) No. W912QR-04-D-0027, Task Order DS02, with oversight by the USACE, Tulsa District.

1.1 Background

LHAAP is located in central-east Texas in the northeastern corner of Harrison County, approximately 14 miles northeast of Marshall, Texas (**Figure 1-1**). The facility occupies approximately 8,416 acres between State Highway 43 in Karnack, Texas, and the western shore of Caddo Lake. Caddo Lake is a large freshwater lake that bounds LHAAP to the north and east. The eastern fence of LHAAP is 3.5 miles from the Texas-Louisiana state border.

1.1.1 Description

LHAAP-50, known as the Former Sump Water Tank, is located in the north central portion of LHAAP and covers an area of approximately 1 acre (**Figure 1-2**). Historically, LHAAP-50 contained a 47,000-gallon aboveground storage tank (AST) which received industrial wastewater transported from various industrial waste production sumps throughout LHAAP from 1955 to 1988. Discharges from the storage tank were made upstream of the bridge on Crockett Avenue into Goose Prairie Creek. The AST has been removed.

LHAAP-50 is bound by Goose Prairie Creek to the north and by Crockett Avenue to the northeast. The northeast portion of LHAAP-50 is an open area of grass and brush that is bounded by South Crockett Avenue to the northeast. The southwestern half of the site is an area of heavy timber. The site is bounded by South Crockett Avenue to the northeast, a railroad spur to the south, drainage ditch to the west, and Goose Prairie Creek to the north. Two gravel access lanes connect LHAAP-50 to South Crockett Avenue. Runoff from the northeastern half of the site is generally toward the northeast. Runoff is collected by a drainage ditch to the northeast that runs parallel to South Crockett Avenue and eventually joins Goose Prairie Creek. Runoff from the remainder of the site is toward the north directly into Goose Prairie Creek. Runoff from the southwestern portion of the site is collected to the west by a drainage ditch that carries the runoff north into Goose Prairie Creek. Groundwater

flow direction is generally east toward Caddo Lake in both the shallow and intermediate zones, consistent with the flow direction at surrounding sites (**Figure 1-3** and **Figure 1-4**). The groundwater flow in the intermediate zone will be reevaluated after additional wells are installed as described in subsequent sections of this RD. The approximate depth of the shallow groundwater zone is 15 to 20 feet below ground surface (bgs) and the intermediate zone is approximately 55 feet bgs at LHAAP-50 (Shaw, 2009).

Several investigations were conducted at LHAAP-50 between 1995 and 2009. The investigations determined that groundwater at LHAAP-50 posed an unacceptable cancer risk and non-cancer hazard for hypothetical future maintenance workers under an industrial scenario. Though the soil did not pose a risk to human health or ecological receptors, it was contaminated with perchlorate at levels that could potentially migrate into the groundwater (Shaw, 2009). There have been no previous remedial actions at LHAAP-50.

The remedial action alternative to be implemented at LHAAP-50 was developed and selected in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Contingency Plan (40 Code of Federal Regulations Part 300). The selected remedy finalized in the Record of Decision (ROD) (U.S. Department of the Army [U.S. Army], 2010) was developed based on the assumption that the reasonably anticipated future land use will be industrial/recreational (e.g., national wildlife refuge). Land use notification will be recorded at the Harrison County courthouse to indicate that the property is suitable for nonresidential use. It is also assumed that this remedial action will be the final action at the site.

1.1.2 Remedial Action Objectives

A remedial action at LHAAP-50 must protect human health and meet applicable or relevant and appropriate requirements (ARARs). As noted in the Final Feasibility Study (FS) (Shaw, 2009), ecological risk is not an issue at LHAAP-50. Therefore, any proposed remedial action need not specifically address ecological risk except as it forms the basis of certain ARARs. The primary environmental issues that must be addressed at LHAAP-50 are:

- Groundwater that exceeds maximum contaminant levels (MCLs) for volatile organic compounds (VOCs) (perchloroethene, trichloroethene [TCE], 1,1,-dichloroethene [DCE], 1,2-dichloroethane (DCA), cis-1,2-DCE, and vinyl chloride).
- Groundwater that exceeds the medium-specific concentration (MSC) for industrial use for perchlorate and has the potential to adversely impact human health.
- Soil that has concentrations of perchlorate in excess of Texas Commission on Environmental Quality (TCEQ) soil MSC for industrial use based on groundwater

protection (GWP-Ind) and has the potential to continue to be a source of groundwater and surface water contamination.

The remedial action objectives (RAOs) for LHAAP-50, consistent with the reasonably anticipated future use as a national wildlife refuge, are as follows:

- Protection of human health by preventing human exposure to the contaminated groundwater;
- Protection of human health by preventing further potential degradation of groundwater and surface water from 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 (U.S. Army, 2010).

The above RAO recognizes the U.S. Environmental Protection Agency's (USEPA) policy to return all groundwater to beneficial uses based on the non-binding programmatic expectation in the National Contingency Plan (NCP). The RAO is also consistent with the NCP regulations requiring the lead agency, the U.S. Army, to establish RAOs specifying contaminants and media of concern, potential exposure pathways, and remediation goals.

1.1.3 Planned Remedial Action

The RAOs were the basis for formulating and evaluating removal alternatives and selecting a remedial action (U.S. Army, 2010). The U.S. Army will implement the following remedial actions at LHAAP-50:

Soil

- Excavation of perchlorate contaminated soil and off-site disposal of the soil at a Resource Conservation and Recovery Act (RCRA) Subtitle D-permitted landfill to eliminate the soil-to-groundwater pathway and soil-to-surface water pathway.

Groundwater

- **Land Use Control.** Land use control (LUC) in the impacted area will ensure the protection of human health by restricting the use of groundwater. The LUC will remain in place until the cleanup levels are met.
- **Monitored natural attenuation (MNA).** MNA is a passive treatment where contaminant concentrations decrease through natural attenuation processes such as biodegradation, dispersion, dilution, sorption, and volatilization (USEPA, 1998).

Data from performance monitoring is used to evaluate whether natural attenuation is occurring and reducing constituents of concern (COCs).

MNA will be implemented to verify that the TCE and perchlorate plumes are stable and will not migrate to nearby surface water at levels that may present an unacceptable risk to human health and the environment. MNA will return groundwater to its potential beneficial use, wherever practicable.

Performance objectives will be evaluated after two years of MNA. During those two years, groundwater monitoring will be performed quarterly. If MNA is found to be ineffective, a contingency remedy to enhance MNA will be implemented.

- **Long-Term Monitoring/Five-Year Reviews.** After MNA is evaluated for two years and verified to be effective, long-term monitoring (LTM) will begin at a semiannual frequency for three years. In subsequent years, LTM will be annual until the next five-year review. The LTM and reporting associated with this remedy will be used to track the effectiveness of MNA and will continue at least once every five years until cleanup levels are achieved. Based on preliminary calculated attenuation rates for LHAAP-50, groundwater cleanup levels are expected to be met through natural attenuation in 50 years. This time-frame will be re-evaluated as part of the MNA evaluation and periodic reviews.

1.2 Cleanup Levels

Soil: Remedial action at LHAAP-50 involves the removal of soil exceeding the cleanup level for perchlorate, and subsequent transport of these soils to an appropriate licensed off-site facility for disposal. Once confirmation sampling results meet the cleanup levels, the excavation area will be backfilled with clean soil and reseeded. **Table 1-1** presents the soil cleanup level at LHAAP-50.

Table 1-1
Soil Cleanup Level

Chemical	Concentration (mg/kg)	Basis
Perchlorate	7.2	GWP-Ind

Notes and Abbreviations:

mg/kg *milligrams per kilogram*
GWP Ind *Soil medium specific concentration for industrial use based on groundwater protection*

Groundwater: Cleanup levels were established to meet the RAOs as included in the ROD (U.S. Army, 2010). **Table 1-2** presents the groundwater cleanup levels for LHAAP-50.

Table 1-2
Groundwater Cleanup Levels

Chemical	Concentration (µg/L)	Basis
Perchlorate	72	GW-Ind
Trichloroethene	5	MCL
cis-1,2-dichloroethene (daughter product)	70	MCL
Vinyl Chloride (daughter product)	2	MCL
1,1- Dichloroethene	7	MCL
1,2-Dichloroethane	5	MCL
Tetrachloroethene	5	MCL

Notes and Abbreviations:

µg/L *micrograms per liter*
MCL *maximum contaminant level*
GW-Ind *groundwater medium-specific concentration for industrial use (there is no MCL for perchlorate.)*

Surface Water: Surface water could potentially be impacted with perchlorate from the soil or groundwater. Periodic sampling of surface water is performed in Goose Prairie Creek to assess this possibility. **Table 1-3** presents the surface water cleanup level at LHAAP-50.

Table 1-3
Surface Water Cleanup Level

Chemical	Concentration (µg/L)	Basis
Perchlorate	26	GW-Res

Notes and Abbreviations:

µg/L *micrograms per liter*
GW-Res *groundwater medium-specific concentration for residential use (there is no MCL for perchlorate)*

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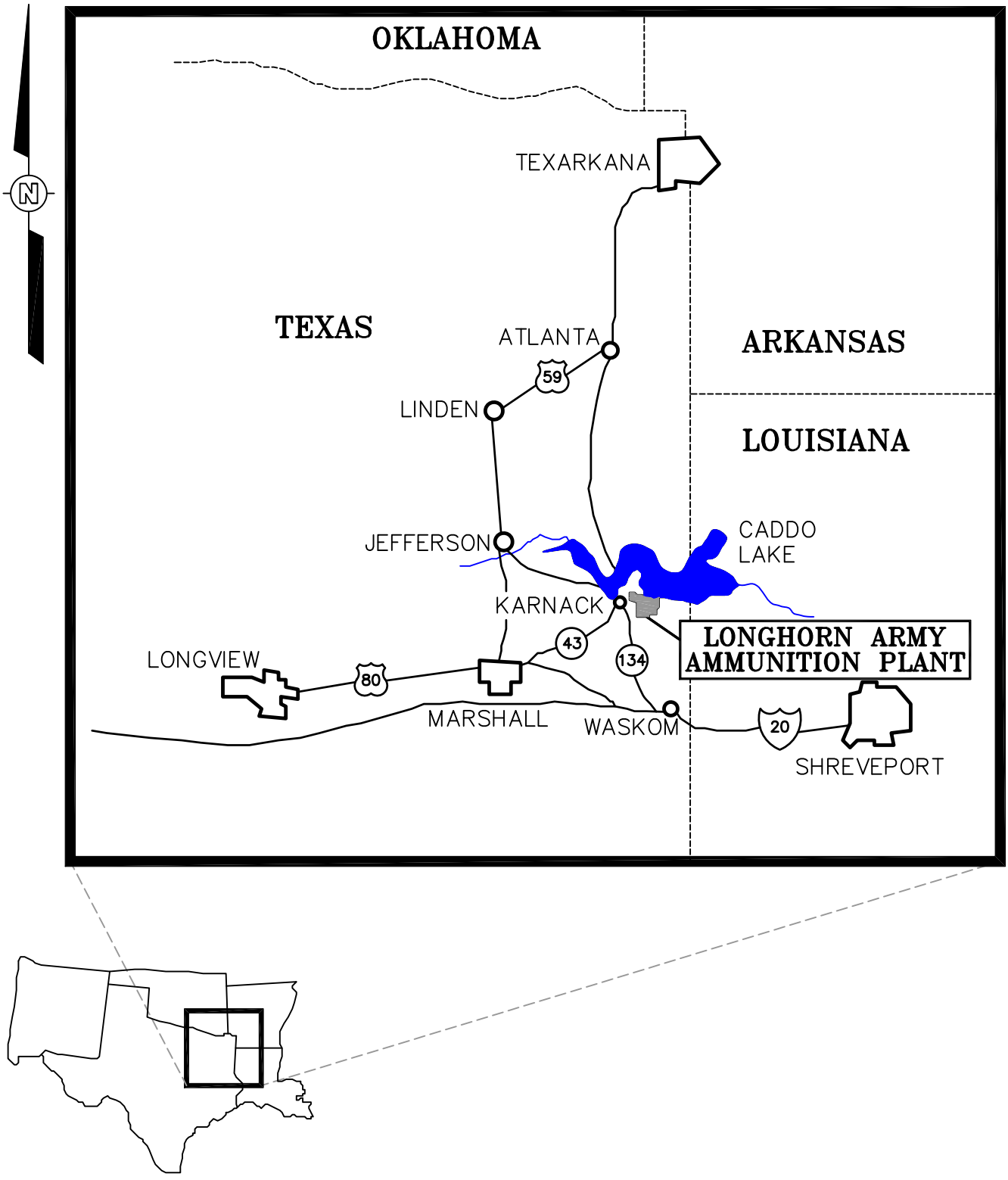

"DRAWING NOT TO SCALE"

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
---	---	Houston, Texas	L. JONES	12/17/03	G. JONES	10/07/09	P. SRIVASTAV	10/07/09	117591-A55

PLOT DATE: 10/07/09
FORMAT REVISION 3/25/99

Shaw

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 1-1

LHAAP LOCATION MAP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FILE PATH	T:\Divisions\Design\GIS\117591_LHAAP\Doc\Mxd\SiteVicinity.mxd
APPROVED BY	P. Srivastav 11/05/10
CHECKED BY	S. Survanarayanan 11/03/10
DRAWN BY	B. Muske 11/03/10
OFFICE	Houston, TX

N

Caddo Lake

LHAAP-46
LHAAP-47
LHAAP-02
LHAAP-35A(58)
LHAAP-60
LHAAP-35B(37)
LHAAP-50
LHAAP-08
LHAAP-67
LHAAP-48
LHAAP-35C(53)

LEGEND

- Stream
- Road
- Sites
- Lake
- LHAAP Boundary

0 1,200 2,400 4,800 Feet

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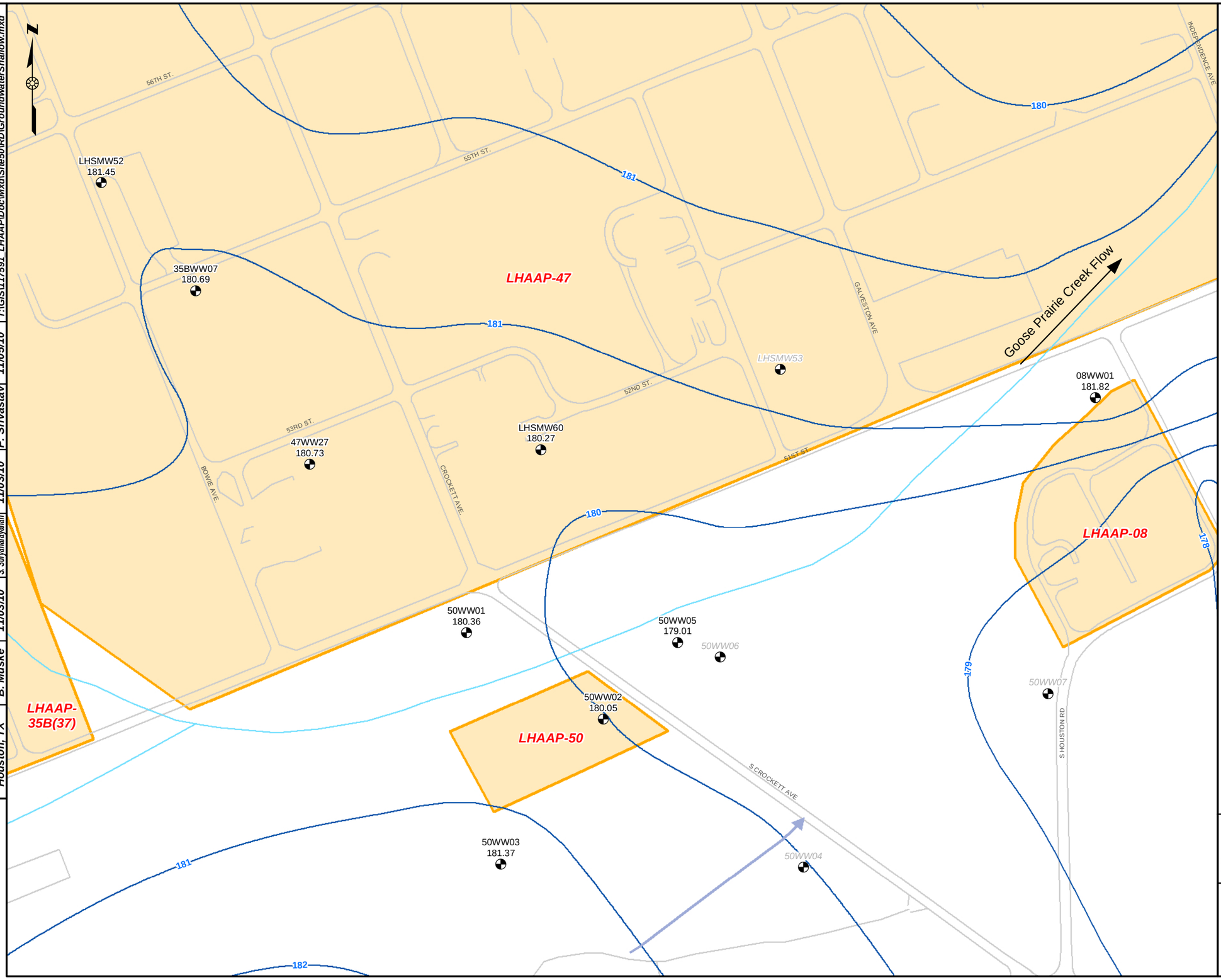
TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 1-2

SITE VICINITY MAP
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FILE PATH	T:\GIS\117591_LHAAP\Doc\Mxd\Site50RD\GroundwaterShallow.mxd
APPROVED BY	P. Srivastav 11/05/10
CHECKED BY	S. Suryanarayanan 11/03/10
DRAWN BY	B. Muske 11/03/10
OFFICE	Houston, TX



LEGEND

- Shallow Monitoring Well
- Shallow Groundwater Elevation Contour
- Groundwater Flow Direction
- Goose Prairie Creek Flow
- Stream
- Road
- Site

Note:

Groundwater contour elevations collected in November - December 2007 were reported in feet. 50WW07 was installed in 2008; the groundwater contours were not developed using data from this well.

0 95 190 380 Feet

Shaw

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

FIGURE 1-3
GROUNDWATER ELEVATION MAP
SHALLOW ZONE
LHAAP-50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FILE PATH	T:\GIS\117591_LHAAP\Doc\Mxd\Site50\RDI\Groundwater\Intermediate.mxd
APPROVED BY	S. Watson 11/05/10
CHECKED BY	S. Suryanarayanan 11/04/10
DRAWN BY	B. Muske 11/04/10
OFFICE	Houston, TX

35BWW06
182.62

35BWW03
178.36

LHAAP-35B(37)

LHAAP-47

47WW28

LHSMW60

LHSMW54
178.91

47WW23

LHAAP-08

50WW06

LHAAP-50

LHAAP-09

LHAAP-67

LHAAP-29

182

181

180

179

178

177

N

LEGEND

- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Inferred Groundwater Elevation Contour
- Stream
- Road
- Former Building or Concrete Slab
- Site

NOTE:

1. Groundwater elevations reported in feet above mean sea level based on data collected April 3, 2008.
2. Wells with elevations shown are used to generate contours.
3. 35BWW03 elevation was anomalous and not used.

0 150 300 600 Feet

Shaw

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

FIGURE 1-4

GROUNDWATER ELEVATION MAP
INTERMEDIATE ZONE
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

2.0 PRE-REMEDIATION ACTIVITIES IN AUGUST 2010

Additional field investigation activities in August 2010 included soil sampling to determine the excavation boundary and groundwater sampling. The soil boring logs, sample collection logs, analytical reports and tables of the August 2010 sampling event are included in **Appendix A**. Soil and groundwater sampling activities conducted at LHAAP-50 are described in sections below.

2.1 Soil Sampling

Soil samples were collected in August 2010 to better delineate contaminated soil areas. The results from the soil sampling event were used to refine the planned excavation boundaries at LHAAP-50.

Shaw collected soil samples from seven locations around STEP50SS01 and STEP50SS02 to determine excavation boundaries (**Figure 2-1**). Soil samples were collected from 0 to 1 foot bgs and 1 to 2 feet bgs and analyzed for perchlorate. Results at all seven locations indicated perchlorate concentrations below the GWP-Ind. The results for these locations are being used to establish the planned excavation boundary.

Shaw also advanced one boring to the vadose zone/groundwater interface at 50SB17 to verify that perchlorate concentrations in soil did not exceed GWP-Ind at a deeper interval. Although historic samples from this location did not exceed GWP-Ind, perchlorate concentrations increased slightly with increasing depths. Samples were collected from the three deeper intervals at the same location as existing soil boring 50SB17 to determine if perchlorate concentrations were increasing at deeper intervals. Samples were collected from 12 to 14 feet bgs, 14 to 16 feet bgs, and 16 to 18 feet bgs. Initially only the 12 to 14 feet bgs interval was analyzed. The deeper sample intervals (14 to 16 feet bgs, and 16 to 18 feet bgs) were placed on hold pending results of the 12 to 14 feet bgs interval. Perchlorate was not detected in the soil sample collected from the 12 to 14 feet bgs interval, so the deeper samples were not analyzed.

2.2 Groundwater Sampling

Monitoring wells 50WW01, 50WW02, 50WW03, 50WW04, 50WW05, 50WW06, and 50WW07 were sampled in August 2010. The wells were sampled for natural attenuation parameters, metals, perchlorate, semivolatile organic compounds, and VOCs. Six of these wells are located in the shallow zone, while well 50WW06 is located in the intermediate zone. Monitoring wells 50WW02, 50WW03 and 50WW04 were dry during the August 2010 sampling event. The groundwater sampling results for perchlorate and TCE are shown on **Figure 2-2**. Perchlorate was below the groundwater MSC for industrial use (GW-Ind) of

72 micrograms per liter (µg/L) in all wells sampled except intermediate well 50WW06. At 50WW06, perchlorate was observed at a concentration of 113 µg/L, which exceeds the GW-Ind. TCE was not detected or concentrations were below its MCL of 5 µg/L in all wells sampled except shallow well 50WW05, where TCE was observed at a concentration of 788 µg/L. The full analytical results from the sampling event in August 2010 are provided in **Appendix A**. In addition to the LHAAP-50 sampling, a new intermediate well, 47WW38, was installed at LHAAP-47 and high concentrations of perchlorate were detected (**Figure 2-2**) (Shaw, 2010). The cross section shown on **Figure 2-3** shows this new well. Additional cross sections are presented in the LHAAP-50 FS (Shaw, 2009) and the Remedial Investigation report (Jacobs, 2002).

2.3 Areas of Contamination

Soil

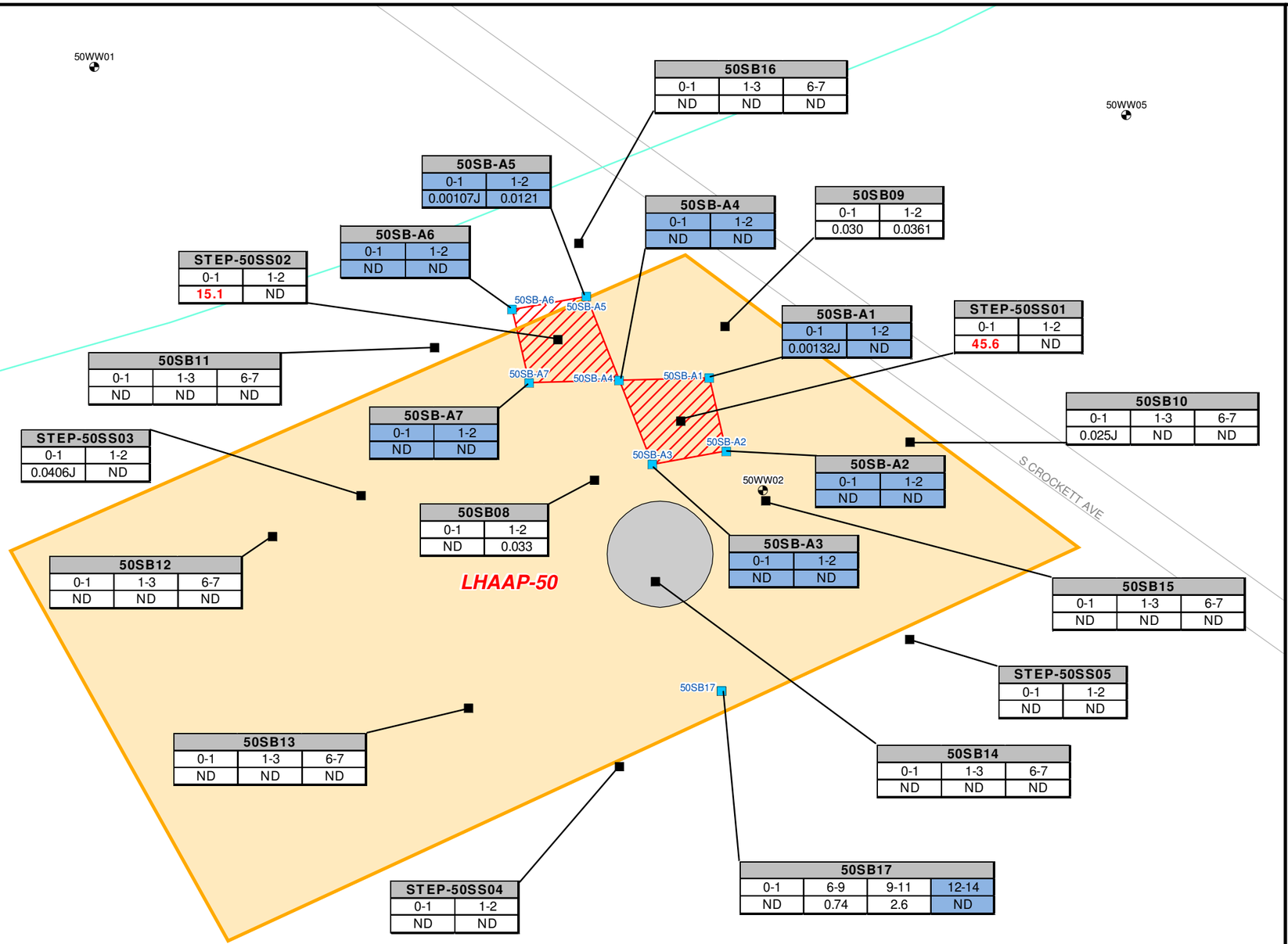
Perchlorate was detected in soil at LHAAP-50 near the location of the former AST. Though the soil at LHAAP-50 does not pose a risk to ecological receptors or human health, it is contaminated with perchlorate at levels that could potentially migrate into groundwater. Perchlorate was detected at a maximum concentration of 45.6 milligrams per kilogram (mg/kg) in the surface soil between 0 to 0.5 feet (Solutions to Environmental Problems, Inc. [STEP], 2005). **Figure 2-1** shows the area where perchlorate was detected above the cleanup level of 7.2 mg/kg at 0 to 0.5 feet bgs. The estimated volume of contaminated soil to be removed, based on a 1-foot-deep excavation, is approximately 4,000 cubic feet or 150 cubic yards.

Groundwater

Based on available sampling data, the groundwater at LHAAP-50 has been identified as a medium of concern due to the presence of TCE and perchlorate at concentrations exceeding the MCL of 5 µg/L and GW-Ind of 72 µg/L, respectively. The shallow groundwater contaminated with TCE and perchlorate is shown on **Figures 2-4** and **2-5**. Assuming 25 percent porosity, the total volume of TCE and perchlorate contaminated groundwater in the shallow zone is estimated to be approximately 5.5 million gallons (Shaw, 2009).

VOCs and perchlorate concentrations were below cleanup levels at intermediate zone monitoring well 50WW06 in years 2005 and 2007. The most recent sampling event in August 2010 shows perchlorate at 113 µg/L (above the GW-Ind of 72 µg/L) at 50WW06. Additional monitoring wells were installed in the intermediate zone to the north of 50WW06 as part of the investigations at LHAAP-47 in August 2010, and high perchlorate concentrations were detected at LHAAP-47 as shown on **Figure 2-6**. However, based on the existing data, the source of contamination in the intermediate zone remains undetermined; the perchlorate may be attributed to a source at LHAAP-47 or at LHAAP-50. This

LHAAP-50 RD will include the installation of seven new monitoring wells in the intermediate zone well to determine if the perchlorate plumes at LHAAP-47 and LHAAP-50 in the intermediate zone are comingled.



LEGEND

- Soil Sample Location, August 2010

Historical Sample Locations

- Shallow Monitoring Well
- Intermediate Monitoring Well
- Existing Soil Sample Location
- Goose Prarie Creek
- Road
- Former Storage Tank Location
- Proposed Excavation Area
- Building or Concrete Slab
- Site

Notes:

1. Perchlorate concentrations are reported in milligrams per kilogram (mg/kg).
2. Soil sample locations where perchlorate was not analyzed are not shown on the figure.
3. Results from August 2010 are shaded in blue.
4. Results prior to August 2010 were obtained from investigations in 2003 by "Solutions to Environmental Problems Inc." and in 2007 by SHAW Environmental Inc.
5. Red - Perchlorate concentration above GWP - Ind (7.2 mg/kg).
6. Initial excavation depth is anticipated to be one foot.

0 25 50 100 Feet

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TULSA, OKLAHOMA

FIGURE 2-1

PERCHLORATE IN SOIL, AUGUST 2010
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	FILE PATH
Houston, TX	B. Muske 11/04/10	S. Suryanarayanan 11/04/10	S. Watson 11/04/10	T:\GIS\117591_LHAAP\Doc\Mxd\Site50\RD\PerchlorateInSoil.mxd

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APPROVED BY	P. Srivastav 6/16/2011
CHECKED BY	R. Duffield 6/16/2011
DRAWN BY	B. Grod 6/16/2011
OFFICE	Houston, TX

N

55TH ST.

47WW26

53RD ST.

52ND ST.

51ST ST.

GALVESTON AVE

LHAAP-47

LHSMW53

08WW01

08WW02

LHAAP-08

S HOUSTON RD

47WW27

CROCKETT AVE

BOWIE AVE

47WW38	
Perchlorate	4,110
TCE	0.565 J

LHSMW60	
Perchlorate	56,600
TCE	0.25 U

A

A'

50WW05	
Perchlorate	0.189 J
TCE	788

50WW01	
Perchlorate	0.158 J
TCE	0.25 U

Flow

Goose Prairie Creek

FORMER
TANK LOCATION

LHAAP-50

50WW06	
Perchlorate	113
TCE	3.33

50WW07	
Perchlorate	0.262
TCE	0.25 U

50WW02	
Perchlorate	*Dry*
TCE	*Dry*

S CROCKETT AVE

50WW03	
Perchlorate	*Dry*
TCE	*Dry*

50WW04	
Perchlorate	*Dry*
TCE	*Dry*

48TH ST.

LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Cross Section (A)
- Stream
- Road
- Site

Notes:

1. Perchlorate and trichloroethene concentrations are measured in micrograms per liter (µg/L).
2. 113 - Contaminant concentrations above the clean-up levels as follows:

   Perchlorate - 72 µg/L
   (medium specific concentration for industrial use)

   Trichloroethene (TCE)- 5 µg/L
   (maximum contaminant level)

0 75 150 300 Feet

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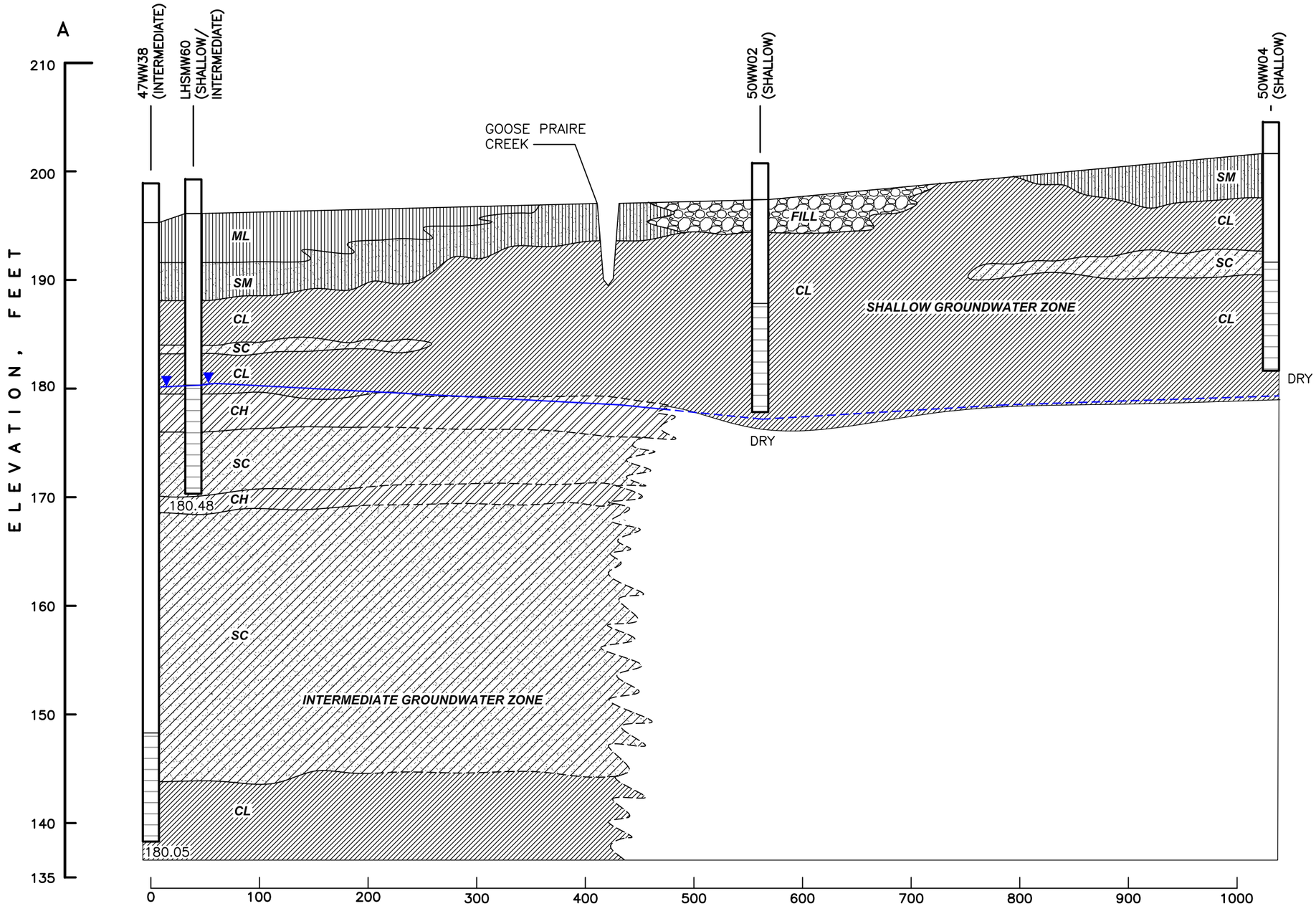
TULSA DISTRICT
TULSA, OKLAHOMA

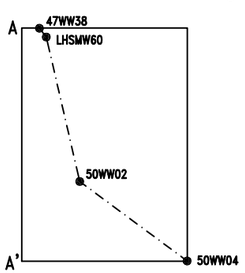
FIGURE 2-2

TCE AND PERCHLORATE CONCENTRATIONS IN GROUNDWATER, AUGUST 2010
LHAAP-50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Knoxville, TN	S. MCCAWLEY 08/09/11	K. EVERETT 08/09/11	S. WATSON 08/09/11	117591-B21

PLOT DATE: 04/21/11
FORMAT REVISION 3/25/99





LEGEND:

- CLAY (CL)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVEL SAND FILL (FILL)
- SCREEN
- INORGANIC SILTS (ML)
- FAT CLAY (CH)
- GROUNDWATER ELEVATION (AUG–SEPT 2010)
- 180.05 GROUNDWATER ELEVATION

SECTION A–A'

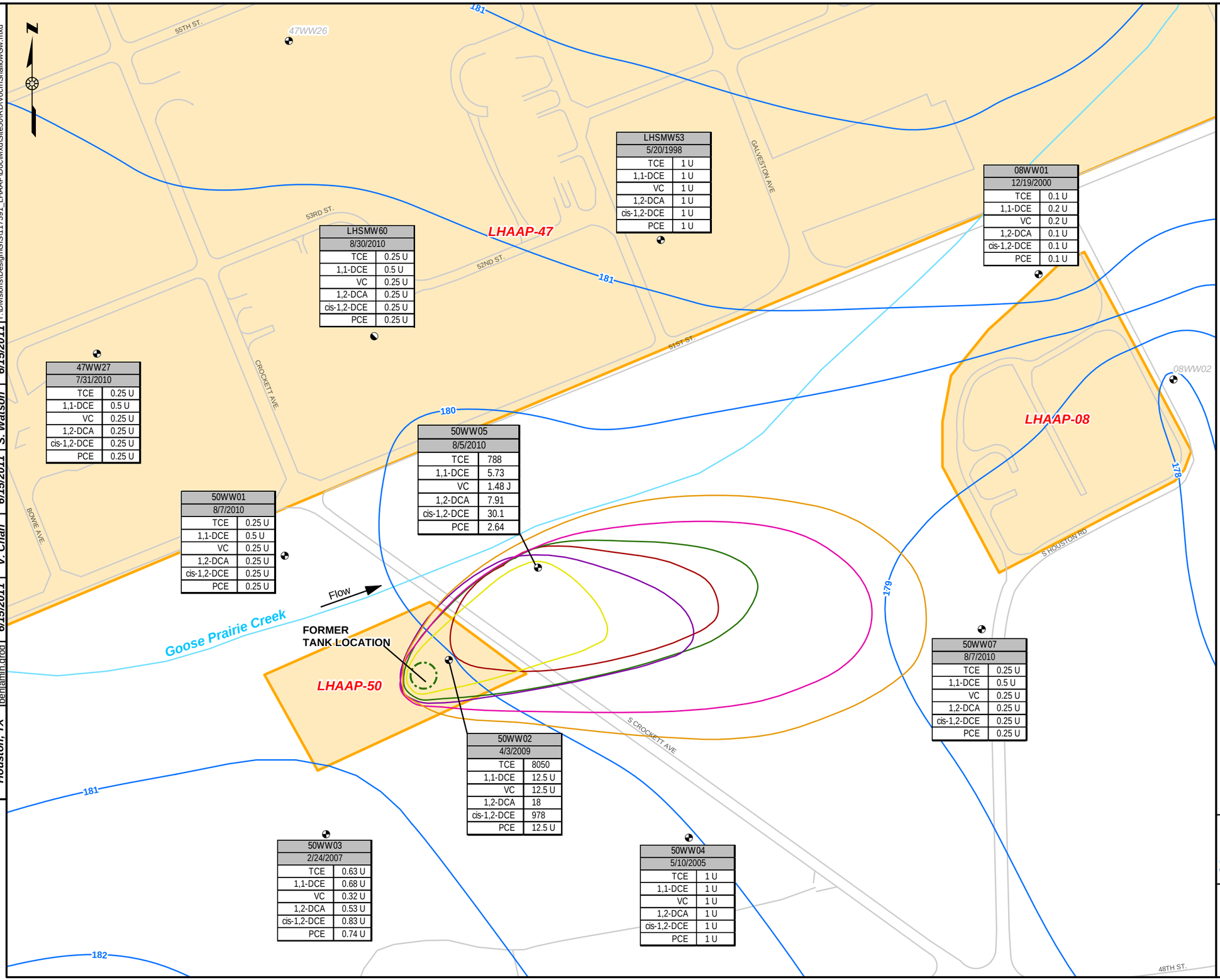
VERTICAL SCALE
0 10 20 30 FEET

HORIZONTAL SCALE
0 100 200 300 FEET

U.S. ARMY CORPS OF ENGINEERS

FIGURE 2–3
CROSS SECTION A–A'
LHAAP–50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FILE PATH	T:\Divisions\Design\GIS\117591_LHAAP\Doc\Mxd\Site50\RD\VocInShallowGw.mxd
APPROVED BY	S. Watson 6/15/2011
CHECKED BY	V. Chan 6/15/2011
DRAWN BY	benjamin.grod 6/15/2011
OFFICE	Houston, TX



LHSMW53	
5/20/1998	
TCE	1 U
1,1-DCE	1 U
VC	1 U
1,2-DCA	1 U
cis-1,2-DCE	1 U
PCE	1 U

LHSMW60	
8/30/2010	
TCE	0.25 U
1,1-DCE	0.5 U
VC	0.25 U
1,2-DCA	0.25 U
cis-1,2-DCE	0.25 U
PCE	0.25 U

08WW01	
12/19/2000	
TCE	0.1 U
1,1-DCE	0.2 U
VC	0.2 U
1,2-DCA	0.1 U
cis-1,2-DCE	0.1 U
PCE	0.1 U

47WW27	
7/31/2010	
TCE	0.25 U
1,1-DCE	0.5 U
VC	0.25 U
1,2-DCA	0.25 U
cis-1,2-DCE	0.25 U
PCE	0.25 U

50WW05	
8/5/2010	
TCE	788
1,1-DCE	5.73
VC	1.48 J
1,2-DCA	7.91
cis-1,2-DCE	30.1
PCE	2.64

50WW01	
8/7/2010	
TCE	0.25 U
1,1-DCE	0.5 U
VC	0.25 U
1,2-DCA	0.25 U
cis-1,2-DCE	0.25 U
PCE	0.25 U

50WW07	
8/7/2010	
TCE	0.25 U
1,1-DCE	0.5 U
VC	0.25 U
1,2-DCA	0.25 U
cis-1,2-DCE	0.25 U
PCE	0.25 U

50WW02	
4/3/2009	
TCE	8050
1,1-DCE	12.5 U
VC	12.5 U
1,2-DCA	18
cis-1,2-DCE	978
PCE	12.5 U

50WW03	
2/24/2007	
TCE	0.63 U
1,1-DCE	0.68 U
VC	0.32 U
1,2-DCA	0.53 U
cis-1,2-DCE	0.83 U
PCE	0.74 U

50WW04	
5/10/2005	
TCE	1 U
1,1-DCE	1 U
VC	1 U
1,2-DCA	1 U
cis-1,2-DCE	1 U
PCE	1 U

LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- 1,1-DCE Plume (7 µg/L Extent)
- 1,2-DCA Plume (5 µg/L Extent)
- PCE Plume (5 µg/L Extent)
- TCE Plume (5 µg/L Extent)
- VC Plume (2 µg/L Extent)
- cis-1,2-DCE Plume (70 µg/L Extent)
- Groundwater Elevation Contour
- Stream
- Road
- Site

Notes:

1. Groundwater contour elevations collected in November - December 2007 were reported in feet.
2. COC concentrations were reported in micrograms per liter (µg/L).
3. Concentrations based on the latest data collected at each well.
4. TCE - Trichloroethene
   DCE - Dichloroethene
   VC - Vinyl chloride
   PCE - Tetrachloroethene
   DCA - Dichloroethane
5. Wells 50WW02, 50WW03, 50WW04, and LHSMW53 were dry in August 2010.
6. Plume extent based on maximum contaminant limit.

0 80 160 320 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 2-4
EXTENT OF VOCS IN SHALLOW GROUNDWATER
LHAAP-50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	FILE PATH
Houston, TX	B. Grod 6/15/2011	R. Duffield 6/15/2011	P. Srivastav 6/15/2011	T:\Divisions\Design\GIS\117591_LHAAP\Doc\Mxd\Site50\RD\PerchlorateInShallowGw.mxd

47WW26
12/20/2000
1.78

55TH ST.

53RD ST.

52ND ST.

51ST ST.

GALVESTON AVE.

CROCKETT AVE.

BOWIE AVE.

LHAAP-47

LHAAP-08

LHAAP-50

LHSMW53
9/23/2002
29 U

LHSMW60
8/30/2010
56600

47WW27
7/31/2010
168

47DPT13
8/20/2010
1.09

08WW01
5/12/2005
1 U

GPSAS08-1

GPSAS08-2

08WW02

181

180

179

178

GPSAS50-3
6/8/2001
9800

50WW01
8/7/2010
0.158 J

50WW05
8/5/2010
0.189 J

STEP-50DW03

STEP-50DW01
3/15/2002
4 U

Flow

Goose Prairie Creek

GPSAS50-1
6/8/2001
4 <

STEP-50DW02
3/15/2002
63600

STEP-50DW05
3/15/2002
4 U

FORMER
TANK LOCATION

GPSAS50-2
6/8/2001
150000

50WW02
2/23/2007
532

STEP-50DW04
3/15/2002
106

STEP-50DW06
3/15/2002
4 U

S CROCKETT AVE

S HOUSTON RD

50WW07
8/7/2010
0.262

50WW03
2/24/2007
4 U

50WW04
5/10/2005
5 U

182

48TH ST.

LEGEND

- DPT and Geoprobe Sample Location
- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Temporary Well
- Perchlorate Plume (72 µg/L Extent)
- Groundwater Elevation Contour
- Stream
- Road
- Site

Notes:

1. Groundwater contour elevations collected in November - December 2007 were reported in feet.
2. COC concentrations were reported in micrograms per liter (µg/L).
3. Concentrations based on the latest data collected at each well.
4. Perchlorate north of Goose Prairie Creek has a seperate source at LHAAP-47.
5. Plume extent based on the groundwater medium-specific concentration for industrial use which is 72 µg/L.

0 75 150 300
Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 2-5
EXTENT OF PERCHLORATE IN SHALLOW GROUNDWATER
LHAAP-50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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Houston, TX	benjamin.grod	6/15/2011	V. Chan	6/15/2011	S. Watson	6/15/2011

LHAAP-46
LHAAP-51
LHAAP-06
LHAAP-07
LHAAP-47
LHAAP-48
LHAAP-35B(37)
LHAAP-35C(53)
LHAAP-08
LHAAP-50
LHAAP-29
LHAAP-09
LHAAP-67

LHSMW38
LHSMW41
LHSMW54 8/6/2010 0.1 U
35BWW06
35BWW03

47WW31 9/2/2004 1 U
47WW06 9/1/2004 1 U
47WW29 7/31/2010 0.1 U
47WW09 8/3/2010 0.1 U
47WW14 8/4/2010 0.1 U
47WW37 9/1/2010 6.42
47WW19 9/22/2002 1.45 U
47WW34 8/3/2010 0.1 U
47WW23 8/6/2010 0.1 U
47WW38 9/1/2010 4110
50WW06 8/7/2010 113
67WW06 8/6/2010 0.1 U
48WW01 5/12/2005 0.5 U

47WW33
47WW32
47WW35
47WW36

179
180
181
182
178
177
176
175
174
173
172
171

N

LEGEND

- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Perchlorate Exceeding GW-Ind (72 µg/L)
- Groundwater Elevation Contour
- Stream
- Road
- Former Building or Concrete Slab
- Site

NOTES:

1. Perchlorate Plume at LHAAP-50 may be comingled with LHAAP-47 perchlorate plume.
2. Plume extent based on the groundwater medium-specific concentration for industrial use which is 72 µg/L.

0 300 600 1,200 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 2-6

EXTENT OF PERCHLORATE CONTAMINATION IN INTERMEDIATE GROUNDWATER
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

3.0 LAND USE CONTROL

The objective of LUC at LHAAP-50 is to prevent human exposure to residual groundwater contamination presenting an unacceptable risk to human health and ensure that there is no withdrawal or use of groundwater beneath the sites for anything other than environmental monitoring and testing until cleanup levels are met. Notification of the groundwater use restriction will accompany all transfer documents and will be recorded at the Harrison County Courthouse in accordance with Texas Administrative Code (TAC) Title 30, §335.566. **Appendix B** provides sample LUC compliance certification documentation.

The LUC addresses the area of LHAAP-50 that has groundwater plumes (in both the shallow and intermediate groundwater zones) with levels of contamination that require implementation of a remedy (see **Section 2.3**). The groundwater restriction LUC would be maintained until the concentration of contaminants and by-product contaminants have been reduced to below their respective cleanup levels.

The U.S. Army and regulators will consult to determine appropriate enforcement actions should there be a failure of an LUC objective at this site after it has transferred. The U.S. Army shall obtain USEPA and TCEQ concurrence prior to termination or significant modification of the LUC, or implementation of a change in land use inconsistent with the LUC objectives and use assumptions of the remedy. Although not a remedy, the land use assumption for LHAAP-50 forms the basis for the remedy. The future use of the site as part of a national wildlife refuge is consistent with an industrial risk exposure scenario. Notification of the land use assumption of this site will be made in transfer documentation and will be recorded in the Harrison County Courthouse in accordance with TAC Title 30, §335.566. Compliance with the use assumption will be documented in the five-year review reports.

Contract No. W912QR-04-D-0027, Task Order No. DS02• Final • Rev 0 • September 2011

4.0 EXCAVATION DESIGN

The elements of the excavation are provided in the following sections. The details of the implementation of the design will be submitted in a separate work plan.

4.1 Excavation Area

The proposed excavation area is shown in **Figure 2-1**. Total volume of contaminated soils to be excavated at LHAAP-50 is estimated to be 150 cubic yards. A 1-foot-deep excavation within a 4,000 square feet area has been proposed. Soil samples in August 2010 did not exceed the GWP-Ind for perchlorate and were used to refine the extent of excavation required (**Section 2.1**). If soil confirmation samples below the 1-foot depth are found to exceed the GWP-Ind for perchlorate, the area will be excavated further and additional confirmation samples will be collected (Shaw, 2009).

A 5-point composite soil sample will be collected from approximately every 750 square feet of the excavation floor area and of each wall. Since the planned excavation limits will extend to the clean samples collected in August 2010, these samples will be considered representative of wall confirmation samples. Additional wall samples will not be collected unless the depth of excavation is extended beyond 1 foot. Confirmation samples will be collected from the floor after excavation is complete. Based on the current excavation area (as shown in **Figure 2-1**), six composite soil samples will initially be collected for confirmation. If the confirmation results exceed cleanup levels, additional excavation and confirmation sampling will be implemented in accordance with **Section 6.5**.

4.2 Surface Water Monitoring

To ensure that soil at LHAAP-50 is not contaminating nearby surface water, -quarterly monitoring of Goose Prairie adjacent to LHAAP-50 for a minimum of eight quarters will be conducted at two locations after excavation (**Figure 4-1**). A new surface water sampling location (GPW-1A) will be added northwest of GPW-1 to monitor for contaminant contributions from runoff from the perchlorate-contaminated portion of LHAAP-47. This new sampling location will be located in a ditch at the upgradient end of a culvert in LHAAP-47. Evaluation of this data will be included in the annual reports to verify that the RAOs are achieved (e.g., to prevent further potential degradation of surface water from contaminated soil and preventing contaminated groundwater from migrating into nearby surface water). The frequency and location of sampling may be modified after evaluation of data. If perchlorate levels in the creek are consistently above TCEQ groundwater MSC for residential use (GW-Res) after two years of monitoring, then additional evaluation will be conducted and any proposed actions will be included in the annual evaluation report to be

submitted after Year 2. The need to continue creek sampling will be evaluated during the five-year reviews.

FILE PATH	
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APPROVED BY	
S. Watson	9/22/2011

CHECKED BY	
V. Chan	9/22/2011

DRAWN BY	
bryan.l.muske	9/22/2011

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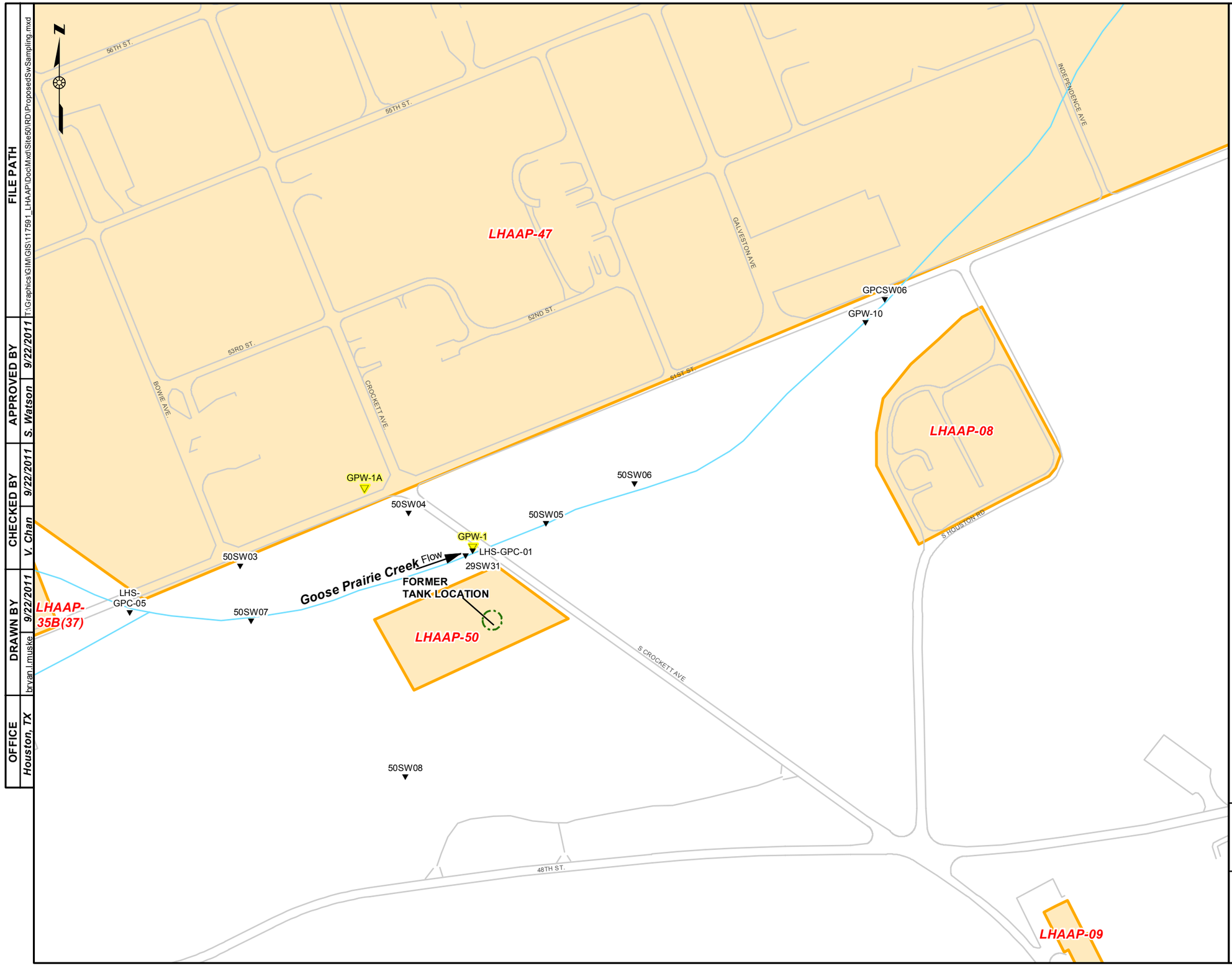
Houston, TX



LEGEND

- Existing Suface Water Sample Location
- Proposed Surface Water Sample Location
- Stream
- Road
- Site

Note:

GPW-1A is located at the culvert on the north side of the road to evaluate contributions from LHAAP-47. The water from this culvert flows into Goose Prairie Creek near LHAAP-50.

0 100 200 400 Feet

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

FIGURE 4-1

SURFACE WATER SAMPLING LOCATIONS
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

5.0 MONITORING SYSTEM DESIGN

As part of the remedy, monitoring will be conducted of the groundwater and surface water. This design presents the elements of MNA remedy for the shallow zone and the rationale for addition of new wells and monitoring in the intermediate and deep zone. A more detailed groundwater monitoring plan will be submitted under separate cover to evaluate and monitor groundwater in both the shallow and intermediate plumes, and the surface water to evaluate any potential migration of groundwater to surface water. Generally the MNA performance monitoring network will be designed to provide at least two wells along the axis inside the plume boundary to evaluate MNA effectiveness; four wells to evaluate lateral plume expansion; and at least one well to evaluate vertical migration. This section discusses the rationale of MNA performance monitoring program designed to meet the following objectives:

Objectives for Performance Monitoring of MNA (USEPA, 1999)

1) Demonstrate that natural attenuation is occurring.

2) Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or other changes) that may reduce the efficacy of any of the natural attenuation processes.

3) Identify any potentially toxic and/or mobile transformation products.

4) Verify that the plume(s) is/are not expanding downgradient, laterally, or vertically.

5) Verify no unacceptable impact to downgradient receptors.

6) Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy.

7) Verify attainment of remediation objectives.

5.1 Monitoring Performance Monitoring Well Locations

In November 2007 a full set of groundwater elevation readings were collected of the entire northern area of LHAAP including LHAAP-50. Each existing well completion was evaluated and wells were assigned to a shallow or intermediate zone. The coordinates and well information is located in **Table 5-1**. Based on these designations, the groundwater contamination is located in the shallow and intermediate zones at LHAAP-50. However, the

source of contamination in the intermediate zone remains undetermined; the perchlorate source may be attributed to a source at LHAAP-47 or the perchlorate at LHAAP-50.

5.1.1 Shallow Groundwater Plume and Additional Soil Sampling

The site hydrogeology is important when designing a monitoring system. The site groundwater flow and cross sections have been presented in the LHAAP-50 FS. The shallow groundwater elevations are approximately 7 to 20 feet bgs, and the most recent readings are 14 to 19 feet bgs. Generally the groundwater flow is in a northeasterly direction as documented in groundwater flow assessments. Groundwater elevation readings collected in November 2007, are presented on **Figure 1-3** and **Figure 1-4**. The current shallow zone wells are completed in the sand interval that is approximately 8 to 28 feet bgs.

The shallow zone perchlorate plume currently has one well within the plume boundary whereas the VOC plume has two wells within the plume boundary. Also, 50WW02, the monitoring well close to the source area, 50WW03 and 50WW04 were dry in the August 2010 sampling event. The shallow zone perchlorate and VOC plume are bounded; however, the exact shape and boundary of the plume may be different than depicted. A direct-push rig will be used to further delineate the edges of the plume, especially the eastern edge, as well as optimize the selection of monitoring well locations within and outside the edge of the plume. Grab samples will be collected using well points and analyzed for VOCs and perchlorate as shown on **Figure 5-1**. Based on these results, additional locations may be selected for optimal locations of the performance monitoring wells. If 50WW02 continues to be dry, a new well will be installed in the shallow/intermediate zone close to the existing location. **Figure 5-2** indicates possible locations for fourteen additional wells based on the current data. Use of existing wells will be maximized as they provide historic data that can be used in the MNA evaluation. **Table 5-2** provides the rationale for the selection of wells in the proposed monitoring well system for the shallow zone as shown on **Figure 5-2**.

As part of the direct-push activities, soil samples will be collected from 50DPT03 at various depths above the groundwater interface and analyzed for perchlorate. This additional soil sampling is to address TCEQ's concerns that the soil across the street from the site, in the vicinity of STEP-50DW02 and GPSAS50-2, may be a source of perchlorate. High groundwater results for perchlorate were observed at STEP-50DW02 and GPSAS50-2.

5.1.2 Intermediate Groundwater Plume

The site hydrogeology is important when designing a monitoring system. The intermediate groundwater elevations are approximately 9 to 13 ft bgs, and the most recent reading is 12.65 feet bgs. Generally, the groundwater flows in a northeasterly direction as documented in groundwater flow assessments. The current intermediate zone wells are completed in the sand interval that is approximately 40 to 55 feet bgs.

The intermediate zone plume has one LHAAP-50 well within the plume. The October 2008 sampling event indicated perchlorate concentrations at 50WW06 above the GW-Ind of 72 µg/L. New monitoring wells will be installed and sampled to determine the source of the perchlorate contamination and delineate the edges of the plume. Two wells will be installed within the plume and five more wells will be installed outside the plume in the intermediate zone. One monitoring well (part of a well cluster) will be installed in the deep zone to ensure that groundwater from the shallow/intermediate zone is not contaminating the deep zone. The samples will be analyzed for VOCs and perchlorate. **Figure 5-3** indicates possible locations of eight monitoring wells in both the intermediate and deep zone based on the current data. Use of existing wells will be maximized as they provide historic data that can be used in the MNA evaluation. **Table 5-3** provides the rationale for the selection of wells in the proposed monitoring well system for the intermediate zone as shown on **Figure 5-3**. Additional sampling of these wells will be conducted to gather data to evaluate a remedy.

Contract No. W912QR-04-D-0027, Task Order No. DS02• Final • Rev 0 • September 2011

Table 5-1
Monitoring Wells to be Sampled at LHAAP-50

Well	Groundwater Zone	Approximate depth [a] (ft bgs)	Location		Ground Elevation (ft MSL)	Top of Casing (ft MSL)
			Northing	Easting		
50WW02	Shallow	19	6957436.64	3309569.44	197.40	200.74
50WW03	Shallow	20	6957162.82	3309376.1	199.88	202.94
50WW04	Shallow	20	6957156.94	3309947.41	201.64	204.51
50WW05	Shallow	22	6957581.45	3309709.69	195.34	197.68
50WW07	Shallow	29	6957484.78	3310408.51	199.88	202.55
A1	Shallow	TBD	TBD	TBD	TBD	TBD
B	Shallow	TBD	TBD	TBD	TBD	TBD
C	Shallow	TBD	TBD	TBD	TBD	TBD
D1 (part of a well cluster)	Shallow	TBD	TBD	TBD	TBD	TBD
E	Shallow	TBD	TBD	TBD	TBD	TBD
F	Shallow	TBD	TBD	TBD	TBD	TBD
G	Shallow	TBD	TBD	TBD	TBD	TBD
H	Shallow	TBD	TBD	TBD	TBD	TBD
I	Shallow	TBD	TBD	TBD	TBD	TBD
J	Shallow	TBD	TBD	TBD	TBD	TBD
K	Shallow	TBD	TBD	TBD	TBD	TBD
L	Shallow	TBD	TBD	TBD	TBD	TBD
M	Shallow	TBD	TBD	TBD	TBD	TBD
N	Shallow	TBD	TBD	TBD	TBD	TBD
50WW06	Intermediate	29	6957553.93	3309790.22	199.88	202.55
47WW38	Intermediate	57	6957975.84	3309427.55	195.3	198.91
LHSMW54	Intermediate	42	6958535.21	3310541.19	191.08	193.71
A2(part of a well cluster)	Intermediate	TBD	TBD	TBD	TBD	TBD
D2 (part of a well cluster)	Intermediate	TBD	TBD	TBD	TBD	TBD
P	Intermediate	TBD	TBD	TBD	TBD	TBD
Q	Intermediate	TBD	TBD	TBD	TBD	TBD
R	Intermediate	TBD	TBD	TBD	TBD	TBD

Table 5-1 (*continued*)
Monitoring Wells to be Sampled at LHAAP-50

Well	Groundwater Zone	Approximate depth [a] (ft bgs)	Location		Ground Elevation (ft MSL)	Top of Casing (ft MSL)
			Northing	Easting		
S	Intermediate	TBD	TBD	TBD	TBD	TBD
T	Intermediate	TBD	TBD	TBD	TBD	TBD
A3	Deep	TBD	TBD	TBD	TBD	TBD

Notes and Abbreviations:

[a] *Approximate depth is the bottom of the screen interval.*

Approximate location of the monitoring wells to be added are shown on Figures 5-2 and 5-3

Coordinate system is Texas State Plane, North American Datum 1983

ft bgs *feet below ground surface*
ft MSL *feet above mean sea level*
TBD *to be determined*

Table 5-2
Rationale for Performance Monitoring Wells in Shallow Zone

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
In plume (VOCs and Perchlorate)	This well is considered closest to the source area. Highest concentrations in plume; Extreme drought has caused this well to be dry at times, also the well is completed with 10-foot screen over a silt and clay interval which may be causing the well to be dry.	50WW02	Provides a data point within the perchlorate and VOCs plume to evaluate presence of any toxic products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes. Possible candidate for replacement as a dry well.
In plume (VOCs and Perchlorate)	New well close to source area within the site boundary	New Well A1 (part of shallow/intermediate/deep well cluster)	Provides a data point within the perchlorate and VOCs plume to evaluate presence of any toxic products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes; Calculate distance based attenuation rate; evaluate plume stability; Evaluate seasonal variations and effects on plume boundary
In plume (VOCs and Perchlorate	New well downgradient of the perchlorate source area	New Well D1 (Part of shallow and intermediate well cluster)	Provides a data point downgradient of the source area, within the perchlorate and VOCs plume to evaluate presence of daughter/toxic products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes; Calculate distance based attenuation rate; evaluate plume stability; Evaluate seasonal variations and effects on plume boundary Calculate distance based attenuation rate; evaluate plume stability.
In Plume (VOCs and Perchlorate)	New well downgradient of the source area	New Well B	Provides another data point downgradient of the source area within the perchlorate and VOCs plume to evaluate presence of daughter/toxic products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes; Calculate distance based attenuation rate; evaluate plume stability; Evaluate seasonal variations and effects on plume boundary

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Table 5-2 (*continued*)
Rationale for Performance Monitoring Wells in Shallow Zone

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
Downgradient (outside the perchlorate plume edge and within VOCs plume)	New well downgradient of the eastern perchlorate plume edge and within the VOCs plume	New Well C	Provides a data point to evaluate downgradient expansion of perchlorate plume and an "in plume" data point for VOCs plume; Calculate distance based attenuation rate; evaluate plume stability; Evaluate seasonal variations and effects on plume boundary; Verify no unacceptable impact to downgradient receptors
In plume (TCE and Perchlorate)	New well crossgradient of the source area	New Well L	Provides a data point within the perchlorate and TCE plume to evaluate the presence of toxic products, changes of the dissolved plume to evaluate MNA processes; Calculate distance based attenuation rate; evaluate plume stability.
Downgradient (outside the eastern edge of the perchlorate plume and within the VOCs plume)	New well downgradient of the eastern edge of the perchlorate plume and within the VOCs plume.	New Well M	Provides a data point to evaluate downgradient expansion of perchlorate plume and an "in plume" data point for VOCs plume; Verify no unacceptable impact to downgradient receptors
Downgradient (outside the east edge of perchlorate and 1,2-DCA plume and within the TCE plume	New well downgradient of perchlorate and 1,2-DCA plume and within the TCE plume	New Well N	Provides a data point to evaluate the dowgradient expansion of the perchlorate/1,2-DCA plume and an "in-plume" data point for the TCE plume; Verify no unacceptable impact to downgradient receptors
Downgradient (outside the east edge of the TCE plume)	New wells downgradient of the TCE plume	New Wells H & I	Provides a data point to evaluate the downgradient expansion of the TCE plume; Verify no unacceptable impact to downgradient receptors
Crossgradient (outside the south edge of the TCE plume)	New wells crossgradient of the TCE plume	New Wells J & K	Provides a data point to evaluate the lateral expansion of the TCE plume
Crossgradient (outside the north edge of the TCE plume)	New wells crossgradient of the TCE plume	New Well E, F and G	Provides a data point to evaluate the lateral expansion of the TCE plume
Downgradient (outside the east edge of the TCE plume)	Existing well downgradient of the TCE plume	50WW07	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors

Table 5-2 (*continued*)
Rationale for Performance Monitoring Wells in Shallow Zone

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
Crossgradient-North side	Existing well outside plume to the north	50WW05	Evaluate lateral expansion
Crossgradient-South Side (near/ outside plume edge)	Existing well outside of the plume boundary to the south	50WW04	Evaluate lateral expansion; Possible candidate for replacement as a dry well.
Upgradient	Well outside the plume boundary to the south west	50WW03	Detect any new contamination flowing into plume area; Evaluate lateral plume expansion. Possible candidate for replacement as a dry well.

Notes and Abbreviations:

DCA *dichloroethane*
MNA *monitored natural attenuation*
TCE *trichloroethene*
VOC *volatile organic compound*

Table 5-3
Rationale for Performance Monitoring Wells in Intermediate and Deep Zone

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
In plume	Highest concentrations in plume in LHAAP-47 area;	47WW38	Evaluate presence of any toxic products in the LHAAP-47 area to help determine if perchlorate plume in the intermediate zone in LHAAP-47 and LHAAP-50 are comingled. Also used to evaluate any geochemical and microbiological changes of the dissolved plume to evaluate MNA processes
In plume	New well between LHAAP-47 and LHAAP-50	New Well P	Evaluate any toxic products in the LHAAP-47 area to determine if the perchlorate contamination in the intermediate zone in LHAAP-50 originates from a potential source in LHAAP-47 or from LHAAP-50
In plume	Existing monitoring well in the plume in the LHAAP-50 area	50WW06	Evaluate presence of any toxic products in the LHAAP-50 area to help determine if the perchlorate plume in the intermediate zone in LHAAP-47 and LHAAP-50 are comingled. Also used to evaluate geochemical and microbiological changes of the dissolved plume to evaluate MNA processes
In plume	Downgradient from highest concentration	New Well Q	Evaluate presence of any toxic and mobile daughter products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes
Outside plume (near west plume edge)	New well upgradient of the plume in LHAAP-47 area	New Well T	Detect any new contamination flowing into plume area from LHAAP-47 or LHAAP-35B; Evaluate lateral expansion
Outside plume(near plume edge)	New monitoring well to be installed within the site boundary of LHAAP-50	New Well A2 (part of shallow/intermediate and deep well cluster)	Installed within the LHAAP-50 site boundary to determine if source of the intermediate zone contamination is from LHAAP-50
Outside plume (near southwest plume edge)	New monitoring well to be installed in the Deep zone within the site boundary of LHAAP-50	New Well A3 (part of shallow/intermediate and deep well cluster)	Installed within the LHAAP-50 site boundary close to the source area to check for contamination in the deep zone close to the source area.
Outside plume (north edge of the plume)	New well outside north edge of the plume	New Well S	Evaluate lateral expansion of the plume
Outside plume (southeast edge of the plume)	New well outside south edge of the plume	New Well R	Evaluate lateral expansion of the plume

Table 5-3 (*continued*)
Rationale for Performance Monitoring Wells in Intermediate and Deep Zone

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
Outside plume (south edge of the plume)	New well outside south edge of the plume	New Well D2 (Part of Shallow and Intermediate well cluster)	Evaluate lateral expansion of the plume
Outside plume (near north west edge)	Existing monitoring well within the plume	LHSMW54	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors

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	9/21/2011	9/21/2011	9/21/2011

N

55TH ST.

47WW26

53RD ST.

52ND ST.

51ST ST.

LHAAP-47

LHSMW53
9/23/2002
80 U

LHSMW60
10/18/2007
1 U

47WW27
10/18/2007
1170

GALVESTON AVE.

CROCKETT AVE.

BOWIE AVE.

08WW01
5/12/2005
1 U

GPSAS08-1

GPSAS08-2

08WW02

LHAAP-08

181

180

179

178

182

GPSAS50-3
6/8/2001
9800

50WW01
5/11/2005
1 U

50DPT11

50WW05
2/23/2007
27.799999

STEP-50DW03

50DPT05

STEP-50DW01
3/15/2002
4 U

50DPT12

50DPT13

50DPT04

Flow

GPSAS50-1
6/8/2001
4 <

STEP-50DW02
3/15/2002
63600

STEP-50DW05
3/15/2002
4 U

50DPT07

Goose Prairie Creek

FORMER
TANK LOCATION

50DPT03

50DPT02

50DPT01

GPSAS50-2
6/8/2001
150000

STEP-50DW04
3/15/2002
106

50WW02
2/23/2007
532

LHAAP-50

50DPT06

50DPT08

50DPT10

STEP-50DW06
3/15/2002
4 U

50DPT09

50WW07

S HOUSTON RD

S CROCKETT AVE

48TH ST.

50WW03
2/24/2007
4 U

50WW04
5/10/2005
5 U

LEGEND

- DPT and Geoprobe Sample Location
- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Perchlorate Plume (72 µg/L Extent)
- Groundwater Elevation Contour
- Stream
- Road
- Site

Notes:

1. Groundwater contour elevations collected in November - December 2007 were reported in feet.
2. COC concentrations were reported in micrograms per liter (µg/L).
3. Concentrations based on the latest data collected at each well.
4. Plume extent based on groundwater medium specific concentration for industrial use which is 72 ug/L.

0 75 150 300
Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 5-1
PROPOSED DPT
LOCATIONS IN SHALLOW GROUNDWATER
LHAAP-50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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bryan.l.muske	9/21/2011
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Houston, TX	

N

47WW26
12/20/2000
1.78

55TH ST.

53RD ST.

52ND ST.

51ST ST.

GALVESTON AVE.

CROCKETT AVE.

BOWIE AVE.

LHAAP-47

LHAAP-08

LHAAP-50

LHSMW53
9/23/2002
29 U

LHSMW60
8/30/2010
56600

47WW27
7/31/2010
168

08WW01
5/12/2005
1 U

GPSAS08-1

GPSAS08-2

08WW02

181

180

179

178

182

GPSAS50-3
6/8/2001
9800

50WW01
8/7/2010
0.158 J

STEP-50DW01
3/15/2002
4 U

STEP-50DW03

50WW05
8/5/2010
0.189 J

GPSAS50-1
6/8/2001
4 <

STEP-50DW02
3/15/2002
63600

GPSAS50-2
6/8/2001
150000

50WW02
2/23/2007
532

STEP-50DW04
3/15/2002
106

STEP-50DW05
3/15/2002
4 U

STEP-50DW06
3/15/2002
4 U

50WW07
8/7/2010
0.262

50WW03
2/24/2007
4 U

50WW04
5/10/2005
5 U

A1
B
C
D1
E
F
G
H
I
J
K
L
M
N

Flow

Goose Prairie Creek

FORMER
TANK LOCATION

S. HOUSTON RD

S. CROCKETT AVE

48TH ST.

LEGEND

- Proposed Shallow Monitoring Well
- DPT and Geoprobe Sample Location
- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Perchlorate Plume (72 µg/L Extent)
- 1,2-DCA Plume
- TCE Plume
- Groundwater Elevation Contour
- Stream
- Road
- Site

Notes:

1. Groundwater contour elevations collected in November - December 2007 were reported in feet.
2. COC concentrations were reported in micrograms per liter (µg/L).
3. Concentrations based on the latest data collected at each well.
4. Plume extent based on groundwater medium specific concentration for industrial use which is 72 ug/L.

0 75 150 300
Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 5-2
PROPOSED MONITORING WELL LOCATIONS IN SHALLOW GROUNDWATER
LHAAP-50 REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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LHAAP-46
LHAAP-51
LHAAP-06
LHAAP-07
LHAAP-47
LHAAP-50
LHAAP-29
LHAAP-09
LHAAP-67
LHAAP-08
LHAAP-35B(37)
LHAAP-35C(53)
LHAAP-48

LHSMW38
LHSMW41
LHSMW54
47WW32
47WW33
47WW35
47WW36
35BWW06
35BWW03

47WW31 9/2/2004 1 U
47WW06 9/1/2004 1 U
47WW29 7/31/2010 0.1 U
47WW09 8/3/2010 0.1 U
47WW14 8/4/2010 0.1 U
47WW37 9/1/2010 6.42
47WW19 9/22/2002 1.45 U
47WW34 8/3/2010 0.1 U
48WW01 5/12/2005 0.5 U
47WW23 8/6/2010 0.1 U
47WW38 9/1/2010 4110
50WW06 8/7/2010 113
67WW06 8/6/2010 0.1 U

175 180 179 181 178 177 176 115 114 173 172 171 182

S T Q P R A2 A3 D2

N

LEGEND

- Proposed Intermediate Montioring Well
- Proposed Deep Montioring Well
- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Perchlorate Exceeding GW-Ind (72 µg/L)
- Groundwater Elevation Contour
- Groundwater Flow Direction
- Stream
- Road
- Former Building or Concrete Slab
- Site

Notes:

1. Plume extent based on groundwater medium specific concentration for industrial use which is 72 ug/L.
2. Well P will be placed adjacent to Shallow well F.

0 300 600 1,200 Feet

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FIGURE 5-3

PROPOSED MONITORING WELL LOCATIONS IN INTERMEDIATE AND DEEP GROUNDWATER LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

6.0 LAND USE CONTROL DESIGN AND IMPLEMENTATION PLAN

This section describes the LUC design and implementation activities for LHAAP-50. The activities will result in a surveyed and recorded groundwater use restriction boundary and an operation and maintenance plan for the LUC.

The objective of the LUC at LHAAP-50 is to prevent human exposure to residual groundwater contamination presenting an unacceptable risk to human health and ensure that there is no withdrawal or use of groundwater beneath the site for anything other than environmental monitoring and testing until cleanup levels are met. Notification of the groundwater use restriction will accompany all transfer documents. The U.S. Army is responsible for long-term implementation, maintenance, inspection, reporting, and enforcement of the LUC.

The LUC will address the area of LHAAP-50 that includes two groundwater plumes with levels of contamination that require implementation of a remedy (see **Section 1.3**). The Land Use Control Operation and Maintenance Plan (LUC O&M) will identify the measures required for monitoring and enforcement of the groundwater use restriction. Upon review and concurrence of this RD, the LUC O&M Plan will be coordinated with regulators, finalized, and distributed as part of the Comprehensive LUC Management Plan for LHAAP.

6.1 Land Use Control Implementation

The U.S. Army will undertake the following actions to implement the groundwater restriction LUC for LHAAP-50:

- ***Define the Area of the Groundwater Use Restriction.*** The groundwater use restriction boundary will be defined based on the review of the first round of groundwater sampling data in conjunction with historic data. The extent of plume will be bounded by a buffer and may extend to natural groundwater and surface water boundaries.
- ***Survey the LUC Boundary.*** The proposed boundary will be finalized after all wells are installed and sampled. Concurrence by USEPA and TCEQ will be obtained, and the LUC boundary will be surveyed by a State-licensed surveyor. A legal description of the surveyed area will be appended to the survey plat.
- ***Record the LUC in Harrison County.*** The LUC plat, legal description and groundwater use restriction language will be recorded in the Harrison County Courthouse in accordance with TAC Title 30, §335.566.

- ***Notify the Texas Department of Licensing and Regulation of the LUC.*** The Texas Department of Licensing and Regulation will be notified of the groundwater restriction which includes the prohibition of water well installation for any purpose other than environmental monitoring and testing without prior approval from the U.S. Army, the USEPA, and the TCEQ. The survey plat, legal boundary and description of the groundwater restriction, in conjunction with a locator map, will be provided in hard and electronic copy.
- ***Develop the LUC O&M Plan.*** An LUC O&M Plan for LHAAP-50 will be developed. It will include the elements presented in **Section 6.2**, the county recordation of the LUC survey plat, legal description and restriction language, and the inspection/certification form.

6.2 Land Use Control Operation and Maintenance

The U.S. Army or its representatives will be responsible for the operation and maintenance of the LHAAP-50 LUC. This includes certification, reporting, and enforcement activities. The U.S. Army shall address LUC problems within its control that are likely to impact remedy integrity and shall address problems as soon as practicable. To facilitate long-term operation and maintenance of the groundwater use restriction LUC remedy, the U.S. Army will develop a plan that will encompass the elements described in the following subsections.

6.2.1 Site Certification and Reporting

Beginning with finalization of this RD and approval of the inspection form, the U.S. Army will undertake inspections and certify continued compliance with the LUC objectives. The U.S. Army or the transferee after transfer will retain the LUC Inspection Certification documents in the project files for incorporation into the five-year review reports, and these documents will be made available to USEPA and TCEQ upon request. In addition, should any violations be found during the certification, the U.S. Army will provide to USEPA and TCEQ, along with the document, a separate written explanation indicating the specific violations found and what efforts or measures have or will be taken to correct those violations. The need to continue certifications will be revisited at five year reviews.

6.2.2 Notice of Planned Property Conveyances

The U.S. Army shall provide notice to USEPA and TCEQ of plans to convey the LHAAP-50 acreage. The notice shall describe the mechanism by which the LUC will continue to be implemented, maintained, inspected, reported, and enforced. Upon transfer, such responsibilities may shift to the transferee via appropriate provisions placed in the Environmental Condition of Property (ECP) or other environmental document for transfer. Although the U.S. Army may transfer responsibility for various implementation actions, the U.S. Army shall retain its responsibility for remedy integrity. This means that the U.S. Army

is responsible for addressing substantive violations of the LUC performance objective that would undermine the U.S. Army's CERCLA remedy. The U.S. Army also will be responsible for incorporating RD information and outlining the transferee's LUC obligations into property transfer documentation.

6.2.3 Opportunity to Review Text of Intended Land Use Controls

The U.S. Army will provide a copy of the groundwater use restriction notification to TCEQ for review and approval prior to its recordation in Harrison County. The USEPA will also receive a copy for review. In addition, the U.S. Army will produce an ECP or other environmental document for transfer of LHAAP-50, but before executing transfer, the U.S. Army will provide USEPA and TCEQ with a copy of the ECP or other environmental document for transfer so that they may have reasonable opportunity, before transfer, to review all LUC-related provisions.

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

Should the U.S. Army discover after conveyance of the site any activity on the property inconsistent with the LUC performance objective, the U.S. Army shall notify USEPA and TCEQ within 72 hours of such discovery. Consistent with **Section 6.2.5** below, the U.S. Army will then work with USEPA, TCEQ and the transferee to correct the problem(s) discovered. This reporting requirement does not preclude the U.S. Army from taking immediate action pursuant to its CERCLA authorities to prevent any perceived risk(s) to human health or the environment.

6.2.5 Land Use Control Enforcement

Should the LUC remedy reflected in this RD fail, the U.S. Army will coordinate with USEPA and TCEQ to ensure that appropriate actions are taken to reestablish its protectiveness. These actions may range from informal resolutions with the USFWS or its lessee, to the institution of judicial action against non-federal third parties. Alternatively, should the circumstances warrant such, the U.S. Army could choose to exercise its response authorities under CERCLA. Should the U.S. Army become aware that any future owner or user of the property has violated any LUC requirement over which a local agency may have independent jurisdiction; the U.S. Army may notify those agencies of such violation(s) and work cooperatively with them to re-achieve owner/user compliance with the LUC.

6.2.6 Modification or Termination of Land Use Controls

The U.S. Army shall not, without USEPA and TCEQ concurrence, make a significant modification to, or terminate an LUC, or make a land use change inconsistent with the LUC objective. Likewise, the U.S. Army shall seek prior USEPA and TCEQ concurrence before

commencing actions that may impact remedy integrity. In the case of an emergency action, the U.S. Army shall obtain prior USEPA and TCEQ concurrence as appropriate to the exigencies of the situation.

The LUC shall remain in effect until such time as the U.S. Army and USEPA agree that the concentrations of COCs have met cleanup levels. When this occurs, the LUC will be terminated as needed. The decision to terminate the LUC will be documented consistent with the NCP process for post-ROD changes, potentially including an explanation of significant differences or a remedial action completion report. If the property has been transferred and a determination by the U.S. Army and USEPA has been made to terminate the LUC, the U.S. Army shall provide to the owner of the property an appropriate release for recordation pertaining to the site and will also timely advise other local stakeholders of the action.

6.2.7 Comprehensive Land Use Control Management Plan

Upon finalization of the LUC O&M Plan, a copy will be inserted into the Comprehensive LUC Management Plan for Longhorn. The Comprehensive LUC Management Plan figure and table will be updated to reflect the inclusion of LHAAP-50.

The Comprehensive LUC Management Plan consists of LHAAP RD documents and a survey plat showing the locations where LUC being implemented at LHAAP are applied. The purpose of this Comprehensive LUC Management Plan is to ensure all site-specific LUC are compiled into one comprehensive location for both pre-transfer use by the installation and for post-transfer use by the transferee. This document will be provided to USEPA and TCEQ and is also accessible to the public. The Comprehensive LUC Management Plan is located in the Marshall Public Library to accompany LHAAP's Administrative Record.

The land use assumption of industrial use as part of a national wildlife refuge forms the basis for the remedy at LHAAP-50 and this land use assumption will be included in the Comprehensive LUC Management Plan with supporting documentation.

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7.0 FIELD ACTIVITIES

This section generally describes the field activities planned at LHAAP-50. Site-specific activities are described in associated subsections. The field activities to be conducted are outlined below:

- Pre-mobilization activities
- Preliminary activities/mobilization
- Site setup
- Soil excavation
- Confirmation soil sampling
- Additional Soil Sampling
- Monitoring well installation
- Groundwater sampling
- Surface water sampling
- Waste management
- Decontamination
- Well abandonment
- Demobilization

The field activities will be conducted in accordance with the Site-Specific Supplement to Health and Safety Plan (HASP) in **Appendix C**. The work will be routinely inspected in accordance with the Contractor Quality Control Plan (CQCP) in **Appendix D**. Additional information regarding these tasks and standard operating procedures can be found in Appendix C, Chemical Data Acquisition Plan (CDAP), and Appendix D, Field Procedures of the *Final Installation-Wide Work Plan* (Shaw, 2006).

7.1 Pre-mobilization Activities

A pre-construction meeting will be held by the U.S. Army, USEPA, TCEQ, and Shaw prior to the initiation of field activities.

The survey to determine the metes-and-bounds for the LUC and the notification of non-residential use will be conducted. The survey will be done by a state-licensed surveyor and

the coordinate system will be Texas State Plane, North American Datum 1983. **Figure 7-1** indicates the LUC boundary that will be surveyed.

Prior to mobilization, Shaw will secure any applicable permits and notifications. These may include federal, state, and local requirements. Shaw will notify TCEQ 10 days prior to the beginning of any excavation work. Shaw will also secure utility clearance for water, sewer, gas, electric, and communication. Shaw does not require any special permit to perform field work at this site. Field activities will be performed in compliance with action specific ARARs detailed in the Final Record of Decision, LHAAP-50 (U.S. Army, 2010).

Shaw will inspect LHAAP-50 to identify underground and overhead obstructions that may restrict groundwater monitoring activities or excavation activities. If power must be shut down, the power outage will be coordinated with groundwater treatment plant (GWTP) and fire station operations. There are no overhead electrical lines at LHAAP-50 that would restrict field activities.

As part of pre-mobilization activities, waste characterization samples will be collected from the excavation footprint to confirm whether or not the soil is classified as hazardous waste. One composite sample will be collected for each 50 in-place cubic yards and submitted to an off-site laboratory for toxicity characteristic leaching procedure. Three samples are expected. Waste characterization results will be reviewed by the disposal facility prior to shipment of any material off-site.

7.2 Preliminary Activities/Mobilization

Shaw anticipates mobilizing the following personnel:

- Site supervisor
- Contractor Quality Control System Manager (CQCSM)/Site Safety Officer
- Two equipment operators
- One laborer/sample technician
- Drilling subcontractor crew

Those personnel will utilize the following major equipment:

- Pickup trucks
- Water truck
- Tracked Excavator
- Dozer

- Drilling equipment
- Groundwater sampling pumps
- Groundwater monitoring field parameters test equipment

Additional equipment will be mobilized as necessary if the field conditions or planned activities merit additional site clearing or well installation.

7.3 Site Setup

A Global Positioning System will be used to delineate and mark the excavation areas per **Figure 2-1**. The potential areas of excavation will then be marked with survey stakes, pin flags, paint, or other appropriate marking.

The areas to be excavated have been established from the soil sampling event conducted in August 2010 (**Section 2.1**). Once the excavation areas have been delineated, removal of shrubs and other vegetative cover within the excavation areas will commence. Clearing of the vegetation will largely be conducted using a tractor mounted bush hog and other conventional equipment. Small vegetation and vegetation debris will be removed from the area to be excavated and a surrounding zone of approximately 25 feet. The area will be sprayed with a defoliant to destroy any hazardous vegetation (e.g., poison ivy), and then will be cleared using brush mowers and/or weed eaters. Any defoliant use will be coordinated with U.S. Fish and Wildlife Service. The area will be raked by mechanical equipment and/or by hand to remove vegetative debris and allow visual observation of the ground surface. Unless it contains soil, the vegetative debris will be stockpiled on site and allowed to decay naturally. If portions of the vegetative debris contain soil, that material will be disposed with the soil from the excavation.

Site set-up for excavation activities will include setting up for temporary decontamination. Any kind of soil adhering to the equipment will be mechanically removed at LHAAP-50. Final equipment decontamination will occur at the permanent decontamination station at LHAAP-18/24 with high-pressure water. Practices of keeping tracks and wheels of equipment outside the contaminated soil will be conducted to minimize possibility of cross contamination. Any generated wash water at LHAAP-50 will be contained and transported to the GWTP for disposal when necessary. Reusable equipment will be decontaminated between groundwater sampling locations and prior to leaving the site. Further information on decontamination procedures are found in the Final Installation Wide Work Plan, Appendix D, Field Procedures (Shaw, 2006).

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Monitoring wells to be sampled (see **Figures 7-2** and **7-3**) will be cleared of vegetation and biohazards (e.g., poison ivy, stinging insects) to ensure safe access for groundwater sampling.

7.4 Soil Excavation

Initial excavation limits will be established as shown on **Figure 2-1** and described in **Section 4.1**. Waste characterization samples will be collected as part of pre-mobilization activities to determine if the soil is hazardous or non-hazardous. The waste stream is expected to be non-hazardous (Shaw, 2009). As the soil is excavated, it will expand; the estimated volume of soil to be disposed at the landfill is approximately 195 cubic yards. Based on waste classification results, the excavated soil will be directly loaded and transported by truck to the appropriate permitted disposal facility. Licensed transporters will follow U.S. Department of Transportation requirements for non-hazardous transport of solids. The haul route across LHAAP is shown on **Figure 7-4**.

Excavation and soil handling activities will be performed utilizing standard health and safety practices to minimize airborne particle generation and exposure pathways that might place workers at risk. Air monitoring will be conducted in work areas to determine if airborne emissions exceed acceptable levels. Modified Level D personal protective equipment (PPE) and decontamination equipment are proposed (**Appendix C**).

To the extent possible, an excavator will be used to excavate the contaminated soils. Additionally, a water truck will be on site during excavation activities for decontamination and dust suppression.

The Site Superintendent and CQCSM will mark the corners of the completed excavation at each site for subsequent surveying. They will also measure and document the depths of excavation, including any depth variations across the excavation. In the event of rainfall, storm water runoff from surrounding areas will be diverted, as feasible, away from the excavation. After the rainfall event, any storm water in the excavation will be pumped to a tank on site, allowed to settle, and then conveyed to the LHAAP-18/24 GWTP.

During excavation, abandoned water lines, sewer lines, and lines to the former tank location may be encountered. Such lines that cross the excavation will be investigated to ensure that they are not active and are truly abandoned. If it is determined that these lines are not active, they will be removed or abandoned in place. Inactive lines that are cut by the excavation will be plugged with grout.

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7.5 Confirmation Soil Sampling

Confirmation sampling will be conducted concurrently with excavation activities to document that the remaining soils meet established cleanup levels. Excavation will continue until soils are below the cleanup level established in **Section 1.0**, **Table 1-1**. The soil sample data collected in August 2010 (prior to excavation) will be used for wall confirmation samples. Confirmation samples will be collected from the floor when the proposed excavation depth is reached. All confirmation soil samples will be analyzed for only perchlorate. A 5-point composite soil sample will be collected from approximately every 750 square feet of the excavation floor area. Six floor confirmation samples are expected based on the excavation area of 4,000 square feet. If perchlorate is detected in the composite samples above their cleanup levels, the area will be excavated an additional foot. This would continue until confirmation samples demonstrate the perchlorate remaining in the soil is below the cleanup level or until groundwater is encountered.

In the event that groundwater is encountered and a floor sample cannot be collected, a linear 5-point composite sample will be collected from each excavation sidewall. The individual grab samples will be collected from sidewalls just above the groundwater interface. If the linear 5-point composite sidewall sample is above the cleanup level, then additional excavation of the sidewall will be conducted to the groundwater interface depth. Confirmation soil sampling will be performed in accordance with the requirements presented in CQCP **(Appendix D**). Additional details for sampling and analysis are found in the *Final Installation-Wide Work Plan*, Appendix C, CDAP, and Appendix D, Field Procedures (Shaw, 2006).

7.6 Soil Sampling

Soil sampling will be performed at 50DPT03 in accordance with the requirements presented in CQCP **(Appendix D**). Soil samples will be collected continuously over the entire boring over 5 foot intervals with the last interval being collected just above the groundwater interface. Additional details for sampling and analysis are found in the *Final Installation-Wide Work Plan*, Appendix C, CDAP, and Appendix D, Field Procedures (Shaw, 2006).

7.7 Monitoring Well Installation

Shaw will add up to fourteen new monitoring wells in the shallow zone as indicated on **Figure 5-2**, and up to seven new monitoring wells in the intermediate zone and one monitoring well in the deep zone as indicated on **Figure 5-3** to better delineate and monitor the groundwater plume. The designations of A through T are temporary locations to facilitate discussion, and the final locations and nomenclature will be selected after the direct-push work. The locations of these monitoring wells and the rationale are indicated on **Figures 5-2** and **5-3** and **Tables 5-2** and **5-3**. Additional details for monitoring well

installation can be found in the Final Installation Wide Work Plan (Shaw, 2006). Well construction details will be included in the Remedy Implementation Report under separate cover.

7.8 Groundwater Sampling

Groundwater sampling will be performed in accordance with the requirements presented in the CQCP (**Appendix D**). Additional details for sampling and analysis are found in the *Final Installation-Wide Work Plan*, Appendix C, CDAP, and Appendix D, Field Procedures (Shaw, 2006).

7.8.1 Monitored Natural Attenuation

The monitoring portion of MNA will be accomplished by collecting groundwater samples from the shallow zone wells highlighted in **Figures 7-2** and **7-3**. The frequency of groundwater monitoring for MNA will be quarterly for two years. All collected groundwater samples will be analyzed for perchlorate, VOCs and field parameters (pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]). A subset of the groundwater samples, those from wells (50WW02, 50WW05, 50WW06 and 47WW38) historically within the groundwater plume and new monitoring wells (A1, B, C, D1, L, M, and N) that will be installed within the plume, will also be tested for MNA parameters (*dehalococcoides* sp. [DHC], alkalinity, chloride, nitrate/nitrite, sulfate/sulfide, total organic carbon [TOC], carbon dioxide, ferric iron, dissolved manganese and iron, and phosphorus). **Table 7-1** indicates the analytes for each well. After the first two years, the effectiveness of MNA will be evaluated. The MNA evaluation criteria are presented in **Section 8.0**. LTM will begin if the MNA evaluation determines MNA to be effective.

Any performance monitoring well found to be dry during quarterly sampling of the MNA performance monitoring will be replaced in the same quarter. The location of the replacement well will be adjacent to the dry well.

7.8.2 Intermediate and Deep Zone Groundwater Sampling

Groundwater samples will be collected from wells in the intermediate and deep zone as shown in **Figure 7-3** to check for vertical migration. The frequency of groundwater monitoring will be quarterly for two years. The collected groundwater samples will be analyzed for perchlorate, VOCs and field parameters (pH, DO, and ORP). A subset of the groundwater samples, those from wells (50WW06 and 47WW38) historically within the groundwater plume and new monitoring wells (P and Q) that will be installed within the plume, will also be tested for MNA parameters (DHC, alkalinity, chloride, nitrate/nitrite, sulfate/sulfide, TOC, carbon dioxide, ferric iron, dissolved manganese and iron, and phosphorus). **Table 7-1** indicates the analytes for each well. The data collected from the intermediate and deep monitoring wells will be used for remedy evaluation.

7.8.3 Long-Term Monitoring

After the first two years, the effectiveness of MNA will be evaluated (**Section 8.0**). If the MNA evaluation determines MNA to be effective, the analytical suite will be reduced to only VOCs and perchlorate and the frequency of sampling will be reduced to semiannual sampling for three years, then annually until the next five-year review. Further reductions in sampling will depend on results of five-year reviews, but sampling will continue at least once every five years until cleanup levels are attained.

7.8.4 Five-Year Reviews

Reviews will be conducted every five years to ensure that the remedy continues to provide adequate protection of human health and the environment. Groundwater sampling will continue once every five years or as determined in the five-year review. Groundwater monitoring results, site inspections, regulatory changes, and other information will be considered to determine whether the current remedy should continue or if a change is required. U.S. Army shall obtain regulatory concurrence prior to termination or significant modification of LTM activities.

Table 7-1
Sample Analytes

Well	Groundwater Zone	VOCs	Perchlorate	Field Parameters	MNA Parameters
50WW02	Shallow	✓	✓	✓	✓
50WW05	Shallow	✓	✓	✓	✓
50WW03	Shallow	✓	✓	✓	
50WW04	Shallow	✓	✓	✓	
50WW07	Shallow	✓	✓	✓	
A1	Shallow	✓	✓	✓	✓
B	Shallow	✓	✓	✓	✓
C	Shallow	✓	✓	✓	✓
D1	Shallow	✓	✓	✓	✓
E	Shallow	✓	✓	✓	
F	Shallow	✓	✓	✓	
G	Shallow	✓	✓	✓	
H	Shallow	✓	✓	✓	
I	Shallow	✓	✓	✓	
J	Shallow	✓	✓	✓	
K	Shallow	✓	✓	✓	

Table 7-1 (*continued*)
Sample Analytes

Well	Groundwater Zone	VOCs	Perchlorate	Field Parameters	MNA Parameters
L	Shallow	✓	✓	✓	✓
M	Shallow	✓	✓	✓	✓
N	Shallow	✓	✓	✓	✓
P	Intermediate	✓	✓	✓	✓
Q	Intermediate	✓	✓	✓	✓
R	Intermediate	✓	✓	✓	
S	Intermediate	✓	✓	✓	
T	Intermediate	✓	✓	✓	
A2	Intermediate	✓	✓	✓	
D2	Intermediate	✓	✓	✓	
A3	Deep	✓	✓	✓	
50WW06	Intermediate	✓	✓	✓	✓
47WW38	Intermediate	✓	✓	✓	✓
LHSMW54	Intermediate	✓	✓	✓	

7.9 Surface Water Sampling

Quarterly performance monitoring of Goose Prairie Creek adjacent to LHAAP-50 will be conducted for at least two years at two locations (**Figure 4-1**) after excavation of the contaminated perchlorate soil. Surface water sampling will be conducted as described in **Section 4.2**.

7.10 Waste Management

This section specifies methods and procedures to be implemented by Shaw to verify that waste generated during site activities are handled, transported, stored, and disposed in compliance with applicable federal, state, and local rules and regulations. The generated solid waste is assumed to be non-hazardous and will be managed in accordance with the requirements of Chapter 335 TAC for industrial solid waste. The waste will be disposed at a facility that meets CERCLA off-site requirements to accept waste from CERCLA sites. Waste management activities will be conducted in accordance with the requirements presented in Task 10 of the CQCP (**Appendix D**).

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Description of Wastes

Excavation and groundwater sampling activities at LHAAP-50 are expected to generate the following waste streams:

Field Activity	Waste Type	Estimated Quantity
Excavation	Perchlorate contaminated soil	150 in-place cubic yards 195 cubic yards to dispose
	Decontamination Water and Drill Cuttings	110 gallons [(2) 55 gallon drums]
	Miscellaneous Wastes (PPE, paper towels, rags, etc.)	—
Groundwater Sampling	Decontamination and Purge Water	385 gallons [(7) 55 gallon drums]
	Miscellaneous Wastes (PPE, paper towels, rags, etc.)	—

Notes and Abbreviations:

PPE personal protective equipment

Waste Characterization

Waste characterization samples will be collected in the pre-mobilization stage to confirm whether or not the soil is hazardous. One waste characterization sample will be collected for every 50 in-place cubic yards of contaminated soil and shipped off site to a laboratory for sample analysis. For waste liquids, composite samples will be collected from the 55-gallon drums of waste water generated. The results will be used to classify and code wastes in accordance with the requirements of 30 TAC 335, Subchapter R. Additional details for disposal sampling are found in the *Final Installation-Wide Work Plan*, Appendix C, CDAP, and Appendix D, Field Procedures (Shaw, 2006).

Waste Accumulation

The contaminated excavated soil from LHAAP-50 will be directed loaded onto trucks and transported to the disposal facility. The non-hazardous decontamination water and drill cuttings will be stored in 55-gallon drums until disposal of water at the LHAAP GWTP. The miscellaneous wastes will be placed in plastic bags until disposal.

Waste Disposal

The table below summarizes the waste disposal method for the various waste types anticipated at LHAAP-50.

Waste Type	Disposal Method
Soil: RCRA Non-Hazardous	RCRA Subtitle D Landfill
Soil: RCRA Hazardous	RCRA Subtitle C Landfill
Decontamination Water and Purge Water - Non-Hazardous Waste	LHAAP Groundwater Treatment Plant
Miscellaneous Wastes	Municipal Solid Waste

Notes and Abbreviations:

RCRA Resource Conservation and Recovery Act

As noted, the liquid waste will be disposed at the GWTP at LHAAP-18/24. If GWTP operations cease at some point in the future, water will be handled in accordance with regulations current at that time and will be transported and disposed of off-site.

7.11 Decontamination of Equipment and Personnel

Equipment that contacts contaminated soil and groundwater will be inspected for contamination prior to leaving the site. Contaminated soil that adheres to the equipment will be removed by mechanical means. If contamination is still visibly present after mechanical cleaning, equipment will be rinsed with decontamination liquids. If visible contamination cannot be removed from the backhoe bucket on site at LHAAP-50, the bucket will be bagged prior to transport to the GWTP decontamination station.

A permanent decontamination station is located at the on-site GWTP near LHAAP-18/24 and can accommodate large equipment. Final equipment decontamination will be performed at the on-site GWTP.

Reusable sampling equipment will be decontaminated between groundwater sampling locations and prior to leaving the site.

Wash water will be contained at LHAAP-50 and later transported to the GWTP for disposal.

Personnel shall be decontaminated as indicated in the Site-Specific Supplement to HASP (**Appendix C**).

Further information on decontamination procedures are found in the *Final Installation-Wide Work Plan*, Appendix D, Field Procedures (Shaw, 2006).

7.12 Well Abandonment

Wells that have been dry, are not needed to gather groundwater level measurements, or are not part of the planned monitoring system, will be abandoned. Recommendations for well abandonment will be submitted as part of the LTM recommendations in the MNA Performance Evaluation Report. Well abandonment will follow the well abandonment procedures in the *Final Installation-Wide Work Plan*, Section 3.9 (Shaw, 2006).

A separate mobilization will be made for well abandonment activities. The waste generated from these activities (concrete, well casings, etc.) will be disposed off site at an approved solid waste landfill.

Once the well abandonment has been completed, Shaw will restore the areas and demobilize. Areas disturbed in the course of well abandonment will be regraded to blend with the surrounding topography.

7.13 Demobilization

Once excavation and groundwater monitoring have been completed, Shaw will restore the site and demobilize. The area will be graded as necessary to blend with the surrounding topography and to ensure positive drainage. Clean backfill will be imported as needed to ensure the graded excavation area meets the surrounding topography. Approximately 6 inches of clean topsoil will be applied, and the disturbed area will be reseeded per applicable USACE requirements.

7.14 Health and Safety

The HASP (the latest revision of Appendix A of the *Final Installation-Wide Work Plan* [Shaw, 2006]) incorporates health and safety policies and safe operating procedures for individual project site activities. These procedures allow work activities to be carried out in a controlled, effective manner, consistent with Shaw policies and USACE requirements (USACE, 2008).

Information specific to the field activities at LHAAP-50 is provided in **Appendix C**. This information includes PPE levels, air monitoring requirements, and activity hazard analyses. These items supplement the HASP; they do not replace it. This information is not addressed by the site-wide HASP because the hazards are unique to the proposed work.

Prior to initiating work at the facility for any site, workers will have signed the HASP to indicate they have read and understood the document. Prior to starting work each day, daily safety meetings will be held with all field crew members to review the day's scope of work, the anticipated site conditions, and hazards that need to be addressed or acknowledged.

7.15 Quality Assurance/Quality Control

The CQCP provides information on quality assurance (QA)/quality control (QC) procedures for this project. The CQCP identifies personnel, procedures, controls, instructions, tests, verifications, documents, and forms to be used and the types of records to be maintained. The CQCP addresses quality control requirements specific to each major feature of work, including special steps that apply to LHAAP-50. The CQCP is provided in **Appendix D**.

The USACE Three-Phase QC process will be used to enforce QA/QC requirements and include preparatory inspections, initial inspections, and follow-up inspections. The three phases of inspections will target each definable feature of work during the execution of project activities.

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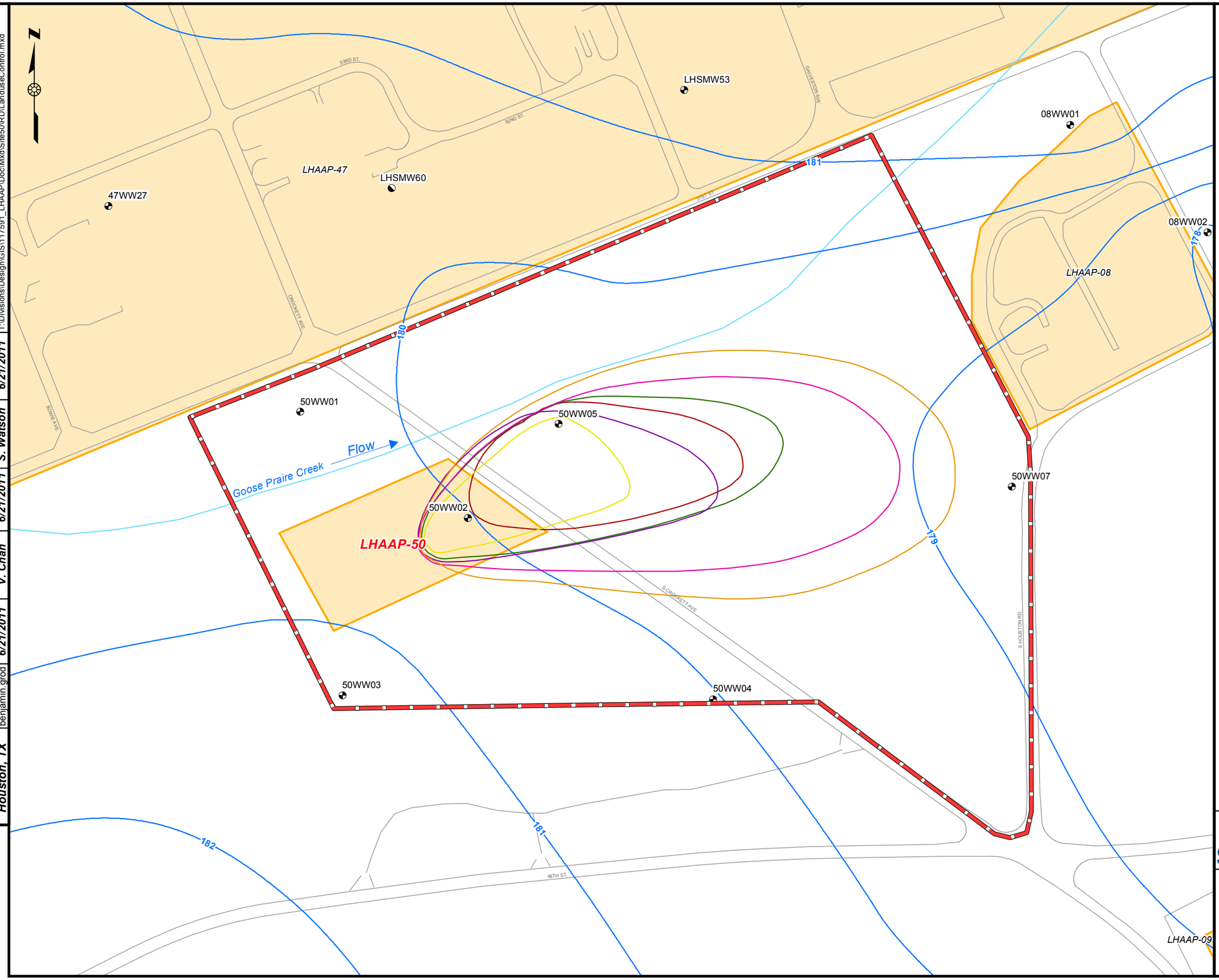

LEGEND

- Land Use Control Boundary
  Groundwater use restricted to environmental monitoring and testing only.
- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- 1,1-DCE Plume (7 µg/L Extent)
- 1,2-DCA Plume (5 µg/L Extent)
- PCE Plume (5 µg/L Extent)
- TCE Plume (5 µg/L Extent)
- VC Plume (2 µg/L Extent)
- cis-1,2-DCE Plume (70 µg/L Extent)
- Groundwater Elevation Contour
- Stream
- Road
- Sites

0 75 150 300 Feet

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FIGURE 7-1

LAND USE CONTROL MAP
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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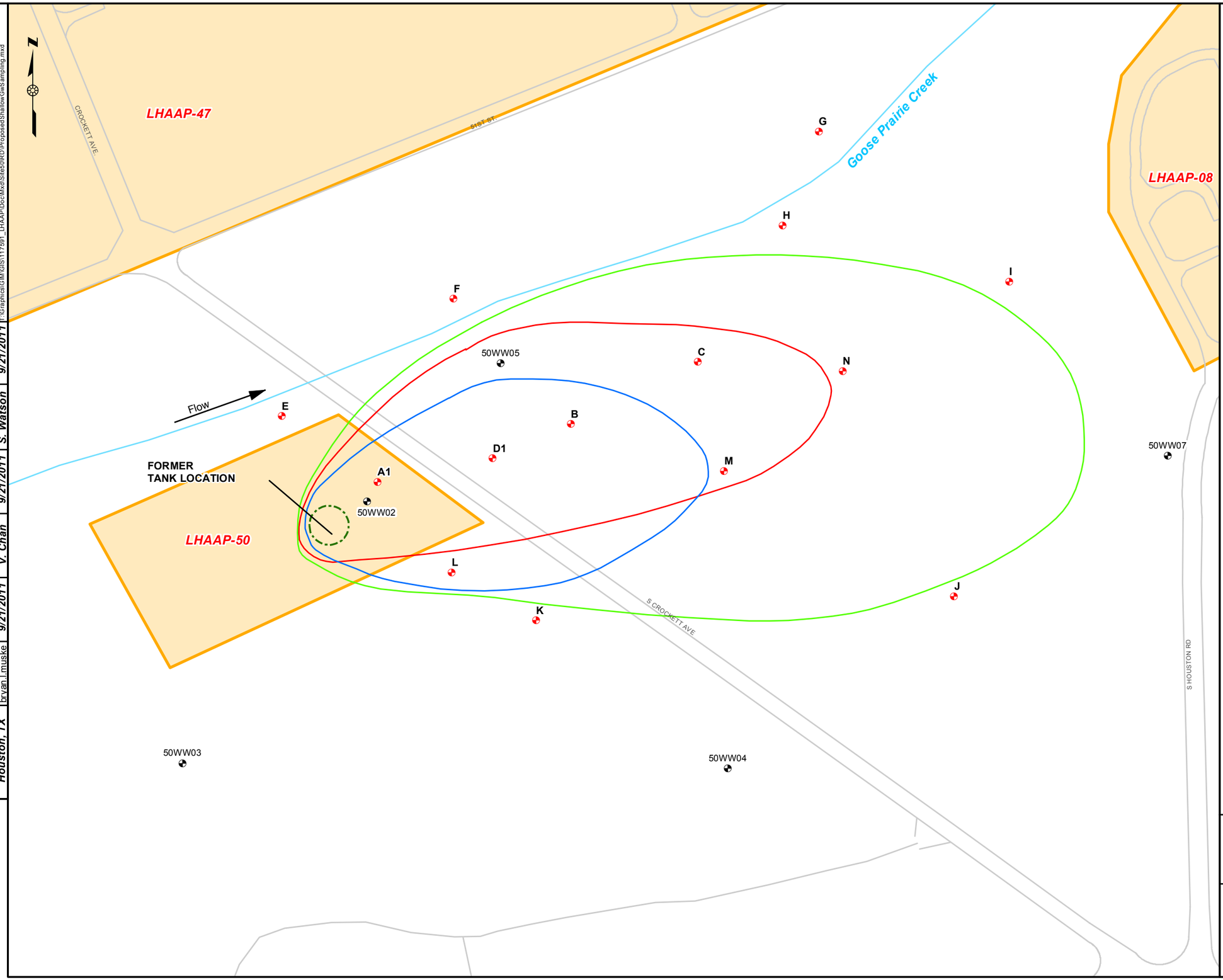

LEGEND

- Shallow Monitoring Well
- Proposed Shallow Monitoring Well
- Perchlorate Plume
- 1,2-DCA Plume
- TCE Plume
- Stream
- Road
- Site

Notes:

1. Figure will be revised after final well locations are determined after completion of direct-push drilling.

0 50 100 200 Feet

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FIGURE 7-2

GROUNDWATER MONITORING LOCATIONS
IN SHALLOW ZONE
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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V. Chan	9/21/2011

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bryan.l.muske	9/21/2011

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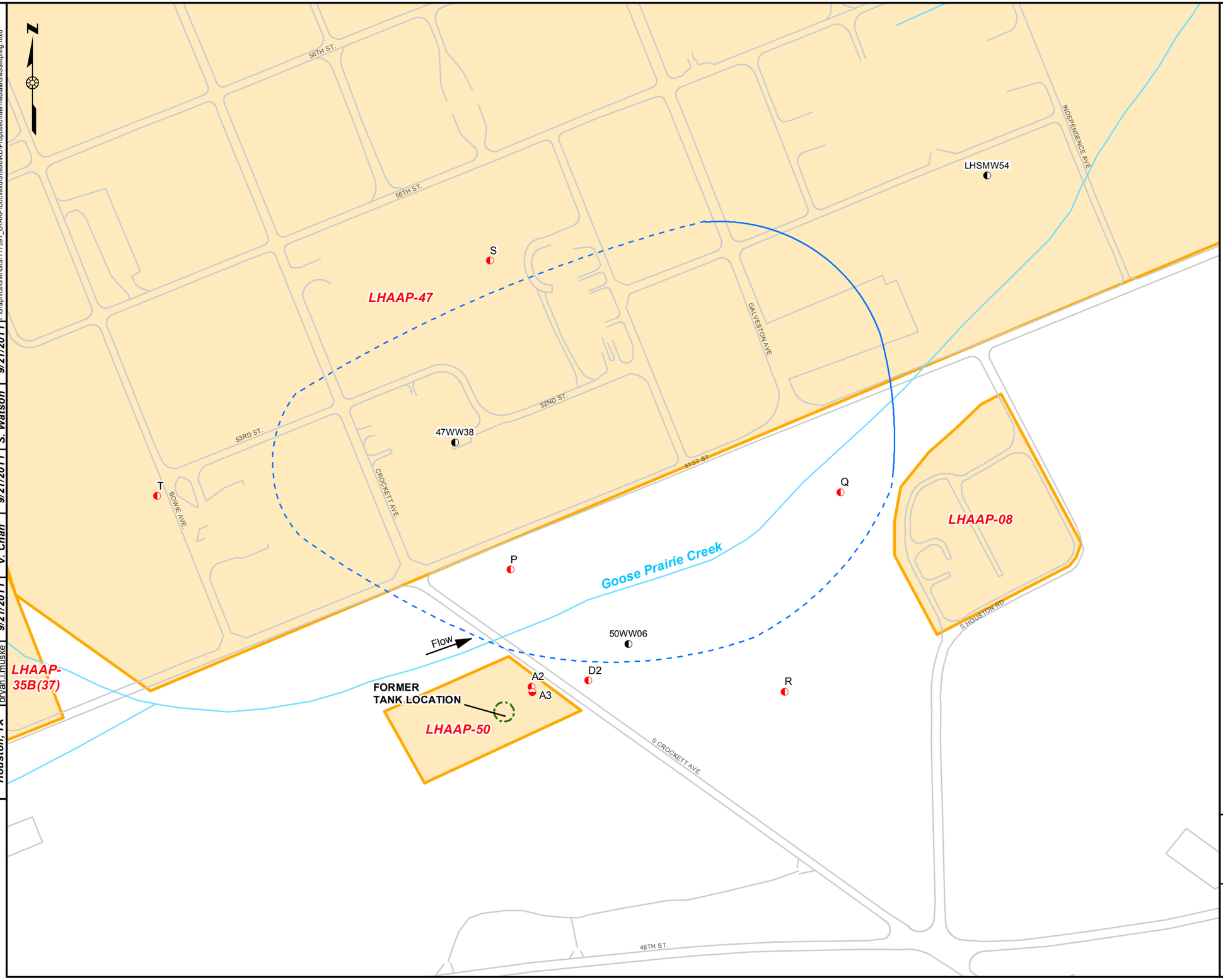

LEGEND

- Intermediate Monitoring Well
- Proposed Intermediate Monitoring Well
- Proposed Deep Monitoring Well
- Perchlorate Plume
  Dashed where inferred.
- Stream
- Road
- Site

Notes:

1. Figure will be revised after final well locations are determined.
2. $D_1 + D_2$ cluster of wells
3. $A_1 + A_2 + A_3$ cluster of wells

0 100 200 400 Feet

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FIGURE 7-3

GROUNDWATER MONITORING LOCATIONS
IN INTERMEDIATE AND DEEP ZONE
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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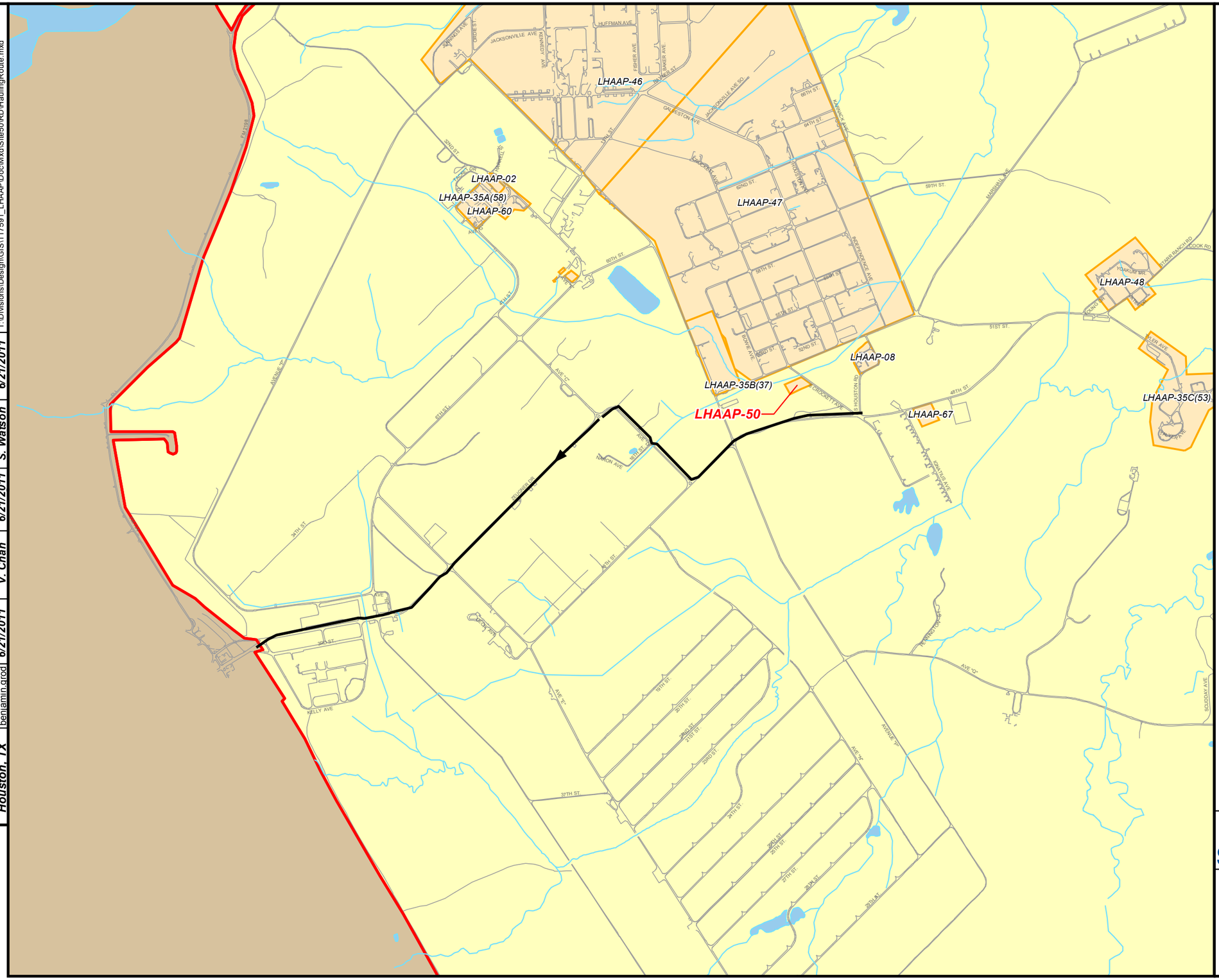

LEGEND

- Proposed Hauling Route
- Stream
- Road
- Sites
- LHAAP Boundary
- Lake

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FIGURE 7-4

PROPOSED HAUL ROUTE WITHIN LHAAP
LHAAP-50 REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

8.0 MONITORED NATURAL ATTENUATION EVALUATION

Monitored natural attenuation (MNA) will be evaluated for TCE, 1,2-DCA and perchlorate plumes. TCE and 1,2-DCA attenuation will be evaluated using the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998). Perchlorate attenuation will generally follow the published criteria as stated in *Monitored Natural Attenuation of Inorganic Contaminants in Groundwater* (USEPA, 2007) and is discussed separately.

Table 8-1
Monitored Natural Attenuation Evaluation Performance Criteria

Performance Criteria	Type	Goal	Explanation
1) Migration/Expansion	Qualitative	Stable or shrinking size; stable position	An expanding or migrating plume indicates MNA should not be continued
2) Concentrations	Quantitative	Falling concentrations or mass in the majority of performance wells	First Line of Evidence (USEPA, 2007) (USEPA, 1998)
3) Aquifer Conditions	Qualitative	Conditions favorable for natural attenuation	Second Line of Evidence (USEPA, 2007) (USEPA, 1998)
4) Microcosm Studies	Qualitative	Presence of appropriate microorganisms	Third Line of Evidence (USEPA, 2007) (USEPA, 1998)

Notes and Abbreviations:

MNA monitored natural attenuation
USEPA U.S. Environmental Protection Agency

8.1 Migration/Expansion (TCE, 1,2-DCA and Perchlorate)

For the evaluation of MNA at LHAAP-50 to be favorable, the MNA evaluation should demonstrate that the contaminant plume is either stable or shrinking. Chlorinated solvents plume includes both TCE and 1,2-DCA plumes.

A decreasing plume is diminishing in concentration and its location is not migrating or expanding; this occurs when the attenuation rate of dissolved-phase pollutants exceeds their generation rate from all sources. Sources that are sustaining the dissolved-phase plume may include pollutants sorbed to fine-grained, low-permeability materials located throughout the plume.

Monitoring must occur over a time period sufficient to demonstrate plume stability or decrease under natural conditions. The time period may depend on site-specific factors,

including the monitoring data trend analysis, potential threats to beneficial uses, and other uncertainties. If monitoring data do not demonstrate plume stability/decrease, this may indicate that more active plume remediation is necessary. The two years of quarterly sampling, combined with historic sampling data, will provide data for stability and trend analysis. MNA cannot continue as a sole remedy if the plume is clearly migrating.

8.2 First Line of Evidence

The first line of evidence is to evaluate historical groundwater data seeking to demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. In the case of a groundwater plume, decreasing concentrations should not be solely the result of plume migration. Thus, other performance wells will be evaluated to determine if the plume is migrating.

Chlorinated Solvents

Concentrations of chlorinated solvents can be evaluated at individual wells to calculate a time-based attenuation rate. They can be evaluated across multiple wells through the centerline of a plume to calculate a distance-based attenuation rate. Average plume concentrations or mass can be evaluated if a consistent set of wells is sampled over multiple sampling episodes. These calculations will be performed using the methods contained in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998).

Time-based attenuation rates will be calculated for any monitoring well that shows consistent COC concentration exceedances of cleanup levels during the eight episodes of quarterly sampling. Distance-based attenuation rates will be calculated through the highest concentration wells along the direction of groundwater flow. Attenuation rates based on average plume concentrations or mass will be calculated if the dataset will support the process. Data from at least two wells within the chlorinated solvent plume will be evaluated to determine if there is a clear and meaningful trend of decreasing concentrations and/or mass.

Perchlorate

The first line of evidence in determining natural attenuation of perchlorate effectiveness is a decreasing trend in the parent compound perchlorate. As perchlorate is biologically reduced, daughter products, chlorate, chlorite, and chloride are observed. The presence of these daughter products and their eventual decrease as the more highly oxidative compounds are eliminated also aid in determining the occurrence of natural attenuation.

Data from at least two wells within the perchlorate plume will be evaluated to determine if there is a clear and meaningful trend of decreasing concentrations and/or mass.

8.3 Second Line of Evidence

The second line of evidence uses chemical analytical data in mass balance to show that decreases in contaminant and electron acceptor/donor concentrations can be directly correlated to increases in metabolic end products or daughter compounds. The evidence can be used to show the groundwater conditions are sufficiently favorable to natural attenuation so that degradation of COCs can occur.

Chlorinated Solvents

The second line of evidence evaluates parameters such as nitrates, sulfates, ferrous iron, DO, ORP, nitrate, ferrous iron, sulfate, methane, ethane and ethene, chloride, TOC, carbon dioxide, alkalinity, pH and phosphorous. The results of tests for these analytes will be interpreted using the *Technical Protocol for Evaluating Attenuation of Chlorinated Solvents in Ground Water* (USEPA, 1998).

If the groundwater conditions in the plume area are favorable to the occurrence of degradation, then MNA may continue to be applied at the site. If groundwater conditions are unfavorable to the extent that any decrease in concentrations must be attributed to migration, then more aggressive treatment will be evaluated as a contingency remedy.

Perchlorate

The second line of evidence used to determine if natural attenuation of perchlorate is occurring is the evaluation of the geochemical parameters including DO, ORP, and nitrate levels. Since perchlorate is being used as a respiratory substrate, DO levels must be reduced to levels near or below 0.5 milligrams per liter (mg/L). Nitrate can also compete with the reductive process of perchlorate when nitrate is present at levels above 1 mg/L. The reduction of perchlorate occurs in slightly reducing conditions which can be measured using ORP. In general, reductive processes are possible at ORP levels less than 50 millivolts.

For the MNA evaluation, if the groundwater conditions in the plume area are favorable to the occurrence of degradation, then MNA may continue to be applied at the site. If groundwater conditions are unfavorable to the extent that any decrease in concentrations must be attributed to migration, then more aggressive treatment will be evaluated as a contingency remedy.

8.4 Third Line of Evidence

The third line of evidence consists of data from field or microcosm studies (conducted in or with actual contaminated site media) which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of

concern. This line of evidence is typically used only to demonstrate biological degradation processes.

Chlorinated Solvents

For the MNA evaluation, the presence of microorganisms (DHC) in the groundwater capable of degrading the chlorinated solvents would be favorable to continued MNA. If such organisms are present, in conjunction with favorable groundwater conditions as demonstrated via the Second Line of Evidence, MNA effectiveness is confirmed and LTM will be initiated. If not, then implementation of a contingency remedy will be evaluated.

Perchlorate

The third line of evidence used to determine if natural attenuation is occurring is the use of microbial data, including microcosm studies using site-specific groundwater. The use of microcosm studies is the primary option for this line of evidence since the organisms that reduce perchlorate are ubiquitous. Site soil and groundwater would be used to conduct a laboratory study to determine the effectiveness of the native site conditions to reduce perchlorate.

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9.0 REMEDY PERFORMANCE REPORTING

Reporting will consist of annual reports, an MNA evaluation report at the end of the eight quarters of sampling, a remedy implementation plan report and five-year review reports. Annual reports will be prepared at the end of each calendar year for every year in which groundwater samples are collected. A single MNA evaluation will be prepared based on the eight episodes of quarterly sampling results from the first two years combined with historic sampling results. The remedy implementation plan report will be prepared on completion of soil excavation activities, direct-push technology (DPT) investigation and installation of new monitoring wells. The five-year reviews will be prepared once every five years for so long as groundwater sampling is required.

9.1 Monitored Natural Attenuation Evaluation Report

After eight quarters of groundwater monitoring has been completed, an MNA evaluation will be conducted and an MNA Evaluation Report prepared. MNA performance criteria are listed in **Table 8-1**. Compilation of the information for the evaluation will occur throughout the first two years of quarterly groundwater monitoring. The MNA Evaluation Report for each of the plumes (TCE, 1,2-DCA and perchlorate) will include:

- Figures of the site, wells, and groundwater level contours
- Tables of groundwater and surface water analytical results
- Comparison of plume extent and concentration over time (**Table 8-1**, Performance Criteria 1)
- Consideration of the first and second lines of evidence for MNA and the third line of evidence if necessary (**Table 8-1**, Performance)
- An evaluation of the effectiveness of MNA at the site
- A recommendation for continued MNA, in situ bioremediation, or another remedy

The completed Preliminary Draft Monitored Natural Attenuation Evaluation will be submitted to the U.S. Army for review and comment. Following this, a Draft Final Monitored Natural Attenuation Evaluation will be submitted to the regulatory agencies for review and comment. A Draft Final Monitored Natural Attenuation Evaluation will address the regulatory comments and will be submitted for review. When regulatory agency comments have been resolved, the Final Monitored Natural Attenuation Evaluation will be issued. The Final Monitored Natural Attenuation Evaluation will conclude whether MNA should continue to be the remedial action applied at LHAAP-50, or whether another more aggressive treatment should be evaluated as a contingency remedy.

The first and second lines of evidence will be evaluated for decreasing COC concentrations and optimal geochemical conditions to demonstrate MNA. The third line of evidence will be evaluated if necessary. If the MNA evaluation determines that MNA is not an effective sole remedy, then an explanation of significant difference will be prepared and an amendment to this document will be made to design and implement a contingency remedy. The contingency remedy would likely be a form of bioremediation which was an alternative evaluated in the FS and also described in the ROD; however, the final design of the contingency remedy would be determined by the results of groundwater samples collected during the MNA performance monitoring period. The MNA Performance Evaluation Report will also include recommendations for future LTM and well abandonments.

9.2 Remedy Implementation Report

The Remedy Implementation Plan Report will be submitted to the U.S. Army for review on completion of soil excavation, DPT investigation and monitoring well installation. This report will include the following:

- A narrative of field activities
- Confirmation soil sampling results from the perchlorate contaminated soil excavation
- DPT investigation results
- Monitoring well installation details

9.3 Annual Reports

An annual report will be prepared at the end of each year of LTM to present groundwater sample results and a description of field activities, and to document other information considered relevant for the five-year review. The annual report will include:

- A narrative of field activities
- Figures presenting the site, monitoring well locations, and groundwater levels
- Tables of groundwater and surface water analytical results
- Copies of field paperwork, including sample collection forms and waste disposal documentation
- Relevant photographs

Data from wells outside the plume will be evaluated for plume migration while data from wells within the plume areas will be evaluated for MNA performance.

9.4 Five-Year Review Reports

Five-year reviews will be performed for LHAAP-50 (U.S. Army, 2010). While the intent is to perform these reviews every five years after the implementation of the remedy (i.e., remedy in place), the performance of the first five-year review of LHAAP-50 will be aligned with the next base-wide five-year review. The five-year review report will present summaries of information from the annual reports and from the five-year sampling event, evaluate that information, and recommend the future course of action. The five-year review will include:

- A narrative of field activities for the past five years
- Figures presenting the site, monitoring well locations, and groundwater levels
- Summary of groundwater and surface water analytical results
- Site inspection with relevant photographs
- Certification of LUC compliance
- Evaluation of progress toward cleanup levels
- Revisions to the LUC or monitoring schedules
- Recommendations for future actions

The progress toward cleanup levels will be evaluated in the five-year review report. The five-year review offers the periodic opportunity to declare whether the site is successfully and completely remediated, progressing satisfactorily toward remediation, or in need of a more aggressive remedy. When groundwater cleanup levels are reached, groundwater monitoring may cease when recommended in the five-year review.

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10.0 SCHEDULE

The estimated length of time for excavation and groundwater monitoring activities including site setup, clearing, groundwater sampling, confirmation sampling, waste management, and site restoration is approximately 14 work days. The estimated length of time to complete eight quarters of groundwater sampling and prepare the MNA evaluation report is approximately two and one half years. **Table 10-1** shows the anticipated duration for each of the major site activities. Shaw's mobilization to LHAAP-50 for the first round of MNA performance sampling is anticipated to begin in 2011 after final approval of the ROD and this document.

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Table 10-1
Durations for Major Site Activities

Activities	Duration	Elapsed Time
Establish land use control	1 month	1 month
Mobilization / Site setup	1 day	—
Excavation	5 days	—
Confirmation Sampling and Analysis	2 days	—
Backfill	2 days	—
Installation and development of new monitoring wells	7 days	—
Groundwater and surface water sampling	3 days	—
Site Restoration	1 day	—
Demobilization	1 day	—
Estimated duration	22 work days	—
Second / third / fourth quarterly sampling	9 months	1 year
Second year of quarterly sampling	1 year	2 years
MNA Evaluation (final document)	0.5 year	2.5 years
Well Abandonment	1 day	—
Three years of semi-annual sampling	3 years	5 years
Five-year review	0.5 year	5 years
Annual sampling (years 5 through 10)	5 years	10 years
Sample once every 5 years (repeated until cleanup levels are met)	—	15, 20, 25, 30 years
Achieve cleanup levels	—	50 years

Notes and Abbreviations:

Does not include pre-mobilization activities or rerouting of utilities.

Includes expectation of favorable MNA Evaluation.

Schedule revision expected after MNA Evaluation and five-year review.

MNA monitored natural attenuation

11.0 REFERENCES

Jacobs, 2002, *Final Remedial Investigation Report for the Group 4 Sites, Longhorn Army Ammunition Plant, Karnack, Texas*, January.

Shaw Environmental, Inc. (Shaw), 2006, *Final Installation-Wide Work Plan, Longhorn Ammunition Plant, Karnack, Texas*, January.

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U.S. Environmental Protection Agency (USEPA), 1998, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*, EPA/600/R-98/128, September.

USEPA, 1999. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, Directive 9200.4-17P. USEPA Office of Solid Waste and Emergency Response, Washington, DC.

USEPA, 2007, *Monitored Natural Attenuation of Inorganic Contaminants in Groundwater*, EPA/600/R-07/140, October.

Appendix A

Analytical Results and Field Forms

(on compact disc)

Appendix B

Inspection/Certification Form

Sample Land Use Control Compliance Certification Documentation

In accordance with the Remedial Design dated _____ for LHAAP-50, a certification of the site was conducted by _____ [indicate transferee] on _____.

A summary of land use control mechanisms is as follows:

- Groundwater restriction – restriction of the use of groundwater to environmental monitoring and testing until cleanup goals are met. [Indicate whether groundwater restrictions are still required at LHAAP-50]

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

- No use of groundwater, installation of new groundwater wells, or tampering with existing wells at LHAAP-50.

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

Date: _____

Name/Title: _____

Signature: _____

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

Attachments

- **Metes and Bound Survey of Area for LUC Implementation**
- **Monitoring Well Logs**
- **Notice of Filed Land Use Controls for LHAAP-50**

The attachments will be submitted once the surveys are completed, the well system is defined and wells are installed, and the notification is filed

Appendix C

Site-Specific Supplement to Health and Safety Plan

Appendix C
Site-Specific Supplement to Health and Safety Plan

Final

Remedial Design
LHAAP-50
Former Sump Water Tank, Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers – Tulsa District
1645 South 101st East Avenue
Tulsa, Oklahoma 74128

Prepared by Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Contract No. W912QR-04-D-0027, Task Order No. DS02
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Acronyms and Abbreviations

AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
DPT	direct-push technology
HASP	Health and Safety Plan
HSM	Health and Safety Manager
LEL/O_2	lower explosive limit/oxygen
mg/m^3	milligrams per cubic meter
PID	photoionization detector
PPE	personal protective equipment
TWA	time-weighted average

Personal Protective Equipment (PPE) Levels

LHAAP-50 – Monitoring Well Sampling/Well Installation or Abandonment/ Direct-Push Technology (DPT) Operations

Level D – Modified PPE:

- Hard hat meeting American National Standards Institute (ANSI) Z89.1 specifications.
- Safety glasses with side shields meeting ANSI Z87.1 specifications.
- Safety-toed work boots meeting ANSI Z41 specifications.
- Nitrile surgical gloves (inner or double layer).
- Disposable Tyvek® coveralls with hoods, elastic wrists, and elastic ankles.
- Chemical resistant boot covers and/or outer boots (polyvinyl chloride/latex/neoprene when there is potential for shoe/boot contact with contaminated soil or water).
- Hearing protection (if necessary or required).
- High visibility vests (ground personnel when working near heavy equipment or vehicular traffic).
- Work gloves, such as leather, cotton, or other material that provides cut/abrasion resistance (as necessary).

LHAAP-50 – Brush Clearing for Access

Level D – Modified PPE:

- Hard hat meeting ANSI Z89.1 specifications.
- Safety glasses with side shields meeting ANSI Z87.1 specifications.
- Safety-toed work boots meeting ANSI Z41 specifications.
- Disposable Tyvek® coveralls with hoods, elastic wrists, and elastic ankles.
- Hearing protection (if necessary or required).
- High visibility vests (ground personnel when working near heavy equipment or vehicular traffic).
- Work gloves, such as leather, cotton, or other material that provides cut/abrasion resistance (as necessary).

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Air Monitoring

Particulates

Real-Time Aerosol Monitor

Real-time aerosol monitors (MIE pDR-1000 or equivalent) shall be used to monitor dust emissions during dust generating activities. The only dust generating activity anticipated is clearing brush for well access or during well abandonment. The real-time aerosol monitors will be placed in the work area (near areas where ground personnel are working) and at the downwind site perimeter. The selected placement of these instruments may need to be adjusted throughout the workday to compensate for changes of wind direction.

Real-Time Aerosol Monitoring Action Levels

The real-time aerosol monitors will be set to alarm when the instantaneous aerosol concentration reaches 1.0 milligrams per cubic meter (mg/m^3). The alarm will be used to indicate that additional dust control is necessary.

The real-time aerosol monitors are capable of collecting and integrating the aerosol concentrations throughout the workday into a time-weighted average (TWA). Aerosol monitors shall be visually checked on an hourly basis during dust generating activities to verify that the TWA remains below 1.0 mg/m^3. Aerosol monitors registering time-weighted average aerosol concentrations at or above 2.0 mg/m^3 require that workers upgrade to Level C PPE and indicate that additional dust control measures are necessary. Failure to control workday time-weighted average dust concentrations to below 4.0 mg/m^3 shall necessitate ceasing dust generating activities and contacting the Project Manager and Health and Safety Manager (HSM) for implementing alternate work practices.

The full work-shift time-integrated concentrations will be evaluated at the conclusion of each workday to verify aerosol concentrations are maintained below action levels.

Volatiles/Oxygen

Photoionization detectors (PIDs) and lower explosive limit/oxygen (LEL/O_2) detectors shall be used to monitor emissions during sampling and well abandonment. Measurements will be collected from the work area and breathing zone during sampling or well abandonment activities. The action levels for the area monitoring are provided in the table below:

Direct Reading Air Monitoring Summary for Volatiles/Oxygen

Monitoring Device	Monitoring Location/Personnel	Monitoring Frequency	Action Level [a]	Action
PID/OVA (breathing zone)	DPT operations, groundwater sampling, and well installation	At start-up, minimum four times daily in work area and breathing zone	>5 ppm	Test for vinyl chloride (colorometric detector tubes)
LEL/O_2 meters	DPT operations, groundwater sampling, and well installation	At start-up, minimum four times daily in work area.	>10% LEL	Stop operations; allow vapors to vent and reach <10% before continuing

Notes and Abbreviations:

[a] *Sustained levels above background for 5 minutes in breathing zone*

DPT *direct-push technology*
LEL/O_2 *lower explosive limit/oxygen*
ppm *parts per million*
PID/OVA *photo ionization detector/organic vapor analyzer*

Personal Air Sampling (time-integrated)

Time-integrated air sampling may be performed at the discretion of the HSM, if air-monitoring action levels are exceeded.

Medical Surveillance

LHAAP-50

There are no special medical surveillance requirements in addition to the requirements of 29 Code of Federal Regulations 1910.120(f), which are already in place.

ACTIVITY HAZARD ANALYSIS FOR GROUNDWATER SAMPLING OR DPT OPERATIONS

Task Breakdown	Potential Hazards	Hazard Control Measures	Personal Protective Equipment	Monitoring Devices
Groundwater Sampling or DPT Operations	Inhalation and contact with hazardous substances	• Provide workers proper skin, eye and respiratory protection based on the exposure hazards present • Review hazardous properties of site contaminants with workers before sampling operations begin	Latex inner gloves, Tyvek® coveralls, nitrile gloves	LEL / O_2, PID
	Flammable, explosive atmospheres	• Test well head atmosphere for flammable/toxic vapors • Wear proper level of PPE for the type of atmospheric contaminants • Eliminate sources of ignition from the work area • Prohibit smoking in development area	Tyvek® coveralls, nitrile gloves	LEL / O_2, PID
	Struck by/against flying particles, protruding objects, liquid splash	• Wear hard hats, safety glasses with side shields and steel-toe safety boots at all times • Wear splash shields and safety goggles when sampling, cleaning, decontaminating test equipment	Hard hat, safety glasses	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Sharp objects	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain all tools in a safe condition • Keep guards in place during use	Cut resistant gloves	—
	High / low ambient temperature	• Monitor for heat/cold stress in accordance with Shaw Health & Safety Program, Volumes I & II, HS400 / HS 401 • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	Meteorological equipment

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools	Small equipment as specified by operations manual	40 hour Hazardous Waste Training Review Health and Safety Plan (HASP) Review site-specific Activity Hazard Analysis (AHA) with all task personnel. Safe driver's training (HS800)

ACTIVITY HAZARD ANALYSIS FOR BRUSH CLEARING PREPARATION

Principle Steps	Potential Safety/Health Hazards	Hazard Control Measures	Personal Protective Equipment	Monitoring Devices
Clearing Brush	Operation of power clearing tools (brush saws, weed whackers)	• Wear eye, face, hand and hearing protection when operating power clearing equipment • Shut-off / idle power tools walking between work areas • Store flammable liquids in well ventilated areas, away from work areas • Shut off equipment during re-fueling • Allow equipment to cool before re-fueling • Use funnels to avoid fuel spillage • Prohibit smoking while operating clearing equipment • Provide ABC (or equivalent) fire extinguishers for all work areas	Face shield, goggles, cloth gloves, ear plugs, steel toe work boots	—
	Handling heavy objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads	—	—
	Sharp objects	• Wear cut-resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain hand and power tools in a safe condition • Keep guards in place during use	Leather gloves with reinforced palm	—
	Eye injuries	• Wear face shield, goggles when operating powered clearing / grubbing equipment	Face shield, goggles, safety glasses	—
Mobilization/Site Setup and Survey/Layout	Slips, trips, falls	• Clear walkways, work areas of equipment, tools, vegetation, excavated material and debris • Mark, identify, or barricade other obstructions • Ensure footing. Look before you step	—	—
	High noise levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 decibels, A-scale (dBA) over an 8-hour work period)	Ear plugs	—
	High/low ambient temperature	• Monitor for heat/cold stress in accordance with Shaw Health & Safety Program, Volumes I & II, HS400 / HS 401 • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	Meteorological equipment

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Hand tools	Daily heavy equipment inspections Small equipment as specified by operations manual	Review Health and Safety Plan (HASP) Review site-specific Activity Hazard Analysis (AHA) with all task personnel. Review equipment safety operations manual Safe driver's training (HS800)

ACTIVITY HAZARD ANALYSIS FOR MONITORING WELL INSTALLATION OR ABANDONMENT

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment	Monitoring Devices
Monitoring Well Installation or Abandonment	Slips, trips, falls	• Clear walkways, work areas of equipment, debris and excavated materials • Mark, identify, or barricade other obstructions • Halt exterior work in high winds, severe weather	—	—
	Sharp objects	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain all hand and power tools in a safe condition • Keep guards in place during use	Leather gloves	—
	Handling heavy objects (piping/casings)	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb. maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads • Move long sections of piping/casing with at least two workers or mechanical equipment • Add tag lines to loads, if necessary, to minimize side-to-side movement • Prohibit workers from standing on top of piping during loading/unloading/transferring pipe or rolling stock • Stand clear of rolling stock/piping; do not attempt to stop rolling piping • Use slip handles to move slips; prohibit kicking slip handles into place	—	—
	Flammable, toxic emissions	• Monitor for flammable/toxic vapors, particulates, and gases • Wear proper level of PPE for the type of atmospheric contaminants	Portable fire extinguishers	PID
	Underground utilities	• Identify all underground utilities around the excavation site before work commences • Cease work immediately if unknown utility markers are uncovered	—	—
	Struck by/against heavy equipment, protruding objects, splashes	• Wear reflective warning vests when exposed to vehicular traffic • Isolate equipment swing areas • Make eye contact with operators before approaching equipment	Warning vest, hard hat safety glasses, steel toe work boots	—

ACTIVITY HAZARD ANALYSIS FOR MONITORING WELL INSTALLATION OR ABANDONMENT

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment	Monitoring Devices
Monitoring well installation or abandonment *(cont.)*	Struck by/against heavy equipment, protruding objects, splashes *(cont.)*	• Wear hard hats, safety glasses with side shields, face shields and goggles, and steel-toe safety boots • Understand and review hand signals • Chock piping/rolling stock stored on trailers/racks/etc to prevent rolling	Warning vest, hard hat safety glasses, steel toe work boots	—
	Equipment failure	• Inspect drilling equipment daily according to manufacturer's specifications • Block and level drilling equipment before use • Ensure equipment not in use is properly stored • Examine fittings, drive rods, hydraulic lines for condition and wear	—	—
	Inhalation and contact with hazardous substances	• Provide workers proper skin, eye and respiratory protection based on the exposure hazards present • Review hazardous properties of site contaminants with workers before operations begin • Monitor breathing zone air to determine levels of contaminants	Tyvek® coveralls, nitrile gloves, latex or neoprene boots	PID
	Insect/ snake bites	• Review injury potential and types of snakes with workers • Avoid insect nests areas, likely habitats of snakes outside work areas • Emphasize The Buddy System where such injury potential exists • Use insect repellant, wear PPE to protect against sting/bite injuries	Tyvek® coveralls, duct tape bottom of coveralls to boots or latex boot covers	—
	Contact dermatitis	• Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants • Identify and review poisonous plants with workers • Apply protective cream/lotion to exposed skin to prevent poison ivy or similar reactions	Tyvek® coveralls, duct tape bottom of coveralls to boots or latex boot covers	—
	Caught in/between moving parts	• Identify and understand parts of equipment which may cause crushing, pinching, rotating or similar motions • Assure guards are in place to protect from these parts of equipment during operation • Wear proper work gloves when the possibility of pinching, or other injury may be caused by moving/ handling large or heavy objects • Maintain all equipment in a safe condition • Keep all guards in place during use • De-energize and lock-out machinery before maintenance or service	—	—

ACTIVITY HAZARD ANALYSIS FOR MONITORING WELL INSTALLATION OR ABANDONMENT

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment	Monitoring Devices
Monitoring Well Installation or Abandonment *(cont.)*	High noise levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) • Assess noise level with sound level meter if possibility exists that level may exceed 85dBA TWA	Ear plugs	Sound level meter
	High/low ambient temperature	• Monitor for heat/cold stress in accordance with Shaw E & I Health and Safety Program, HS400, HS401 • Provide fluids to prevent worker dehydration	Insulated clothing (subject to ambient temperature)	Meteorological equipment

EQUIPMENT TO BE USED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
Drill rig Hand tools	Daily heavy equipment inspections Daily Drill Rig Inspections Small equipment as specified by operations manual	40 hour Hazardous Waste Training Review Health and Safety Plan (HASP) Review site-specific Activity Hazard Analysis (AHA) with all task personnel Review equipment safety operations manual Safe driver's training (HS 800)

Appendix D

Contractor Quality Control Plan

Appendix D
Contractor Quality Control Plan

Final
Remedial Design
LHAAP-50
Former Sump Water Tank, Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers – Tulsa District
1645 South 101st East Avenue
Tulsa, Oklahoma 74128

Prepared by Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

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Acronyms and Abbreviations

CDAP	Chemical Data Acquisition Plan
CQC	contractor quality control
CQCP	Contractor Quality Control Plan
CQCSM	Contractor Quality Control System Manager
DPT	direct-push technology
GPS	Global Positioning System
HASP	Health and Safety Plan
LHAAP	Longhorn Army Ammunition Plant
MARC	Multiple Award Remediation Contract
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
QAR	quality assurance representative
QC	quality control
Shaw	Shaw Environmental, Inc.
SSO	Site Safety Officer
TO	task order
USACE	U.S. Army Corps of Engineers

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Tulsa District, contracted Shaw Environmental, Inc. (Shaw), under the Louisville District's Multiple Award Remediation Contract (MARC) No. W912QR-04-D0027, Task Order (TO) No. DS02, to perform closure of multiple environmental sites at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. TO DS02 is being administered by the Tulsa District of USACE.

LHAAP is located in central-east Texas, in Harrison County, between State Highway 43 at Karnack, Texas, and Caddo Lake. Figure 1-1 of the Remedial Design shows the location of LHAAP and surrounding communities.

The objective of this TO is to perform investigations, collect data, perform remediation activities at multiple sites on an expedited basis to achieve site closures, and bring as many sites as possible into the long-term management/long-term operation stage as early as possible. This Contractor Quality Control Plan (CQCP) documents quality control (QC) requirements that will be implemented during remediation at LHAAP-50.

2.0 CONTRACTOR QUALITY CONTROL PLAN PURPOSE AND SCOPE

2.1 Contractor Quality Control Plan Purpose

This CQCP establishes procedures that enable common project field activities to be completed successfully and documents QC requirements for services provided by Shaw and its subcontractors during project activities at LHAAP-50. This plan describes requirements for organizing, planning, performing, reviewing, documenting, and reporting activities that may affect the quality of the work. This CQCP applies the specific requirements of Shaw's Contractor Quality Control (CQC) System to this project by establishing controls for:

- QC staff organization and authority
- Workmanship
- Construction activities for major definable features of work
- Records
- Inspections and tests
- Documentation
- Audits
- Subcontractor performance

This plan references standard field procedures, policies, regulations, and practices required to implement the work. A controlled copy of applicable Field Procedures from Appendix D of the *Final Installation-Wide Work Plan, Longhorn Army Ammunition Plant* (Shaw, 2006) will be available as a reference document.

2.2 Contractor Quality Control Plan Scope

This CQCP is applicable to the work proposed at LHAAP-50, including the major definable features of site work (or major project tasks) identified below:

Task 1 – Pre-mobilization Activities
Task 2 – Preliminary Activities/Mobilization
Task 3 – Site Setup
Task 4 – Soil Excavation
Task 5 – Confirmation Soil Sampling
Task 6 – Monitoring Well Installation
Task 7 – Groundwater Sampling
Task 8 – Surface Water Sampling
Task 9 – Waste Management
Task 10 – Decontamination
Task 11 – Well Abandonment
Task 12 – Demobilization

2.3 Acceptance of Contractor Quality Control Plan

Work within the scope of this plan will not be started prior to providing this CQCP to USACE, unless otherwise permitted by USACE. Any proposed changes to this CQCP will require notification to USACE in writing. Proposed changes are subject to the approval of USACE.

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3.0 ORGANIZATION AND RESPONSIBILITIES

3.1 Personnel and Structure

The Contractor Quality Control System Manager (CQCSM) coordinates implementation of this CQCP with the Project Manager, Remediation Manager, Program QC Manager, and subcontractors.

3.2 Duties and Responsibilities

The duties and responsibilities of personnel with regard to the CQC program are briefly outlined below. Duties and responsibilities of health and safety personnel are presented in Appendix A, Health and Safety Plan (HASP) (Shaw, 2006).

Project Manager: The Project Manager is responsible for all activities on the project, and directs and monitors the Site Superintendent in planning, coordinating, and controlling the work. The Project Manager has overall responsibility for establishing the CQCP and for its implementation, and he has the authority to access the required resources throughout Shaw to ensure compliance with the contract requirements.

Remediation Manager: The Remediation Manager reports to the Project Manager and is responsible for site remediation technical assurance. This individual will oversee the site remediation activities. The Remediation Manager has the following duties and authorities:

- Perform and/or oversee the purging and sampling of monitoring wells
- Perform and/or oversee the preservation, packaging, and shipping of samples to an off-site, fixed laboratory for environmental analyses
- Ensure documentation accuracy, completeness, and consistency among field team members
- Stop work that deviates from the contract documents or is otherwise nonconforming or unsafe.

CQCSM: The CQCSM is responsible for the overall management of the project CQC program during field activities. The CQCSM receives administrative and day-to-day direction from the Remediation Manager. The CQCSM is responsible to the Shaw Program QC Manager for direction on matters that may affect the QC requirements for the project. The CQCSM is assigned the following duties:

- Monitor and verify that the work is performed in accordance with the contract requirements

- Review and verify the disposition of discrepancy and corrective action reports
- Perform QC inspections and surveillance, and report daily on project QC
- Monitor project submittals in accordance with submittal register requirements
- Submit QC reports to the USACE Field Representative/Quality Assurance Representative (QAR) on a daily basis, unless other arrangements are agreed to by the USACE

The CQCSM has the authority to reject materials and workmanship that do not comply with project requirements, and to stop nonconforming work activities (see **Figure 3-1**).

Due to the limited size of the field effort at LHAAP-50, the CQCSM may also serve as the Site Safety Officer (SSO). In this dual role, the CQCSM/SSO is responsible to the Shaw Program Health and Safety Manager for safety-related matters. The SSO duties are discussed in detail in the Installation-Wide CQCP provided as Appendix B of the Installation-Wide Work Plan.

Program QC Manager: The Program QC Manager is responsible to review, monitor, and report the conformance to QC requirements set forth in the CQCP. He may also advise the CQCSM on QC methods and practices. He will maintain a record of his quality monitoring activities and will inform the CQCSM of his monitoring activities. He shall also be responsible for performing periodic internal audits, and reporting his findings to the CQCSM.

Subcontractors: Shaw assumes overall responsibility for conformance to the quality requirements for the subcontracted items and services. Subcontractors are responsible to the Project Manager and Remediation Manager for completing the portion of work assigned to them, and to the CQCSM for CQCP activities. They shall verify that their construction and materials comply with the requirements of the contract plans and specifications. Subcontractors include organizations supplying quality-related items or services to the project.

3.3 Qualification of Personnel

Shaw personnel assigned to the project are qualified to perform the tasks to which they are assigned. The Project Manager and the Remediation Manager will appraise the qualification of professional and/or technical personnel assigned to the project. The appraisal will include the comparison of the requirements of the job assignment with the relevant experience and training of the prospective assignee.

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Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

To:	To Be Determined
From:	John W. Patin, QC Manager
Date:	October 2011
Subject:	Contractor Quality Control System Manager, Letter of Authority U.S. Army Corps of Engineers, Tulsa District MARC Contract No. W912QR-04-D0027, Task Order No. DS02

This letter describes the responsibilities and authority delegated to you in your capacity as the Contractor Quality Control System Manager for Remediation of LHAAP-50 at Longhorn Army Ammunition Plant, Karnack, Texas.

In this position, you are responsible for the implementation and enforcement of the CQCP and site specific addenda. You will use the plan to verify that the quality of materials, workmanship, operations, and safety monitoring conforms to the Remedial Design/Work Plan, its appendices, and addenda.

Your responsibilities include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and requesting solutions for nonconforming activities. You have the authority to control or stop project activities until satisfactory disposition and implementation of corrective actions are achieved. Detailed responsibilities and guidelines are given in the Remedial Design, its appendices, and addenda.

Figure 3-1
Letter of Authority

4.0 CONTRACTOR QUALITY CONTROL SYSTEMS

4.1 Control Measures

The CQCP provides measures to verify and document that the work performed complies with the requirements specified in the contract documents. These measures include:

- CQC inspections
- Document control
- Submittals
- Completion inspection
- Records

Procedures for implementing the above measures are included throughout the CQCP. The CQCP may be supplemented by additional guidelines or instructions for implementing the work and/or verifying compliance with the contract requirements.

4.2 Quality Control Monitoring

The project CQC program is monitored to verify that the program is in compliance with the CQCP. Monitoring activities are performed by the Shaw Program QC Manager, or his representative, and include the review of daily QC reporting and instructions, or directions given to the CQCSM on QC matters. If required, an assessment of the project's CQC system is performed. If performed, the assessment includes the following items:

- Subcontractor performance
- Field operation and records
- CQC and health and safety inspections, testing, and records
- Document control
- Training records

4.3 Quality Control Testing

As applicable, the CQCSM monitors the equipment/materials testing firm and/or analytical laboratory activities to verify the following:

- Execution of required tests
- Location of tests
- Timely and accurate reporting of test results
- Correct frequency of tests
- Completeness of documentation

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5.0 INSPECTION PLAN

QC inspections include inspection of equipment, materials, testing procedures, documentation/submittals, and workmanship before, during, and after each definable feature of work. QC inspections are performed by the CQCSM in accordance with the Three-Phase CQC system. The CQCSM gives the USACE QAR advance notification (at least 24 hours) of formal inspections.

Definable features of site work (or major work tasks) for which QC inspections will be performed are addressed below.

Definable Features of Site Work:

Task 1 – Pre-mobilization Activities
Task 2 – Preliminary Activities/Mobilization
Task 3 – Site Setup
Task 4 – Soil Excavation
Task 5 – Confirmation Soil Sampling
Task 6 – Additional Soil Sampling
Task 7 – Monitoring Well Installation
Task 8 – Groundwater Sampling
Task 9 – Surface Water Sampling
Task 10 – Waste Management
Task 11 – Decontamination
Task 12 – Well Abandonment
Task 13 – Demobilization

Other site remediation activities that constitute definable features of site work will be defined within site-specific addenda to the work plan. Those addenda will also identify related QC inspection requirements.

5.1 Task 1 – Pre-mobilization Activities

Surveying may be conducted as a pre-mobilization activity, or in conjunction with other tasks. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- A qualified land surveyor licensed by the State of Texas is employed to perform well surveying and metes and bounds land-use control boundary surveys.
- Survey datum (vertical and horizontal) used is consistent with the work plan requirements and/or historical datum.

- Survey team undergoes preparatory meeting to verify their understanding of the scope of work.
- Surveying equipment is operative and properly calibrated.
- Instrument calibration is performed per manufacturer instructions.
- Survey points are clearly marked or labeled (e.g., notch in the top of casing and/or brass surveying marker embedded in surface pad).
- Field documentation is legible, accurate, and complete.
- Worker protection is adequate for the associated task hazards.

For identifying locations of soil samples and limits of excavation, a Global Positioning System (GPS) may be used in lieu of land surveying. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Survey team undergoes preparatory meeting to verify their understanding of the scope of work.
- Surveying equipment is operative and properly calibrated.
- Instrument calibration is performed per manufacturer instructions.
- Survey points are clearly marked or labeled
- Field documentation is legible, accurate, and complete.
- Worker protection is adequate for the associated task hazards.

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5.2 Task 2 – Preliminary Activities/Mobilization

Following approval of the Remedial Design, Shaw will mobilize the necessary personnel and equipment. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Site personnel have the necessary Occupational Safety and Health Administration (OSHA) training and medical surveillance statements/certifications
- Heavy equipment (e.g., drilling rig) has undergone safety and preventive maintenance checks, and is suitable for the task for which it will be used.
- Measuring and test equipment has undergone calibration and/or calibration checks to assure accuracy and precision.
- The project team understands the investigation/remediation requirements.

- Site personnel have reviewed the HASP provided by the SSO and have acknowledged this review by signing the HASP acknowledgment form.

5.3 Task 3 – Site Setup

Shaw will prepare the site for remedial activities. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Installed government property plan (when applicable) is reviewed and implemented for the equipment to be installed on site.
- Work zones and decontamination facilities are established in accordance with the HASP.
- Material storage areas are kept orderly.
- Site security measures are adequately maintained to prevent unauthorized access.
- Work zones are clearly demarcated using temporary barricading or fencing as required.

Once the site is mobilized and set up, field activities will commence.

5.4 Task 4 – Soil Excavation

The field work involves soil excavation and disposal off-site. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Preparatory meetings are held with work crews to discuss the regulatory requirements for soil excavation, transportation, and disposal off-site.
- Personnel associated with this task have applicable OSHA training and medical surveillance certifications.
- Worker protection is adequate for the associated task hazards.
- Materials and equipment are suitable and approved for use prior to starting the work.
- Required agency permits and/or notifications are completed prior to starting activities.
- Waste generated during activities is handled and disposed according to the waste management plan.

- Excavation locations are marked in the field by Shaw personnel or under the direction of Shaw personnel, based on the Remedial Design/Work Plan, and recorded in a logbook.
- The excavation is backfilled with clean soil and regraded as appropriate.

5.5 Task 5 – Confirmation Soil Sampling

Confirmation soil samples will be collected from the excavation walls or floors to verify that contaminated soil has been removed to cleanup levels. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the Chemical Data Acquisition Plan (CDAP) (Appendix C of the Final Installation-Wide Work Plan [Shaw, 2006]) and Work Plan and understand the scope of work.
- The SSO has briefed sampling personnel on task hazards and the appropriate personal protective equipment (PPE) level before sampling begins.
- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- Soil cuttings are contained in drums and managed in accordance with Work Plan waste handling requirements. Field screening procedures are found in Appendix D of the *Final Installation-Wide Work Plan*, Attachment 1.
- The specified sampling equipment and materials are used for sample collection.
- The sampling team leader (i.e., Remediation Manager) has instructed samplers on the sampling procedures and protocols and has assigned specific duties and responsibilities to each team member.
- Sampling equipment decontamination procedures are performed according to the CDAP.
- Sampling documentation procedures in the CDAP are followed and field documentation is legible, accurate, and complete.
- Quality assurance and QC samples are collected at prescribed frequencies in accordance with CDAP protocols and procedures.
- Sample labels, custody seals, and chain-of-custody forms contain pertinent sampling and analytical information before samples are packaged and shipped off site for laboratory analysis.

- Sampling and analytical records are maintained in the project file (in secured area).

5.6 Task 6 – Additional Soil Sampling

Soil sampling will be performed using direct-push technology (DPT) method. The DPT method will involve the use of a high-capacity hydraulic ram mounted on an all-terrain vehicle to advance a drive sampler attached to steel push rods. Soil samples will be collected continuously during drilling using a 24- to 48-inch-long sampler with a disposable liner. The exact total depths of the borings will be based on the groundwater depth and will be determined during drilling. The procedures for sampling each boring are summarized as follows:

- Execute work in accordance with Shaw and other applicable site-specific health and safety plan.
- Set up portable sample table and cover with plastic sheeting.
- Calibrate field analytical and health and safety instruments.
- Don a new pair of disposable sample gloves between sampling intervals to prevent cross-contamination.
- Decontaminate the sampling equipment as described in Section 4.5 in the Chemical Data Acquisition Plan, Appendix C of the Work Plan (Shaw, 2006).
- Observe the drilling operations to verify that proper safety, sampling, and drilling methods are being instituted.
- When soil sample is received from the driller, open the soil-filled sampler, remove the sample liner from the barrel, cut open the liner, and place the sample liner and sample on the plastic sheeting.
- Describe the length of the sample according to ASTM D2488-93, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* and record on the Shaw Drilling Log Form.
- After determining the appropriate sampling intervals based on the lithology, collect composite soil samples for laboratory analysis by filling the appropriate number and types of sample containers specified by the laboratory.
- Samples will be composited by collecting representative portions of soil from the designated interval, placing in a decontaminated stainless steel bowl or disposable container for mixing, and placing in the appropriate laboratory-supplied sample jar.

- Label each sample container as described in Section 4.6.2 of Appendix C of the Work Plan (Shaw, 2006), enclose each container in a sealable plastic bag, and place in a cooler containing ice.
- Repeat the above sequence of procedures for each interval to the total boring depth.
- Record the drilling activities and sampling procedures on a Field Sampling Report or logbook. Complete chain-of-custody documentation.

5.7 Task 7 – Monitoring Well Installation

Well installation is proposed for this site. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Preparatory meetings are held with work crews to discuss the regulatory requirements for well installation.
- Personnel associated with this task have applicable OSHA training and medical surveillance certifications.
- Worker protection is adequate for the associated task hazards.
- Drilling operations will employ a well driller licensed in the state of Texas.
- Materials and equipment are suitable and approved for use prior to starting the work.
- Required agency permits and/or notifications are completed prior to starting activities.
- Well installation locations are marked in the field by Shaw personnel or under the direction of Shaw personnel, based on the Remedial Design/Work Plan, and recorded in a logbook.
- Waste generated during activities is handled and disposed according to the waste management plan.

5.8 Task 8 – Groundwater Sampling

Following the installation of groundwater monitoring wells, Shaw will collect groundwater samples for laboratory analyses. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the CDAP (Appendix C of the Final Installation-Wide Work Plan [Shaw, 2006]) and Work Plan and understand the scope of work.
- The SSO has briefed sampling personnel on task hazards and the appropriate PPE level before sampling begins.
- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- Well depth and depth-to-water measurements are performed consistently from a common location at top-of-well casing (e.g., notch in top of casing or northern lip of casing).
- Well water volume is calculated accurately using well measurements.
- Well is purged of the required quantity of well water and water quality is stabilized as defined by the CDAP prior to sample collection.
- Purged water is contained in drums and managed in accordance with Work Plan waste handling requirements. Field screening procedures are found in Appendix D of the Final Installation-Wide Work Plan, Attachment 1.
- The specified sampling equipment and materials are used for sample collection.
- The sampling team leader (i.e., Remediation Manager) has instructed samplers on the sampling procedures and protocols and has assigned specific duties and responsibilities to each team member.
- Sampling equipment decontamination procedures are performed according to the CDAP.
- Sampling documentation procedures in the CDAP are followed and field documentation is legible, accurate, and complete.
- Quality assurance and QC samples are collected at prescribed frequencies in accordance with CDAP protocols and procedures.
- Sample labels, custody seals, and chain-of-custody forms contain pertinent sampling and analytical information before samples are packaged and shipped off site for laboratory analysis.

- Sampling and analytical records are maintained in the project file (in secured area).
- All field instruments are calibrated at the start of the testing day.

5.9 Task 9 – Surface Water Sampling

Shaw will collect surface water samples for laboratory analyses. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Sampling personnel have reviewed the CDAP (Appendix C of the Final Installation-Wide Work Plan [Shaw, 2006]) and Work Plan and understand the scope of work.
- The SSO has briefed sampling personnel on task hazards and the appropriate PPE level before sampling begins.
- A sampling equipment checklist is developed for this task and is reviewed with sampling personnel before sampling begins.
- The specified sampling equipment and materials are used for sample collection.
- The sampling team leader (i.e., Remediation Manager) has instructed samplers on the sampling procedures and protocols and has assigned specific duties and responsibilities to each team member.
- Sampling equipment decontamination procedures are performed according to the CDAP.
- Sampling documentation procedures in the CDAP are followed and field documentation is legible, accurate, and complete.
- Quality assurance and QC samples are collected at prescribed frequencies in accordance with CDAP protocols and procedures.
- Sample labels, custody seals, and chain-of-custody forms contain pertinent sampling and analytical information before samples are packaged and shipped off site for laboratory analysis.
- Sampling and analytical records are maintained in the project file (in secured area).
- All field instruments are calibrated at the start of the testing day.

5.10 Task 10 – Waste Management

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Waste generated during the project activities will be segregated by type (e.g., soil cuttings, used PPE, well development and purging liquids, trash/debris) and stored in approved 55-gallon drums or other containers.
- Waste containers are labeled with a waterproof marker according to the Work Plan, indicating the content, accumulation date, waste code(s) (if known) and pertinent analytical information.
- Waste handling activities are documented in the field logbook and a tracking log is prepared that indicates waste type, point of waste generation (i.e., well number) container size and type, accumulation date, storage location, disposal destination, transporter name, shipping paper/manifest number, and transportation and disposal dates.
- Waste containers are leak proof and stored in a secure storage area.
- Waste storage area is clearly demarcated using barricade tape and/or temporary barricade fencing, as required.
- Waste container and storage area inspections are performed on a weekly basis (at a minimum) and documented in the field logbook and/or in a standard inspection form.

5.11 Task 11 – Decontamination

Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Personnel are decontaminated in accordance with the *Final Installation-Wide Work Plan*, Appendix D, Field Procedures (Shaw, 2006).
- Equipment that contacts contaminated soil and groundwater are inspected for contamination prior to leaving the site.
- Contaminated soil that adheres to the equipment is removed by mechanical means. If contamination is still visibly present after mechanical cleaning, equipment will be rinsed with decontamination liquids. If visible contamination cannot be removed from the backhoe bucket on-site, the bucket will be bagged prior to transport to the permanent decontamination station at the Groundwater Treatment Plant at LHAAP-18/24.

- Reusable sampling equipment is decontaminated between groundwater sampling locations and prior to leaving the site.
- Wash water is contained on-site and later transported to the Groundwater Treatment Plant for disposal.

5.12 Task 12 – Well Abandonment

Shaw will abandon monitoring wells that were installed during any investigation and remediation activities as needed. Using the Three-Phase CQC system, the CQCSM will monitor this task to affirm the following:

- Preparatory meetings are held with work crews to discuss the regulatory requirements for well abandonment.
- Personnel associated with this task have applicable OSHA training and medical surveillance certifications.
- Worker protection is adequate for the associated task hazards.
- Abandonment activities will employ a well driller licensed in the state of Texas.
- Well abandonment materials and equipment are suitable and approved for use prior to starting the work.
- Well locations and top of casing elevations are verified and recorded in a logbook prior to abandonment.
- Required agency permits and/or notifications are completed prior to starting abandonment activities.
- Waste generated during abandonment activities is handled and disposed according to the waste management plan.
- Quantity and depth measurements are made and recorded accurately the amount of grout used, depth below ground surface of the top of the grout once the grout has settled and hardened, and the amount of cover soil placed and compacted above the top of the grout to re-establish a level ground surface.
- A multi-purpose completion report and/or well abandonment log is accurately completed for each abandoned well and submitted to the State of Texas. Copies are maintained in the project file until submitted to the USACE with the final report.

5.13 Task 13 – Demobilization

Shaw will restore the site and demobilize once response complete is attained. Using the Three-Phase CQC system, the CQCSM will affirm the following:

- Equipment installed for the purposes of this project, and not intended to be operated after this project is demobilized.
- Information for remaining equipment or installed materials has been submitted to LHAAP and USACE.

5.14 Other Site Remediation Tasks

Shaw will perform various site remedial activities to include optimizing the existing on-site groundwater treatment plant, soil/groundwater flushing, and instituting bioremedial solutions where applicable. Using the Three-Phase CQC system, the CQCSM will monitor these tasks as appropriate. Specific QC requirements for these tasks will be identified in site-specific addenda to the work plan.

6.0 DOCUMENT CONTROL

6.1 Documentation

The CQCSM maintains current records of QC activities and tests performed, including those of suppliers and subcontractors. The records will be maintained as evidence that required control measures and tests have been performed, and indicate the results of the activities. Photographic documentation is also maintained for this project in accordance with **Section 6.4** of this plan.

6.2 Daily CQC Report

The daily CQC Report is completed and maintained by the CQCSM using a standard form. The form is provided in **Attachment 1**. As applicable, standard forms used to document safety, technical, and operations aspects of daily field activities will be attached to the Daily CQC Report.

6.3 Daily Weather Conditions/Lost Time Report

A Daily Weather Conditions/Lost Time Report is prepared daily by the CQCSM. A report form is provided at the end of this section. Lost time will be logged into the report in increments of 25% (in other words, 0%, 25%, 50%, 75% or 100%). The amount of lost time incurred will be agreed upon and initialed by the CQCSM and the USACE QAR or Technical Manager overseeing the project work. Upon completion of the report for the specified period of time, one copy of the report should be submitted to the QAR/Technical Manager once each month during fieldwork and an extra copy should be maintained by the CQCSM for future reference.

6.4 Photographs

The CQCSM will photograph the project activities. Photographs will be taken on a regular basis during the course of the project to document the work, events, and equipment used. The frequency and number of pictures taken will depend upon the activities occurring and the amount of documentation needed. The Project Manager or Remediation Manager will use judgment to determine the frequency and number of pictures taken; however, a sufficient quantity of pictures will be taken to effectively document the TO.

Pictures will be taken using 35mm film or digital medium (using a digital camera or video camera). Photos will be documented on a project log (see standard form in **Attachment 1**), which includes the photo number, date, time, description of the task depicted, and the view direction (e.g., facing northwest). A copy of the photo log, pictures, slides/videos, and digital media will be maintained in Project Files.

6.5 Review of Vendor Submittals

Vendors and subcontractors are required to expeditiously submit items such as drawings, test data, and specifications to Shaw for review to enable timely submittals to USACE. Shaw technical and CQC personnel review each submittal for compliance with contract documents. If acceptable, the item is stamped or indicated as such, and forwarded to USACE for review and acceptance.

If unacceptable, errors or deficiencies are identified and returned to the vendor or subcontractor for correction. The corrected document is resubmitted to Shaw for review until it meets contract requirements.

6.6 Government Property Accounting and Control

If applicable, Shaw will acquire, manage, and dispose of government property. At the completion of the project, all real property (removed and/or installed) will be listed on a Property Inventory Sheet.

6.7 Submittals

The Project Manager, Remediation Manager, the Program Controls Engineer, and the CQCSM are responsible for project submittals. A submittal register prepared for this project is given in **Figure 6-1**.

SUBMITTAL REGISTER

DACA56-94-D-0020
TO No. 0109

TITLE AND LOCATION: Longhorn Army Ammunition Plant – LHAAP-50

CONTRACTOR: Shaw Environmental Inc.

				TYPE OF SUBMITTAL									CLASSI-FICATION			CONTRACTOR SCHEDULE DATES			CONTRACTOR ACTION			GOVT. ACTION		
TRANSMITTAL NO a.	ITEM NO b.	SPEC PARA NO c.	DESCRIPTION OF ITEM SUBMITTED d.	DATA e.	DRAWINGS f.	INSTRUCTIONS g.	SCHEDULES h.	STATEMENTS i.	REPORTS j.	CERTIFICATES k.	SAMPLES l.	RECORDS m.	INFO ONLY n.	GOVT. APPROVED o.	REVIEWER p.	SUBMIT q.	APPROVAL NEEDED BY r.	MAT'L NEEDED BY s.	CODE t.	DATE u.	SUBMIT TO GOVT v.	CODE w.	DATE x.	REMARKS
			Work Plan (and Appendices)		X	X	X							X		Per Project Schedule								
			Site Personnel OSHA Medical & Training Certificates							X		X	X			Prior to start of work								
			CQC and Safety Reports						X				X			Daily								
			Well Construction Methods/Specifications	X	X								X			Per Work Plan								
			Transporter ID, Insurance Cert							X			X			Prior to subcontract award								
			Manifests/Shipping Papers									X	X			Prior to shipment								
			Disposal Facility ID	X									X			Prior to subcontract award								
			Environmental Inspection Sheets									X	X			Per Work Plan								
			Groundwater Sampling Results	X					X				X			Upon data evaluation								
			Survey Drawings (As-built)		X									X		Upon completion								
			Well Construction Completion Forms									X		X		To State of Texas within 30 days of construction completion								
			Well Abandonment Forms									X		X		To the State of Texas within 30 days of construction completion								
			Drilling Logs & Groundwater Sampling Forms									X				With Daily QC Reports								

Figure 6-1
Submittal Register

7.0 SUBCONTRACTOR QUALITY CONTROL

Subcontractors for this project are responsible for compliance with the QC requirements of their respective subcontract. Subcontractors include organizations supplying quality related items or services to the project. Shaw assumes overall responsibility for conformance to the quality requirements for the subcontracted items and services.

Subcontract documents should include the requirements for personnel qualifications, technical performance levels, QC procedures, acceptability criteria, and documentation. The CQCSM, or his designee, reviews the subcontract procurement documents to verify that the QC requirements are communicated to the subcontractor.

Each subcontractor is required to identify an adequately qualified individual within the organization to perform QC duties. The qualifications of this individual are submitted to the CQCSM for review and approval. The CQCSM coordinates the QC functions with the designated subcontractor QC representative. The Project Manager, or his authorized designee, assists the CQCSM in managing subcontractor QC.

The CQCSM is responsible for the performance of inspections, surveillance, document reviews, audits, and other QC functions to verify compliance with the subcontract requirements. These activities are documented on inspection reports, checklists, audit reports, field logs, or other forms appropriate to the function performed.

For field operations, the CQCSM performs QC inspections before, during, and after the subcontractor activities, to the extent required, to verify that the subcontractor is in compliance with the QC requirements of the contract and the applicable subcontract documents.

Audits of subcontractor activities are conducted by the CQCSM as necessary to verify compliance with the CQCP. Objective evidence of conformance to the subcontract documents is reviewed during the audits.

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8.0 REFERENCES

Shaw Environmental, Inc. (Shaw), 2006, *Final Installation-Wide Work Plan, Longhorn Army Ammunition Plant, Karnack, Texas*, Houston, Texas, January.

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Attachment 1

Field Forms

- Preparatory Inspection Check List
- Initial/Follow-Up Inspection Form
- Final Inspection Form(s)
- Daily Contractor Quality Control Report
- Daily Weather Conditions/Lost Time Report
- Photo Log Form
- Corrective Action Report

PREPARATORY INSPECTION CHECKLIST

Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Project Name:_____
Project Location:_____
Project No.:_____

Plan or Specification Title/Section:_____ **Drawing Nos.:**_____

A. Personnel present *(use back of form to list additional personnel)*

Name	Position	Company

B. Submittals involved: *(use back of form to list additional submittals)*

Number and Type	Description	Indicate Contractor of Government Approval

C. Are all materials on hand and in accordance with approvals: ☐ Yes ☐ No
List all deficiencies:

D. Test required: (list/reference all quality control tests with their required frequencies):

E. Accident prevention preplanning (list all health and safety items discussed):

CQCSM: _____

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INITIAL/FOLLOW-UP INSPECTION FORM

Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Project Name:_____
Project Location:_____
Project No.:_____

(check one)

INITIAL PHASE CHECK LIST ☐ OR
FOLLOW-UP PHASE CHECK LIST ☐

Plan or Specification Section:_____ Drawing Nos.:_____

A. Personnel present:

Name	Position	Company

B. Materials are in strict conformance with contract specifications: ☐ Yes ☐ No
If no, explain:

C. Work being performed is in strict conformance with contract specifications: ☐ Yes ☐ No
If no, explain:

D. Workmanship is acceptable: ☐ Yes ☐ No
If improvement is needed, explain:

CQCSM: _____

FINAL INSPECTION FORM

Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Project Name:_____
Project Location:_____
Project No.:_____

FINAL INSPECTION FORM

Plan or Specification Title/Section:_____Drawing Nos.:_____

Inspected Work (list feature(s) of work inspected):

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

Performance Specification by Contract Delivery Order Reference	Status of Inspection

On behalf of Shaw, I certify that the work inspected is complete and meets the performance specifications cited above and that all material and equipment used and work performed was completed in accordance with approved plans and work instructions and meets contract delivery order requirements.

CQCSM _____ Date_____/_____/_____

Site Manager_____ Date_____/_____/_____

DAILY CONTRACTOR QUALITY CONTROL REPORT

Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Project Name:_____
Project Location:_____
Shaw Report No.:_____

WEATHER: ( ) Clear ( ) P. Cloudy ( ) Cloudy
Wind_____
Temperature: High_____ Low_____
Precipitation: Today_____ Previous Period (i.e., weekend)_____
Site Conditions:_____
Lost Time Due to Inclement Weather: _____%

PRIME CONTRACTOR/SUBCONTRACTORS AND AREAS OF RESPONSIBILITY/LABOR COUNT:
(Include number, trade, hours, employer, location, and description of work.)
a.

b.

c.

d.

e.

f.

WORK PERFORMED: (Include location and description of work performed including equipment used. Refer to work performed by prime and/or subcontractors as previously designated by letter above. Attached subcontractor daily activity reports when applicable):

MATERIALS AND/OR EQUIPMENT DELIVERED: (Include a description of materials and/or equipment, quantity, date/hours used, date of safety check, and supplier)

DAILY CONTRACTOR QUALITY CONTROL REPORT *(cont.)*

RESULTS OF SURVEILLANCE: (Include satisfactory work completed or deficiencies with action to be taken.)
a. Preparatory Inspection: (Attach Minutes)

b. Initial Inspection: (Attach Minutes)

c. Follow-up Inspection: (List results of inspection compared to specification requirements.)

d. Safety Inspection: (Include safety violations and corrective actions taken.)

OFF-SITE SURVEILLANCE ACTIVITIES: (Include action taken.)

QC TESTS PERFORMED AND RESULTS: (As required by plans and/or specifications.)

VERBAL INSTRUCTIONS RECEIVED OR GIVEN: (List any instructions received from government personnel or given by Shaw on construction deficiencies identified, required retesting, etc., and the corresponding action to be taken.)

CHANGED CONDITIONS/DELAYS/CONFLICTS ENCOUNTERED: (List any conflicts with the delivery order [i.e., Scope of Work and/or drawings], delays to the project attributable to site, and weather conditions, etc.)

DAILY CONTRACTOR QUALITY CONTROL REPORT *(cont.)*

SUBMITTALS REVIEWED: (Include submittal number, specification reference, and name of submitter.)

MEETINGS: (List the meetings, i.e., Health and Safety, Site Operations, Cost/Schedule, etc.)

VISITORS:

REMARKS: (Any additional information pertinent to the project not defined by the previous entries.)

CONTRACTOR'S VERIFICATION: The above report is complete and correct. All material and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above.

_____ _____/_____/_____
Shaw CQCSM (or designee) Date

DAILY WEATHER CONDITIONS / LOST TIME REPORT

DAILY WEATHER CONDITIONS/LOST TIME REPORT FOR WEEK/MONTH OF_____

Contract No.:_____ Delivery Order No.:_____ Project:_____

Contractor:_____

DAY	DATE	W/C. L/T	% LOST	ACTIVITY DELAYED	REMARKS	CONCUR	
						CQCR	QAR
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

Weather Conditions (W/C): R-Precipitation C-Extreme Temperature M-Muddy Site Conditions W-Extreme Winds
Other Lost Time Conditions (L/T): D-Demobilized S-Standby

Representative of the Contractor_____

Representative of the Government_____

PHOTO LOG FORM

PROJECT PHOTO LOG

Project Name:_____ Project Location:_____ Project No.:_____

Photo No.	Date	Time	Task and Description	View Direction

CORRECTIVE ACTION REPORT

Shaw Environmental, Inc.
1401 Enclave Parkway, Suite 250
Houston, Texas 77077

Project Name:_____
Project Location:_____
Report No.:_____

DESCRIPTION OF PROBLEM:_____

PERSONNEL RESPONSIBLE FOR INVESTIGATIVE PROCESS:_____

RECOMMENDED CORRECTIVE ACTIONS:_____

PERSONNEL RESPONSIBLE FOR IMPLEMENTATION OF CORRECTIVE ACTIONS:_____

RESULTING ACTIONS AND EFFECTIVENESS OF THOSE ACTIONS:_____

PERSONNEL RESPONSIBLE FOR MONITORING EFFECTIVENESS OF CORRECTIVE ACTIONS:_____

FINAL DISPOSITION APPROVED BY:

Name:_____ Title:_____

Date:_____

Name:_____ Title:_____

Date:_____

COPIES TO:

Contract No. W912QR-04-D-0027, Task Order No. DS02• Final • Rev 0 • September 2011