Final

Remedial Design
LHAAP-46
Plant 2 Area, 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: U.S. Army Corps of Engineers – Tulsa
CESWT-PP-M
1645 South 101st East Ave
Tulsa, Oklahoma 74128

Re: ***Final Remedial Design for LHAAP-46***
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-46, Plant 2 Area, Group 4** **Longhorn Army Ammunition Plant, Karnack, Texas**

Aaron– Enclosed are two copies of Shaw's final version of the above-named document.

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-46, Plant 2 Area, 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-46, Plant 2 Area, 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, 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 4:47 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-46 RD
Attachments: (Main Text) 09 11 DRAFT FINAL RD LHAAP-46.pdf

Hi Rose,

The EPA has reviewed the Draft Final Remedial Design for LHAAP-46 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>, "Duffield, Robert" <robert.duffield@shawgrp.com>, "Everett, Kay" <Kay.Everett@shawgrp.com>
Date: 09/30/2011 04:13 PM
Subject: D-F RD, LHAAP-46

Steve/Fay:

The Draft Final Remedial Design for LHAAP-46 is attached. The file contains the main text and figures to keep the size of the file within manageable limits for email. 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
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From: Fay Duke [Fay.Duke@tceq.texas.gov]
Sent: Friday, September 30, 2011 5:00 PM
To: Srivastav, Praveen; Tzhone.Stephen@
Cc: Duffield, Robert; Everett, Kay; Lambert, JohnR SWT; Watson, Susan; Williams, Aaron K SWT; Zeiler, Rose Ms CIV USA OSA
Subject: TCEQ Approval: D-F RD, LHAAP-46

Rose,

The TCEQ has completed its review of the Draft Final RD for LHAAP-46 and has no further comments.

Thank you.

Fay Duke (MC-136)
Remediation Division, TCEQ
PO Box 13087
Austin, Texas 78711-3087
512-239-2443
512-239-2450 (Fax)

>>> On 9/30/2011 at 4:12 PM, <Praveen.Srivastav@shawgrp.com> wrote:

> Steve/Fay:
>
> The Draft Final Remedial Design for LHAAP-46 is attached. The file contains the main text and figures to keep the size of the file within manageable limits for email. The files for the entire document are being uploaded to the Longhorn Stakeholder portal. We are also shipping out hard copies today.
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> Thank you,
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> **Praveen Srivastav, PhD, PG, PMP**
> Project Manager
> Federal Division/Project Management
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Acronyms and Abbreviations

µg/L	micrograms per liter
bgs	below ground surface
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	chemicals of concern
CQCP	Contractor Quality Control Plan
DHC	dehalococcoides
DO	dissolved oxygen
ECP	Environmental Condition of Property
GWTP	groundwater treatment plant
HASP	Health and Safety Plan
Jacobs	Jacobs Engineering, Inc.
LHAAP	Longhorn Army Ammunition Plant
LTM	long-term monitoring
LUC	land use control
LUC O&M	Land Use Control Operation and Maintenance
MARC	Multiple Award Remediation Contract
MCL	maximum contaminant level
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Contingency Plan
ORP	oxidation reduction potential
PPE	personal protective equipment
QA/QC	Quality Assurance/Quality Control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
ROD	Record of Decision
Shaw	Shaw Environmental, 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

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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-46, Plant 2 Area at the former Longhorn Army Ammunition Plant (LHAAP) near Karnack, Texas. This Remedial Design (RD) for LHAAP-46 is a part of the response. Subsequent work plans will be prepared to provide more details of the implementation of this remedial design (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 LHAAP Background

LHAAP is located in central-east Texas in the northeastern corner of Harrison County, approximately 14 miles northeast of Marshall, Texas (see **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 LHAAP-46 Description

LHAAP-46 (Plant 2 Area) is in the north-central portion of LHAAP in an industrial area as shown on **Figure 1-2** where pyrotechnic and illumination devices were produced until 1997. LHAAP-46 is approximately 190 acres and is triangular in shape, bounded by Avenue "P" to the southwest, the LHAAP property boundary fence to the north, and LHAAP-47 to the southeast. The surface features at LHAAP-46 are a mixture of asphalt-paved roads, parking areas, building foundation remnants, old buildings, and overgrown wooded and grassy vegetation-covered areas. The topography in this area is relatively flat with the surface drainage flowing east into tributaries of Goose Prairie Creek. Runoff from the site enters Caddo Lake via Goose Prairie Creek.

Preliminary field investigations were conducted at the Plant 2 Area between 1991 and 2001, with subsequent site investigations in 2003, 2006, 2007, and 2008 (soil, groundwater and pit sampling for site characterization). The investigations showed that there had been impacts to groundwater in the shallow and intermediate zones, but soil and pit residues posed no threat to human health or the environment (Shaw, 2009). There have been no previous remedial actions at LHAAP-46.

The remedial action alternative to be implemented at LHAAP-46 was developed and selected in accordance with the CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986, and the National Oil and Hazardous Substances Contingency Plan (NCP) (40 Code of Federal Regulations Part 300). The selected remedy finalized in the Record of Decision (ROD) (U.S. Army, 2010) was developed based on the assumption that future land use will be industrial/recreational (e.g., national wildlife refuge). The remedial action assumes that 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-46 must protect human health and meet applicable or relevant and appropriate requirements. As noted in the *Final Feasibility Study* (Shaw, 2009), there is no ecological risk at LHAAP-46. Therefore, the proposed remedial action addresses human health risk. The threat that must be addressed at LHAAP-46 is groundwater contamination that could adversely affect human health via ingestion, inhalation, and direct contact (Shaw, 2009).

The remedial action objectives (RAOs) for LHAAP-46, consistent with the reasonably anticipated future use as a national wildlife refuge, are:

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

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 NCP and is consistent with the NCP regulations requiring the lead agency, the U.S. Department of the Army (U.S. Army) in this case, 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 response at LHAAP-46:

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- **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 for groundwater restriction will remain in place until the cleanup levels are met.

- **Monitored Natural Attenuation (MNA).** MNA will be implemented to verify that the trichloroethene (TCE) plume is 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.** If MNA is found to be effective, it will be continued, and 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-46, groundwater cleanup levels are expected to be met through natural attenuation in 23 to 30 years. This time frame will be re-evaluated as part of the MNA evaluation and periodic reviews.

1.2 Cleanup Levels

Cleanup levels were established to meet the RAOs as included in the ROD (U.S. Army, 2010). **Table 1-1** presents the cleanup levels for LHAAP-46.

Table 1-1
Cleanup Levels

Chemical	Concentration (µg/L)	Basis
Trichloroethene	5	MCL
cis-1,2-Dichloroethene (daughter product)	70	MCL
trans-1,2-Dichloroethene (daughter product)	100	MCL
Vinyl Chloride (daughter product)	2	MCL

Notes and Abbreviations:
µg/L micrograms per liter
MCL Safe Drinking Water Act maximum contaminant level

1.3 Areas of Contamination

Based on available sampling data, the groundwater at LHAAP-46 has been identified as a medium of concern due to the presence of TCE concentrations exceeding the U.S. Safe

Drinking Water Act maximum contaminant level (MCL) value of 5 micrograms per liter (µg/L) in both the shallow and intermediate groundwater zones. Based on the sampling results, the area of TCE contaminated shallow zone groundwater exceeding the MCL is estimated to be approximately 5 acres (1.41 million gallons). This area of contaminated shallow groundwater bounded by the 5 µg/L concentration contour is illustrated on **Figure 1-3**. The area of TCE contaminated intermediate zone groundwater exceeding the MCL is estimated to be approximately 16 acres (7.85 million gallons). This area of contaminated intermediate groundwater zone bounded by the 5 µg/L concentration contour is illustrated on **Figure 1-4**.

1.4 Hydrogeology

Groundwater at the site was encountered approximately 13 to 28 feet below ground surface (bgs) in the shallow groundwater zone, approximately 27 to 37 feet bgs in the intermediate zone, and approximately 33 feet bgs in the deep zone. The groundwater flow in the shallow zone at the site is generally to the east and in the intermediate zone is generally to the northeast. When there is no apparent separation between the zones or sand layers, the layers are considered interconnected. This occurs at LHAAP-46 near wells LHSMW23 and LHSMW26 and the groundwater bearing zone has been designated as a composite shallow/intermediate zone. A new set of groundwater elevations were collected on April 15, 2011 and are shown on **Figure 1-3** and **Figure 1-4**. **Figure 1-3** shows groundwater elevation contours in the shallow zone and **Figure 1-4** shows groundwater elevation contours in the intermediate zone. The tabular form of the data is shown in **Table 1-2**.

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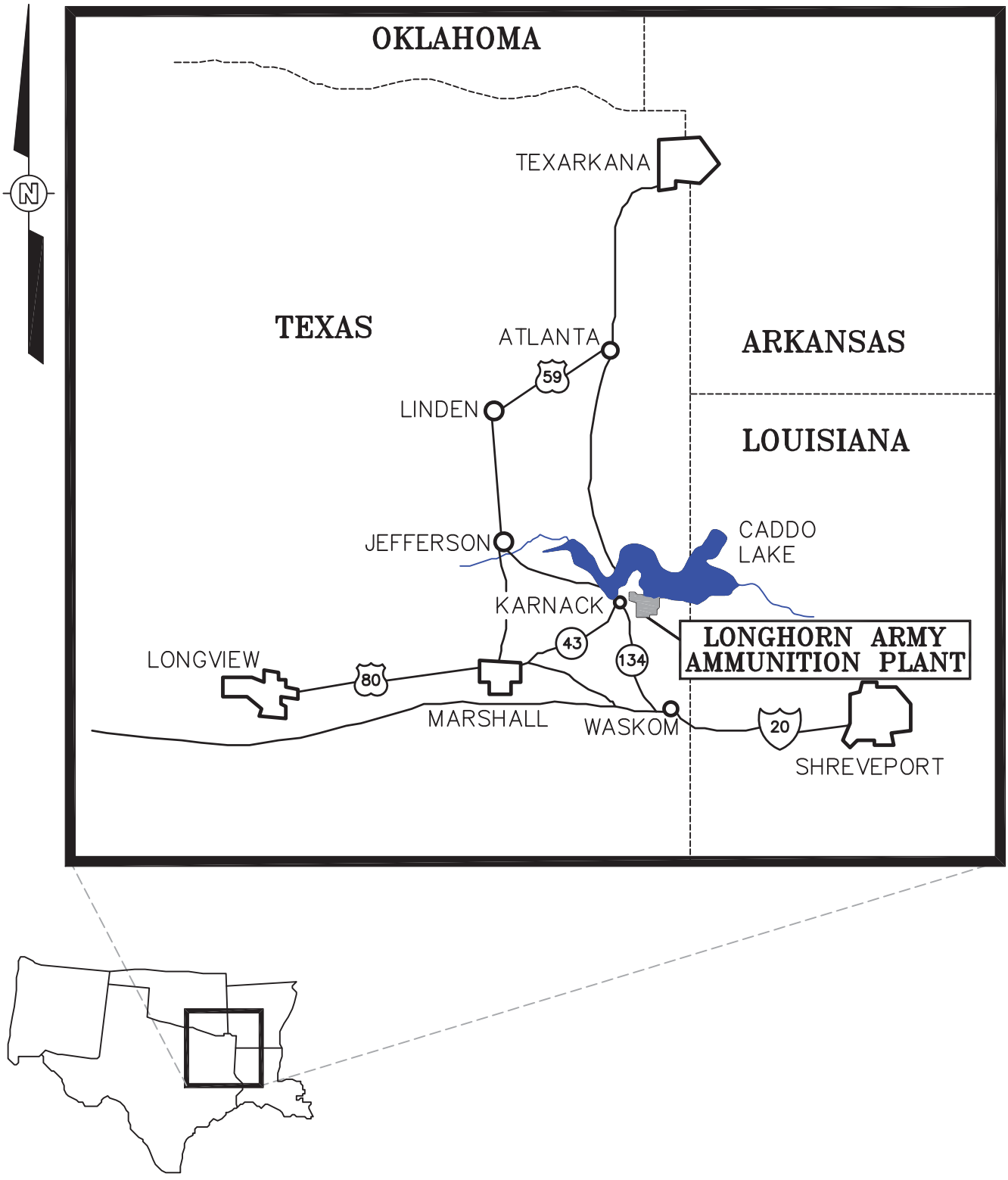
Table 1-2
Groundwater Elevations – April 15, 2011

Well ID	Zone	Depth to Water (feet)	Total Well Depth (feet)	Top of Casing Elevation (feet MSL)	Groundwater Elevation (feet MSL)
46WW01	Shallow	25.02	26.75	212.82	187.80
46WW02	Intermediate	33.93	47.40	212.21	178.28
46WW03	Deep	38.30	103.35	212.47	174.17
46WW04	Shallow	21.80	27.70	215.39	193.59
46WW05	Intermediate	35.42	45.00	208.24	172.82
46WW06	Intermediate	36.86	52.20	213.84	176.98
LHSMW08	Intermediate	27.80	35.49	207.85	180.05
LHSMW09	Shallow	22.29	26.30	210.68	188.39
LHSMW11	Shallow	24.94	26.95	212.91	187.97
LHSMW12	Shallow	Dry	16.85	209.02	Dry
LHSMW13	Shallow	Dry	18.00	209.50	Dry
LHSMW14	Shallow	13.17	20.10	244.78	231.61
LHSMW15	Shallow	23.20	24.90	226.65	203.45
LHSMW16	Shallow	18.92	24.60	232.19	213.27
LHSMW17	Shallow	26.55	26.80	214.58	188.03
LHSMW18	Shallow	23.53	28.70	215.35	191.82
LHSMW19	Shallow	22.83	29.80	212.96	190.13
LHSMW20	Shallow	22.87	24.80	209.29	186.42
LHSMW21	Shallow	18.35	29.55	207.67	189.32
LHSMW22	Shallow	27.97	28.80	209.60	181.63
LHSMW23	Shallow-Intermediate	29.55	47.00	208.82	179.27
LHSMW24	Shallow	25.07	28.60	203.84	178.77
LHSMW25	Intermediate	27.28	42.41	201.97	174.69
LHSMW26	Shallow-Intermediate	28.25	37.47	204.72	176.47
LHSMW27	Shallow	Dry	20.00	202.10	Dry

Notes:

MSL mean sea level



"DRAWING NOT TO SCALE"

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

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

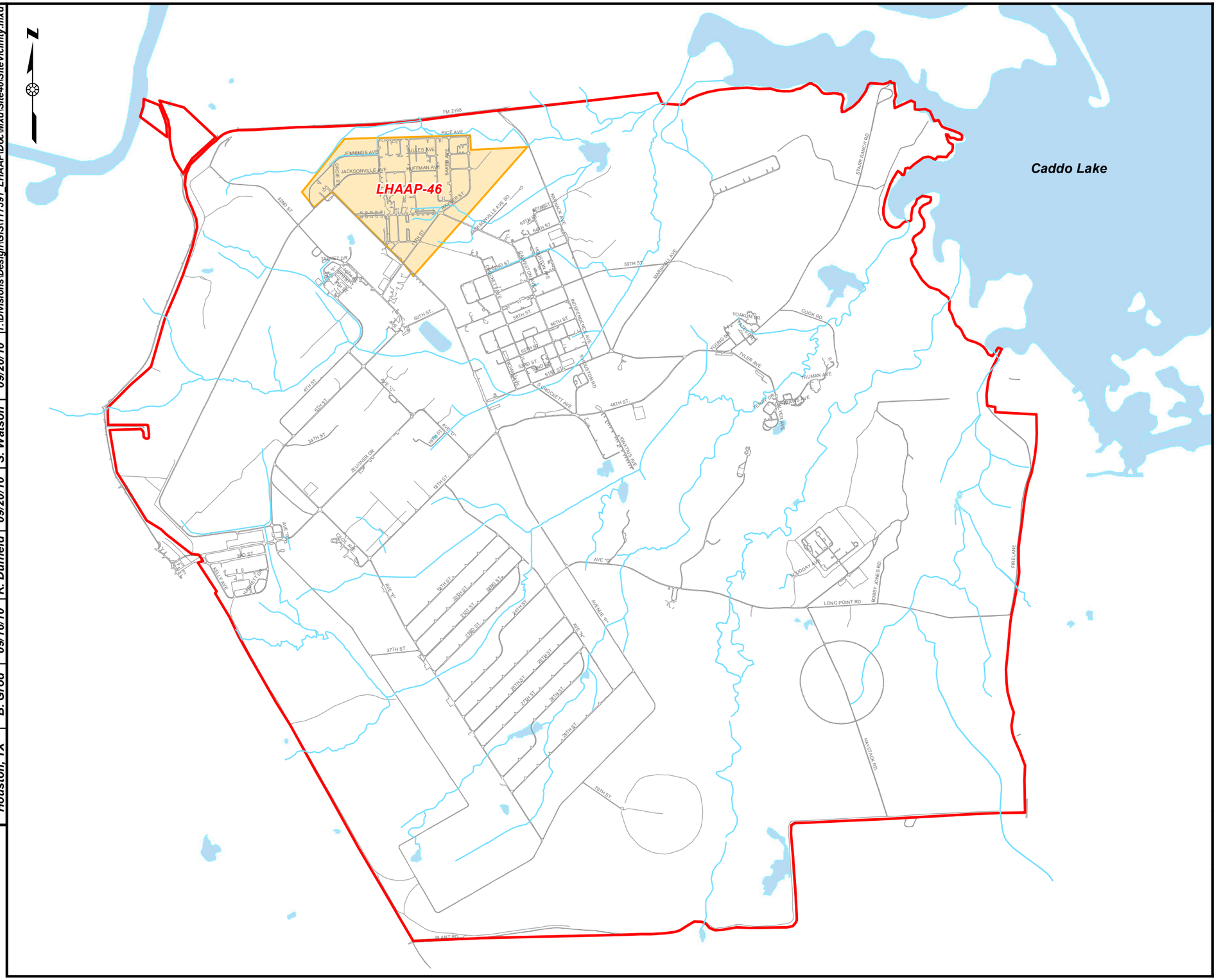
U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 1-1

LHAAP LOCATION MAP

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	FILE PATH
Houston, TX	B. Grod 09/16/10	R. Duffield 09/20/10	S. Watson 09/20/10	T:\Divisions\Design\GIS\117591_LHAAP\Doc\Mxd\Site46\SiteVicinity.mxd



LEGEND

- Stream
- Road
- Site
- Lake
- LHAAP Boundary

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TULSA DISTRICT
TULSA, OKLAHOMA

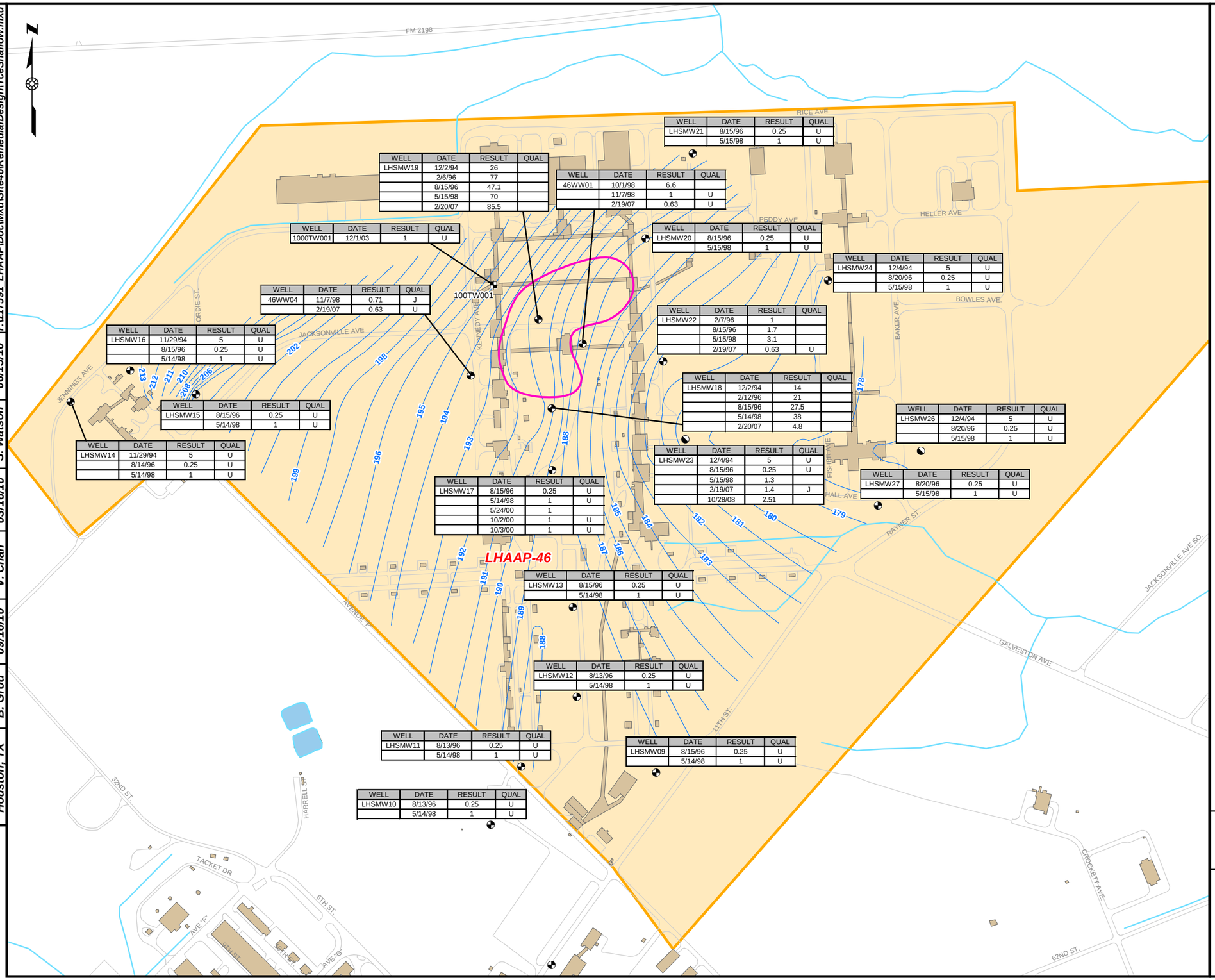
FIGURE 1-2

SITE VICINITY MAP
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FILE PATH	APPROVED BY	CHECKED BY
T:\117591_LHAAP\Doc\Mxd\Site46\RemedialDesign\TceShallow.mxd	S. Watson 06/15/10	V. Chan 03/16/10

DRAWN BY	OFFICE
B. Grod 09/16/10	Houston, TX



WELL	DATE	RESULT	QUAL
LHSMW19	12/2/94	26	
	2/6/96	77	
	8/15/96	47.1	
	5/15/98	70	
	2/20/07	85.5	

WELL	DATE	RESULT	QUAL
46WW01	10/1/98	6.6	
	11/7/98	1	U
	2/19/07	0.63	U

WELL	DATE	RESULT	QUAL
LHSMW21	8/15/96	0.25	U
	5/15/98	1	U

WELL	DATE	RESULT	QUAL
1000TW001	12/1/03	1	U

WELL	DATE	RESULT	QUAL
LHSMW20	8/15/96	0.25	U
	5/15/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW24	12/4/94	5	U
	8/20/96	0.25	U
	5/15/98	1	U

WELL	DATE	RESULT	QUAL
46WW04	11/7/98	0.71	J
	2/19/07	0.63	U

WELL	DATE	RESULT	QUAL
LHSMW22	2/7/96	1	
	8/15/96	1.7	
	5/15/98	3.1	
	2/19/07	0.63	U

WELL	DATE	RESULT	QUAL
LHSMW16	11/29/94	5	U
	8/15/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW18	12/2/94	14	
	2/12/96	21	
	8/15/96	27.5	
	5/14/98	38	
	2/20/07	4.8	

WELL	DATE	RESULT	QUAL
LHSMW26	12/4/94	5	U
	8/20/96	0.25	U
	5/15/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW15	8/15/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW14	11/29/94	5	U
	8/14/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW23	12/4/94	5	U
	8/15/96	0.25	U
	5/15/98	1.3	
	2/19/07	1.4	J
	10/28/08	2.51	

WELL	DATE	RESULT	QUAL
LHSMW27	8/20/96	0.25	U
	5/15/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW17	8/15/96	0.25	U
	5/14/98	1	U
	5/24/00	1	
	10/2/00	1	U
	10/3/00	1	U

WELL	DATE	RESULT	QUAL
LHSMW13	8/15/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW12	8/13/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW11	8/13/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW09	8/15/96	0.25	U
	5/14/98	1	U

WELL	DATE	RESULT	QUAL
LHSMW10	8/13/96	0.25	U
	5/14/98	1	U

LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Zone
- Temporary Monitoring Well
- Shallow Zone TCE Plume (5 µg/L)
- Groundwater Elevation Contour
- Stream
- Road
- Former Building or Concrete Slab
- Site

Note:

1. Sampling results reported in micrograms per liter (µg/L).
2. Groundwater elevation levels collected in April 2011.

0 200 400 800 Feet

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

FIGURE 1-3

TCE IN SHALLOW ZONE
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FILE PATH	
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	DRAWN BY	CHECKED BY	APPROVED BY
OFFICE	B. Grod	V. Chan	S. Watson
Houston, TX	09/16/10	03/16/10	06/15/10

46WW05		
DATE	RESULT	QUAL
10/9/08	5.9	

46WW02		
DATE	RESULT	QUAL
2/20/07	28.9	
10/28/08	31.2	

46WW06		
DATE	RESULT	QUAL
10/9/08	0.25	U

LHSMW23		
DATE	RESULT	QUAL
2/19/07	1.4	J
10/28/08	2.51	

LHSMW25		
DATE	RESULT	QUAL
10/28/08	0.25	U

LHSMW26		
DATE	RESULT	QUAL
5/15/98	1	U

LHAAP-46

LEGEND

- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Intermediate Zone TCE Plume (5 µg/L) *Dashed where inferred*
- Groundwater Elevation Contour
- Stream
- Road
- Former Building or Concrete Slab
- Site

Note:

1. Sampling results reported in micrograms per liter (µg/L).
2. TCE - trichloroethene
3. TCE MCL is 5 µg/L.
4. Groundwater elevation levels collected in April 2011.

0 200 400 800 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 1-4

TCE IN INTERMEDIATE ZONE
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

2.0 LAND USE CONTROL

The objective of the LUC at LHAAP-46 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 goals 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 A** provides sample LUC compliance certification documentation.

The LUC addresses the area of LHAAP-46 that includes two groundwater plumes at LHAAP-46 with levels of contamination that require implementation of a remedy (see **Section 1.3**). The U.S. Army is responsible for implementing, maintaining, monitoring, reporting on, and enforcing the LUC.

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. U.S. Army shall obtain USEPA and Texas Commission on Environmental Quality (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-46 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.

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3.0 MONITORING SYSTEM DESIGN

As part of the remedy, monitoring will be conducted of the groundwater and surface water. The groundwater monitoring system was designed to evaluate and monitor natural attenuation in both the shallow and intermediate plumes and the surface water system was designed 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 according to expectations
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 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.

3.1 MNA 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-46. Each existing well completion was evaluated and wells were assigned to a shallow, shallow-intermediate, or intermediate zone. Based on these designations, the groundwater contamination is located in two zones at LHAAP-46, shallow and intermediate. A deep groundwater zone also exists, but contamination has not been observed in the deep zone. The coordinates and well information are located in **Table 3-1**.

3.1.1 Shallow Groundwater Plume

The site hydrogeology is important when designing a monitoring system. The shallow groundwater elevations are approximately 13 to 28 feet bgs. Generally the groundwater flow

is in an easterly direction as documented in groundwater flow assessments. The current shallow zone wells are completed in the sand interval that is approximately 15 to 25 feet bgs.

The shallow zone plume boundary has shrunk over time and currently has one well within the plume boundary. The plume is bounded; however, the exact shape and boundary of the plume may be smaller 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 a second well location within the plume. Approximately 10 grab samples will be collected using well points and analyzed for volatile organic compounds (VOCs). Based on these results, additional locations may be selected for optimal locations of the performance monitoring wells. **Figure 3-1** indicates possible locations of four additional monitoring wells based on the current data and groundwater elevations. Use of existing wells will be maximized as they provide historic data that can be used in the MNA evaluation. **Table 3-2** provides the rationale for the selection of wells in the proposed monitoring well system for the shallow zone as shown on **Figure 3-1**. The cross sections have been shown on **Figure 3-3**. Additional cross sections are presented in the LHAAP-46 Feasibility Study (Shaw, 2009) and Remedial Investigation report (Jacobs, 2002).

3.1.2 Intermediate Groundwater Plume

The site hydrogeology is important when designing a monitoring system. The intermediate groundwater elevations are approximately 27 to 37 feet bgs. Generally, the groundwater flows in a north-easterly direction as documented in groundwater flow assessments. The current intermediate zone wells are completed in the sand interval that is approximately 36 to 43 feet bgs.

The intermediate zone plume has two wells within the plume. The February 2007 sampling event indicated TCE concentrations at 46WW05 above the MCL at 5.9 µg/L. New monitoring wells will be installed and sampled to delineate the edges of the plume, especially the northern, north-eastern and north-western edge. A third well location will also be installed within the plume. The samples will be analyzed for VOCs. **Figure 3-2** indicates possible locations of four additional monitoring wells based on the current data and groundwater elevations. Use of existing wells will be maximized as they provide historic data that can be used in the MNA evaluation. **Table 3-3** provides the rationale for the selection of wells in the proposed monitoring well system for the intermediate zone as shown on **Figure 3-2**. The cross sections have been shown on **Figure 3-3**. Additional cross sections are presented in the LHAAP-46 Feasibility Study (Shaw, 2009) and Remedial Investigation report (Jacobs, 2002).

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3.1.3 Vertical Well Cluster

Well cluster 46WW01, 46WW02 and 46WW03 have been completed close to the highest concentration wells. 46WW03 has been installed in the deep zone and will be monitored as part of the MNA network to assess any vertical migration.

3.2 MNA Evaluation

The schedule for groundwater monitoring for MNA will be quarterly for two years. This data will be used to evaluate seasonal variation, and attenuation rates. Historical data will be used to evaluate MNA effectiveness and determine if monitoring should continue or a contingent action should be implemented. All collected groundwater samples will be analyzed for VOCs and field parameters (pH, dissolved oxygen [DO], and oxidation reduction potential [ORP]). A subset of the groundwater samples, those from wells historically within the groundwater plume, will also be tested for MNA parameters (dehalococcoides [DHC] (optional), alkalinity, chloride, nitrate/nitrite, sulfate/sulfide, total organic carbon [TOC], carbon dioxide, ferric iron, dissolved manganese and iron, and phosphorus). After the first two years, the effectiveness of MNA will be evaluated (**Section 6.1**). LTM will begin if the MNA evaluation determines MNA to be effective.

3.3 Long-Term Monitoring

LTM will be initiated in the following year after the 2 years of MNA evaluation. For LTM, the analytical suite will be VOCs, and the frequency of sampling will be semiannual for three years, then annually until the next five-year review. Further reductions in sampling frequency will depend on results of five-year reviews, but sampling will continue at least once every five years until cleanup levels are achieved. Based on the LTM results, a reduction in the number of wells to be sampled may be included in the five-year review. Recommendations for reducing the number of wells will be included in monitoring and/or five-year reports.

3.4 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 for VOCs 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.

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3.5 Thallium Monitoring

In addition to monitoring the chemicals of concern (COCs) at LHAAP-46, monitoring for thallium will also be conducted every quarter for the first year (U.S. Army, 2010). Thallium was detected at LHAAP-46 above its MCL of 2 µg/L during the remedial investigation phase and during subsequent monitoring for a geochemical evaluation of metals. Historically the highest thallium concentration was observed in LHMW27. However this data has not been reproducible in the following sampling events (Jacobs, 2002). Shaw will monitor all the monitoring wells in the shallow, intermediate and deep zone. Even though the conclusions of the geochemical evaluation were that thallium was naturally occurring, it was decided that additional groundwater sampling for thallium would be conducted at all monitoring wells to confirm this decision (U.S. Army, 2010).

3.6 Surface Water Monitoring

To ensure that groundwater at LHAAP-46 is not contaminating nearby surface water, semi-annual monitoring of Goose Prairie adjacent to LHAAP-46 will be conducted at one location (**Figure 3-4**). A new surface water sampling location (46SW01) will be added to monitor for contaminant contributions from the groundwater at LHAAP-46. Evaluation of this data will be included in the annual reports. The frequency and location of sampling may be modified after evaluation of data. If TCE levels in the creek are consistently above TCEQ groundwater MSC for residential use 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.

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Table 3-1
Monitoring Wells to be Sampled at LHAAP-46

Well	Groundwater Zone	Approximate depth [a] (ft bgs)	Location		Ground Elevation (ft MSL)	Top of Casing (ft MSL)
			Northing	Easting		
46WW01	Shallow	24	6962839.74	3306046.3	209.75	212.82
46WW02	Intermediate	45	6962842.6	3306068.17	209.16	212.21
46WW03	Deep	100	6962841.67	3306057.06	209.8	212.47
46WW04	Shallow	24	6962709.27	3305584.77	212.47	215.39
46WW05	Intermediate	44	6963454.92	3306300.8	205.59	208.24
46WW06	Intermediate	52.20	6962687.89	3305588.7	211.24	213.84
*46WW07	Intermediate	TBD	TBD	TBD	TBD	TBD
*46WW08	Intermediate	TBD	TBD	TBD	TBD	TBD
*46WW09	Intermediate	TBD	TBD	TBD	TBD	TBD
*46WW10	Shallow	TBD	TBD	TBD	TBD	TBD
*46WW11	Shallow	TBD	TBD	TBD	TBD	TBD
*46WW12	Shallow	TBD	TBD	TBD	TBD	TBD
*46WW13	Shallow	TBD	TBD	TBD	TBD	TBD
*46WW14	Intermediate	TBD	TBD	TBD	TBD	TBD
LHSMW08	Intermediate	33.8	6961325.2	3306617.02	204.49	207.85
LHSMW11	Shallow	24	6961100.93	3305792.93	209.89	212.91
LHSMW12	Shallow	13.6	6961387.04	3306021.93	205.98	209.02
LHSMW14	Shallow	17.4	6962600.77	3303935.98	241.67	244.78
LHSMW15	Shallow	21.6	6962630.67	3304451.98	223.68	226.65
LHSMW16	Shallow	21.6	6962728.61	3304181.02	229.3	232.19
LHSMW18	Shallow	24.5	6962572.94	3305918.42	212.38	215.35
LHSMW19	Shallow	26.6	6962939.93	3305863.42	209.8	212.96
LHSMW20	Shallow	22	6963272.98	3306305.05	206.21	209.29
LHSMW21	Shallow	26.6	6963621.13	3306499.52	204.66	207.67
LHSMW22	Shallow	25.5	6962766.71	3306377.68	206.41	209.6
LHSMW23	Shallow/ Intermediate	38.4	6962446.76	3306469.07	205.8	208.82
LHSMW24	Shallow	25.6	6963099.29	3307057.41	200.52	203.84
LHSMW25	Intermediate	39.2	6963255.59	3307259.52	199.07	201.97
LHSMW27	Shallow	17.6	6962173.9	3307262.99	199.2	202.1

Notes and Abbreviations:

Coordinate system is Texas State Plane, NAD 1983

* Proposed Monitoring Well

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

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

Table 3-2
Rationale for Shallow Plume Performance Monitoring Wells

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
In plume	Highest concentrations in plume; Extreme drought has caused this well to be dry at times, but the well is completed with 10-foot screen over the 2.5-foot sand interval where contamination was found.	LHSMW19	Evaluate presence of any toxic and mobile daughter products, geochemical and microbiological changes of the dissolved plume to evaluate monitored natural attenuation (MNA) processes
In plume	Downgradient from highest concentration in same sand zone	New Well 46WW11	Evaluate presence of daughter products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes; calculate distance based attenuation rate; evaluate plume stability
Downgradient (near plume edge)	Existing well near eastern plume edge	46WW01	Evaluate downgradient plume stability (expansion/contraction), evaluate seasonal variations and effects on plume boundary, and evaluate MNA processes
Downgradient (near plume edge)	Near eastern plume edge	New Well 46WW12	Evaluate downgradient plume stability (expansion/contraction), evaluate seasonal variations and effects on plume boundary, and evaluate MNA processes
Downgradient (near plume edge)	Near eastern plume edge	New Well 46WW13	Evaluate downgradient plume stability (expansion/contraction), evaluate seasonal variations and effects on plume boundary, and evaluate MNA processes
Downgradient	Existing well downgradient of eastern plume edge	LHSMW22	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors; Demonstrate groundwater to surface water contamination will not occur since plume is stable
Crossgradient – North side	Existing well outside plume to the north	LHSMW20	Evaluate lateral expansion
Crossgradient – South side (near/outside plume edge)	Existing well outside of the plume boundary to the south	LHSMW18	Evaluate lateral expansion; evaluate seasonal variations if it is determined that this well is on the plume boundary – if not on the plume boundary, this will be the primary cross gradient well.
Crossgradient – South side (outside plume edge; optional location)	Existing well outside of the plume boundary to the south	LHSMW17	Evaluate lateral expansion of the plume. If direct-push technology (DPT) investigation determines that the plume boundary is not near LHSMW18, than this well will not be part of the monitoring network and LHSMW18 would be the used as the cross gradient well.
Upgradient	Well outside the plume boundary to the west	New Well 46WW10	Detect any new contamination flowing into plume area; Evaluate lateral plume expansion
Upgradient (optional location)	Existing well outside the plume boundary to the west	46WW04	Detect any new contamination flowing into plume area; Evaluate lateral expansion

Table 3-3
Rationale for Intermediate Plume Performance Monitoring Wells

Performance Monitoring Well Location	Monitoring Well Location Relative to Plume	Well ID	Utility
In plume	Highest concentrations in plume;	46WW02	Evaluate presence of any toxic and mobile daughter products, geochemical and microbiological changes of the dissolved plume to evaluate monitored natural attenuation (MNA) processes
In plume	New monitoring well to be installed within the plume	New Well 46WW09	Evaluate presence of any toxic and mobile daughter products, geochemical and microbiological changes of the dissolved plume to evaluate MNA processes
In plume (near north boundary edge)	Downgradient from highest concentration in same sand zone	46WW05	Evaluate presence of daughter 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
Cross-gradient (near/outside the plume edge)	Existing well near south-western plume edge	46WW06	Evaluate lateral expansion (expansion/contraction) and evaluate seasonal variations and effects on plume boundary
Downgradient (outside the plume edge)	Existing well downgradient of the plume	LHSMW25	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors
Downgradient (outside the plume edge)	New monitoring well to be installed outside the plume to the north	New Well 46WW07	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors; Demonstrate groundwater to surface water contamination will not occur since plume is stable
Downgradient (outside the plume edge)	New monitoring well to be installed outside the plume to the north-west	New Well 46WW08	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors; Demonstrate groundwater to surface water contamination will not occur since plume is stable
Upgradient (outside the plume edge)	Existing well outside plume to the south. Well has 20-foot screen; screened over shallow-intermediate and intermediate sands.	LHSMW23	Detect any new contamination flowing into plume area; Evaluate lateral expansion
Downgradient (outside the plume edge)	New monitoring well to be installed outside the plume to the north-east	New Well 46WW14	Evaluate downgradient expansion; Verify no unacceptable impact to downgradient receptors; Demonstrate groundwater to surface water contamination will not occur since plume is stable; Evaluate MNA processes

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Houston, TX	B. Grod 04/26/2011	V. Chan 04/26/2011

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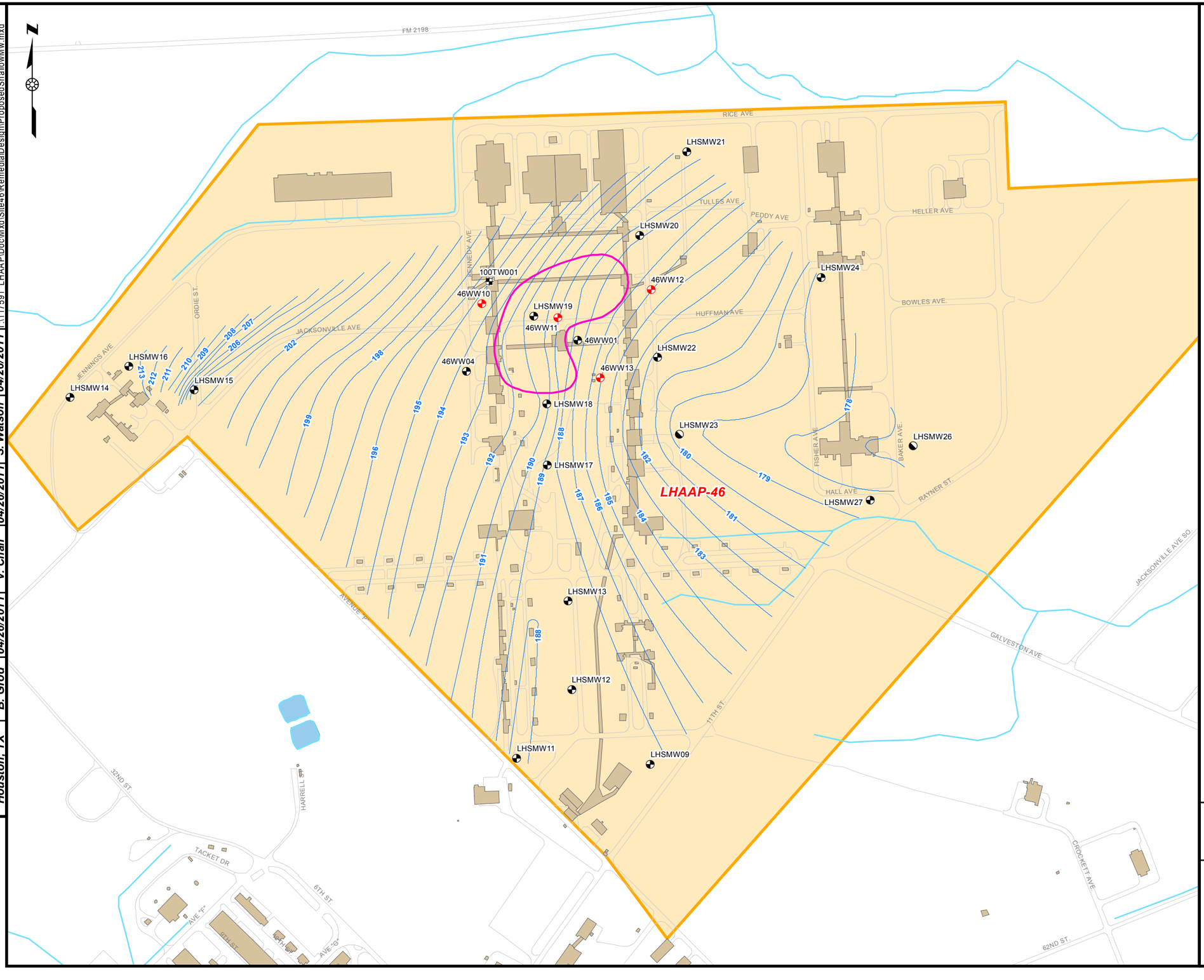

LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Proposed Shallow Monitoring Well
- Temporary Monitoring Well
- Groundwater Elevation Contour
- Shallow Zone TCE Plume (5 µg/L)
- Stream
- Road
- Former Building or Concrete Slab
- Site

Note:

1. Groundwater elevation measured on April 15, 2011.

0 200 400 800 Feet

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TULSA, OKLAHOMA

FIGURE 3-1
PROPOSED MONITORING WELLS FOR INSTALLATION IN THE SHALLOW ZONE LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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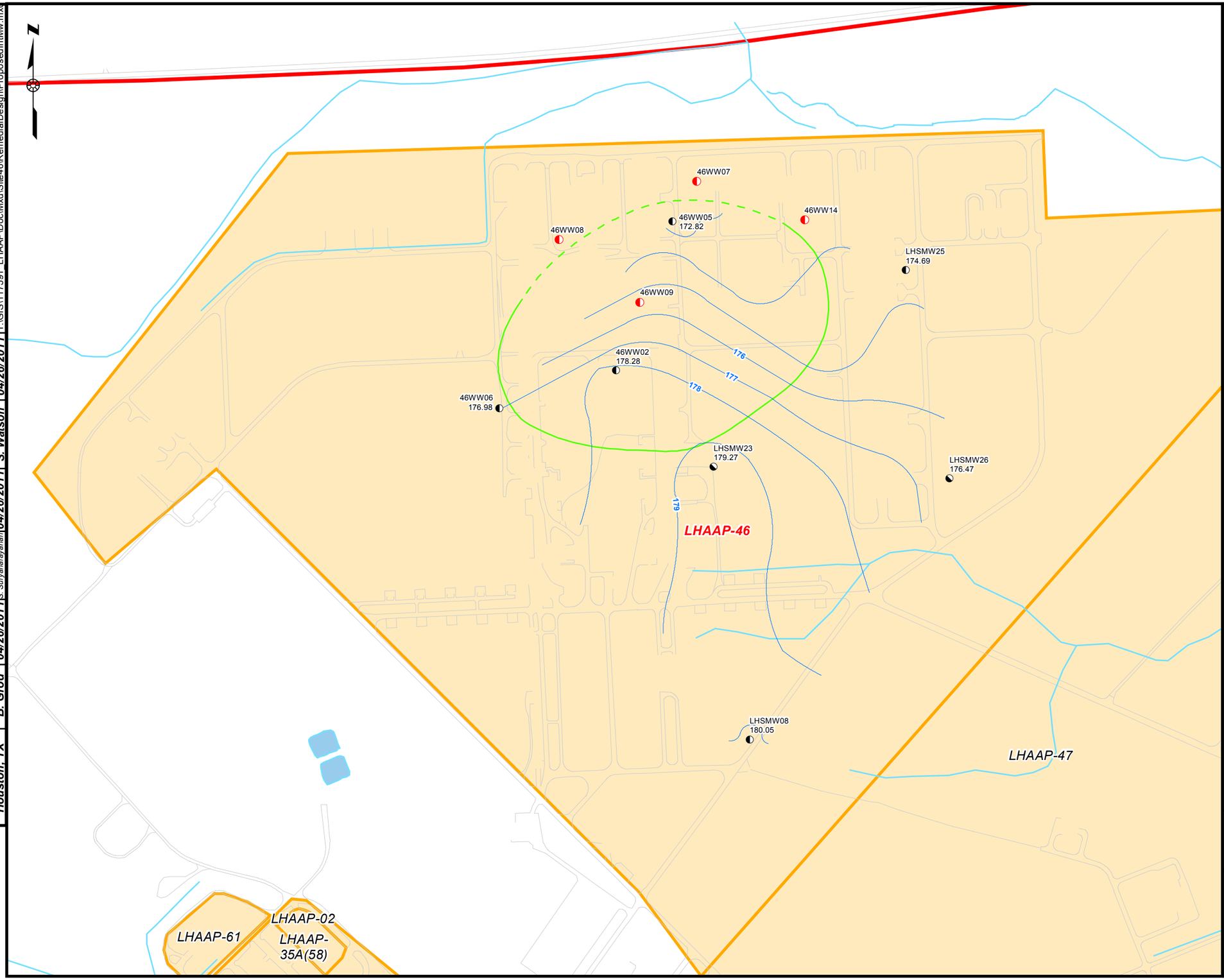
Houston, TX	04/26/2011	04/26/2011	04/26/2011



LEGEND

- Intermediate Monitoring Well
- Shallow/Intermediate Monitoring Well
- Proposed Intermediate Monitoring Well
- Groundwater Elevation Contour
- Intermediate Zone TCE Plume (5 µg/L) *Dashed where inferred*
- Stream
- Road
- Approximate LHAAP Boundary
- Site

Note:

1. Groundwater elevation measured on April 15, 2011.

0 200 400 800 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 3-2
PROPOSED MONITORING WELLS
FOR INSTALLATION IN
THE INTERMEDIATE ZONE
LHAAP-46, REMEDIAL DESIGN
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

IMAGE	X-REF	OFFICE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
---	---	Knoxville, TN	C. BENTLEY			117591-B20

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

A

A'

46WW06 (INTERMEDIATE)
LHSMW18 (SHALLOW)
46WW01 (SHALLOW)
46WW02 (INTERMEDIATE)
LHSMW20 (SHALLOW)
46WW05 (INTERMEDIATE)

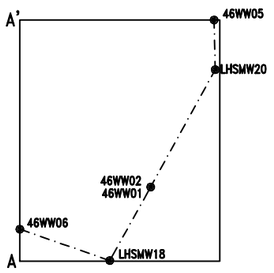
ELEVATION, FEET

220
210
200
190
180
170
160
150

SM
CL
CH
SC
SC/CL
SC/SP
SP/SM
CH/CL
MH

SHALLOW GROUNDWATER ZONE
INTERMEDIATE GROUNDWATER ZONE

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300



LEGEND:

- CLAY (CL)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- POORLY GRADED SAND (SP)
- SCREEN
- INORGANIC SILTS (MH)
- FAT CLAY (CH)
- GROUNDWATER ELEVATION APRIL 15, 2011

SECTION A–A'

VERTICAL SCALE
0 10 20 30 FEET

HORIZONTAL SCALE
0 100 200 300 FEET

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FIGURE 3–3
CROSS SECTION A–A'
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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Houston, TX	B. Grod 02/10/11	S. Suryanarayanan 02/10/11	S. Watson 02/10/11

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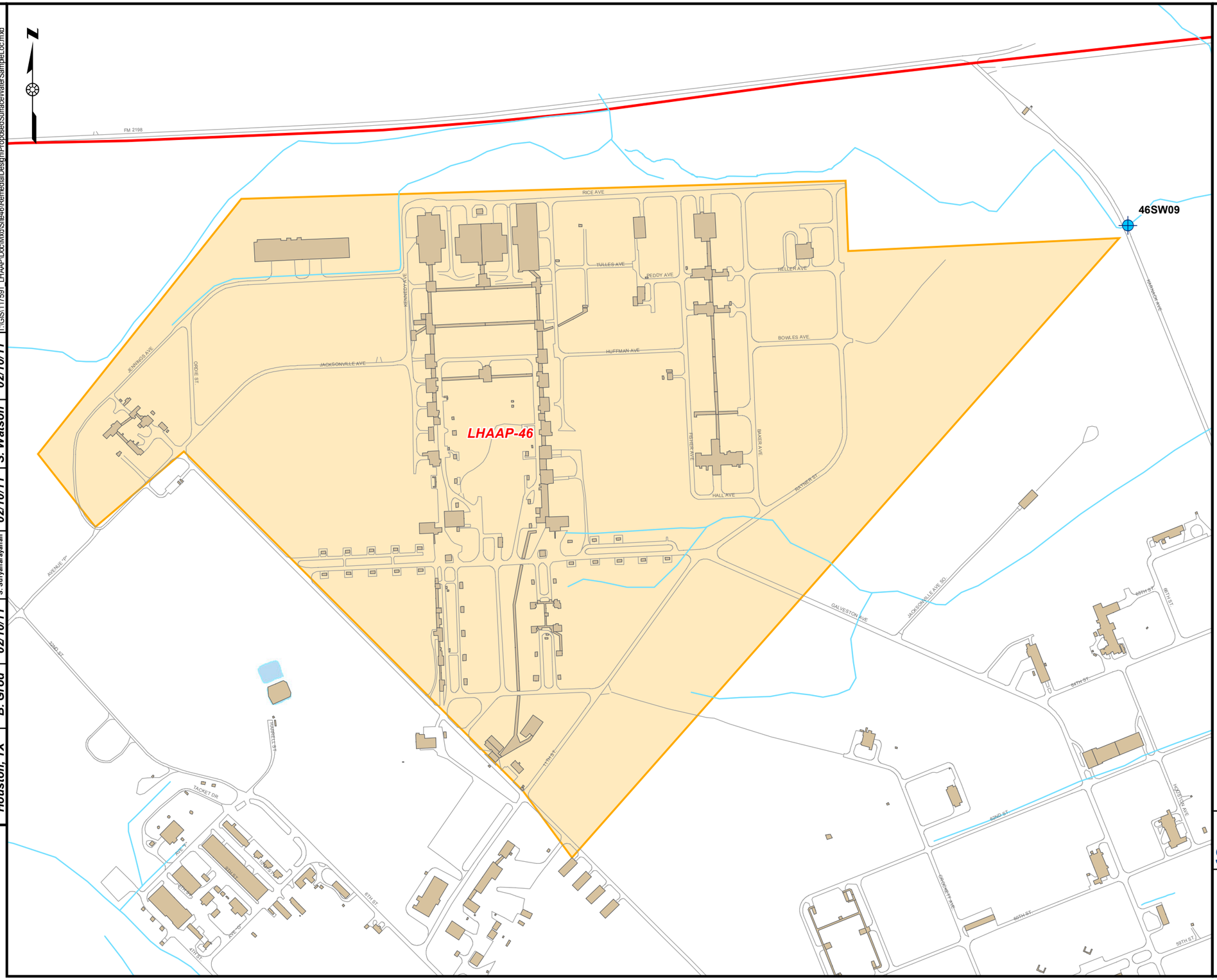

LEGEND

- Surface Water Sample
- Stream
- Road
- Site
- Former Building or Concrete Slab
- Lake
- LHAAP Boundary

0 250 500 1,000 Feet

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TULSA DISTRICT
TULSA, OKLAHOMA

FIGURE 3-4

PROPOSED SURFACE WATER SAMPLING LOCATION
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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4.0 LAND USE CONTROL DESIGN AND IMPLEMENTATION PLAN

This section describes the LUC design and implementation activities for LHAAP-46. 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-46 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 goals 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-46 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 (LUC O&M) Plan will identify the measures required for the 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.

4.1 Land Use Control Implementation

The U.S. Army will undertake the following actions to implement the groundwater restriction LUC for LHAAP-46:

- 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, §335.56.

- 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. A LUC O&M Plan for LHAAP-46 will be developed. It will include the elements presented in **Section 4.2** below, the county recordation of the LUC survey plat, legal description and restriction language and the annual inspection/certification form.

4.2 Land Use Control Operation and Maintenance

The U.S. Army or its representatives will be responsible for the operation and maintenance of the LHAAP-46 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, U.S. Army will develop a plan that will encompass the elements described in the following subsections.

4.2.1 Site Certification and Reporting

Beginning with finalization of this RD and approval of the annual inspection form, the U.S. Army will undertake annual inspections and certify continued compliance with the LUC objectives. The U.S. Army, or the transferee after transfer, will retain the annual 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 annual 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 annual certifications will be revisited at five year reviews.

4.2.2 Notice of Planned Property Conveyances

The U.S. Army shall provide notice to USEPA and TCEQ of plans to convey the LHAAP-46 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

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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.

4.2.3 Opportunity to Review Text of Intended Land Use Controls

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. 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-46, 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.

4.2.4 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 4.2.5** 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.

4.2.5 Land Use Control Enforcement

Should the LUC remedy reflected in this LUC 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 U.S. Fish and Wildlife Service or its lessee, to the institution of judicial action against nonfederal 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.

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4.2.6 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 a 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 LUCs 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.

4.2.7 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-46.

The Comprehensive LUC Management Plan consists of LHAAP RD documents and a survey plat showing the locations where LUCs being implemented at LHAAP are applied. The purpose of this Comprehensive LUC Management Plan is to ensure all site-specific LUCs 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 will also be accessible to the local government and 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 reuse as part of a national wildlife refuge forms the basis for the remedy at LHAAP-46 and this land use assumption will be in included in the Comprehensive LUC Management Plan with supporting documentation.

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5.0 FIELD ACTIVITIES

This section describes the field activities planned at LHAAP-46. General activities would apply to any site with similar characteristics. Site-specific activities are described in associated subsections. The field activities to be conducted under this RD are outlined below:

- Pre-Mobilization Activities
- Preliminary Activities/Mobilization
- Site Clearing
- Monitoring Well Installation
- Groundwater Sampling
- Surface Water Sampling
- Waste Management
- Decontamination
- Well Abandonment
- Demobilization
- Health and Safety
- Quality Assurance/Quality Control

The field activities will be conducted in accordance with the Site-Specific Supplement to Health and Safety Plan (HASP) in **Appendix B**. The work will be routinely inspected in accordance with the Contractor Quality Control Plan (CQCP) in **Appendix C**. Additional information regarding these tasks 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).

5.1 Pre-mobilization Activities

A pre-construction meeting will be held for 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 a state-licensed surveyor and the coordinate system will be Texas State Plane, NAD 1983.

Prior to mobilization, Shaw will secure any applicable permits and notifications. These may include federal, state and local requirements. Shaw will also secure utility clearance for water, sewer, gas, electric, and communication if any intrusive work is needed. At this time, no intrusive work is planned at LHAAP-46.

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Shaw will inspect LHAAP-46 to identify overhead electrical lines that may restrict groundwater monitoring activities. As necessary, Shaw will either shut down power, reroute power, remove poles, and/or ensure that the poles are guy-wired for stability. If power must be shut down, the power outage will be coordinated with groundwater treatment plant (GWTP) and fire station operations.

5.2 Preliminary Activities/Mobilization

Shaw anticipates mobilizing the following personnel:

- Quality control/safety manager
- One laborer/sample technician

Those personnel will utilize the following equipment:

- Pickup trucks
- Groundwater monitoring field parameters test equipment
- Groundwater sampling pumps

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

5.3 Site Clearing

Site maps and a Global Positioning System will be used to locate and identify monitoring wells selected for sampling as shown on **Figure 5-1** and **Figure 5-2**. Monitoring wells to be sampled will be cleared of vegetation and biohazards (e.g., poison ivy, stinging insects) to ensure safe access for groundwater sampling.

5.4 Monitoring Well Installation

Shaw will add five monitoring wells in the shallow and intermediate zone as shown in **Figures 3-1, 3-2,** and **5-1**. Up to 10 DPT groundwater samples will be collected prior to installing the monitoring wells to better define the shallow and intermediate plumes.

5.5 Groundwater Sampling

Groundwater sampling will be performed in accordance with the requirements presented in the CQCP (**Appendix C**). 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).

5.5.1 Monitored Natural Attenuation

The monitoring portion of the MNA will be accomplished by collecting groundwater samples from the seventeen wells shown on **Figure 5-1**. Eight of these wells are located in the shallow zone, seven are located in the intermediate zone, one in the shallow-intermediate zone and one in the deep groundwater zone. These wells were selected for their placement relative to the TCE plumes to monitor the effectiveness of natural attenuation at LHAAP-46. Groundwater levels will be measured in these and several surrounding wells to evaluate groundwater flow direction.

The electronic interface probe used to measure depth to groundwater in monitoring wells and pumps used for well development, purging and sampling will be decontaminated prior to use at each well. The equipment will be decontaminated using a non-phosphate detergent (such as Alconox, Liquinox, or equivalent), followed by two potable water rinses, one deionized water rinse, and air dried. Decontamination fluids will be containerized for subsequent disposal. Clean single use disposable equipment (tubing or bailers) may be used for sampling a well without this decontamination process.

The schedule for groundwater monitoring for MNA will be quarterly for two years. All seventeen collected groundwater samples will be analyzed for VOCs and the following field parameters: pH, temperature, ORP, DO, conductivity, and turbidity. A subset of the groundwater samples (LHSMW19, 46WW11, 46WW02, 46WW05 and 46WW09), those from wells historically within the groundwater plume, will also be tested for the following MNA parameters: alkalinity, common anions (chloride, sulfate, nitrate, nitrite), sulfide, TOC, dissolved iron and manganese, total phosphorus, carbon dioxide and dissolved gases (methane, ethane, ethene), total iron, and ferric iron. Also, the following MNA parameters are optional in the MNA analysis, and may or may not be collected: DHC, hydrogen and volatile fatty acids. **Table 5-1** indicates the analytes for each well. **Table 5-2** lists the analytes, test methods, and other sampling information.

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

5.5.2 Thallium

Groundwater samples will be collected from all monitoring wells for thallium as shown on **Figure 5-2**. Samples will be analyzed for thallium at an off-site lab, for the field parameters listed in **Section 5.5.1**, and for an additional field parameter, ferric iron. Sampling for thallium will be conducted concurrently with MNA sampling for the first year (4 quarters). If any well has concentrations below the MCL for four quarters, it will be dropped from the thallium sampling program. The data will be evaluated to determine if the thallium

monitoring will continue until the first five-year review. If it is determined that thallium monitoring will continue, the wells and frequency will be selected. A letter report documenting the conclusions and transmitting the analytical data reports will be produced.

5.5.3 Long-Term Monitoring

After the first two years, the effectiveness of MNA will be evaluated (**Section 6.1**). If the MNA Evaluation determines MNA to be effective, the analytical suite will be reduced to only VOCs for the wells indicated on **Figure 5-1**, 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.

5.6 Surface Water Sampling

Semi-annual performance monitoring of Goose Prairie Creek adjacent to LHAAP-46 will be conducted at one location as shown in **Figure 3-4**. Surface water sampling will be conducted as described in **Section 3.6**.

5.7 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. Waste management activities will be conducted in accordance with the requirements presented in Task 3 of the CQCP (**Appendix C**).

Description of Wastes. Groundwater sampling activities at LHAAP-46 are expected to generate the following waste streams:

Waste Type	Estimated Quantity
Decontamination and Purge Water	330 gallons [(6) 55-gallon drums]
Miscellaneous Wastes (personal protective equipment, paper towels, rags, well casings, etc.)	—

Waste Handling. The liquid waste will be disposed at the GWTP at LHAAP-18/24. If at some point in the future when the GWTP may cease its operations, water will be handled in accordance with current regulations at that time, and will be transported and disposed of off-site. Additional details for disposal sampling are found in the *Final Installation-Wide Work Plan*, Appendix C, CDAP and Appendix D, Field Procedures (Shaw, 2006).

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The non-hazardous decontamination and purge water will be stored in 55-gallon drums until disposal at the LHAAP GWTP. The miscellaneous wastes will be placed in plastic bags until disposal.

The miscellaneous wastes will be disposed of at an off-site municipal solid waste facility.

Waste Type	Disposal Method
Decontamination Water-Non-Hazardous Waste	LHAAP Groundwater Treatment Plant (GWTP)
Miscellaneous Wastes	Municipal Solid Waste

5.8 Decontamination of Equipment and Personnel

A permanent decontamination station is located at the on-site GWTP at LHAAP-18/24 and can accommodate large equipment. Temporary decontamination pads will be constructed at an approved on-site location as needed to decontaminate equipment and prevent cross-contamination between well locations. The decontamination pad will be approximately 15 feet in length and width, bermed, and covered with high-density polyethylene sheeting. Wash water 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).

5.9 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. Tentative wells planned to be abandoned are indicated on **Figure 5-3**. LHSMW12, LHSMW15, and LHSMW27 will be monitored for thallium in the first four quarters and abandoned after one year, if thallium concentrations are below the MCL. Final recommendation 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). These abandonment procedures were developed in reference to and conform to the requirements of 16 TAC 76.1004.

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.

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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.

5.10 Demobilization

Upon completion of well abandonment operations, Shaw will remove any temporary facilities, perform final equipment decontamination, and demobilize personnel and equipment.

5.11 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 groundwater monitoring activities at the LHAAP-46 is provided in **Appendix B**. This information includes personnel protective equipment 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 in the designated area to indicate they have read and understood the document. Also, daily safety meetings will be held with all field crew members prior to starting work each day in order to review the day's scope of work, any site conditions expected, and any hazards that need to be addressed or acknowledged.

5.12 Quality Assurance/Quality Control

The CQCP provides information on quality assurance/quality control (QA/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-46. The CQCP is provided in **Appendix C**.

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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Table 5-1
Sample Analytes

Well ID	VOCs	Thallium	Field Parameters	MNA Parameters
Shallow				
46WW01	✓	✓	✓	✓
46WW04	✓	✓	✓	
*46WW10	✓	✓	✓	
*46WW11	✓	✓	✓	✓
*46WW12	✓	✓	✓	✓
*46WW13	✓	✓	✓	✓
LHSMW11		✓	✓	
LHSMW12		✓	✓	
LHSMW14		✓	✓	
LHSMW15		✓	✓	
LHSMW16		✓	✓	
LHSMW18	✓	✓	✓	
LHSMW19	✓	✓	✓	✓
LHSMW20	✓	✓	✓	
LHSMW21		✓	✓	
LHSMW22	✓	✓	✓	
LHSMW24		✓	✓	
LHSMW27		✓	✓	
Shallow/Intermediate				
LHSMW23	✓	✓	✓	
Intermediate				
46WW02	✓	✓	✓	✓
46WW05	✓	✓	✓	✓
46WW06	✓	✓	✓	
*46WW07	✓	✓	✓	
*46WW08	✓	✓	✓	
*46WW09	✓	✓	✓	✓
*46WW14	✓	✓	✓	✓
LHSMW08		✓	✓	
LHSMW25	✓	✓	✓	
Deep				
46WW03	✓		✓	

Notes and Abbreviations:

Field parameters for all wells: pH, temperature, oxidation reduction potential, dissolved oxygen, conductivity, turbidity, and ferrous iron. In addition, for wells analyzed for thallium: ferric iron.

MNA parameters (only first two years): alkalinity, common anions (chloride, sulfate, nitrate, nitrite), sulfide, total organic carbon, dissolved iron and manganese, total phosphorus, carbon dioxide and dissolved gases (methane, ethane, ethene), total iron, and ferric iron. Optional parameters: hydrogen, volatile fatty acids, and dehalococcoides,.

* Proposed monitoring wells to be installed

MNA monitored natural attenuation
VOCs volatile organic compounds (i.e., trichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, vinyl chloride)

Table 5-2
Sample Methods, Containers, and Preservation

Parameter	Minimum Sample Volume	Holding Time	Preservation	Method
Water				
Volatiles	3x40 mL glass vial with PTFE septa cap	14 days	pH < 2 HCl, Cool to 4°C, no headspace	8260B (or latest method)
Dehalococcoides (DHC)	2x1 L amber glass bottles with teflon-lined cap(s)	14 days	Cool to 4°C	polymerase chain reaction (PCR)
Alkalinity (total, carbonate and bicarbonate)	250 mL polyethylene bottles	14 days	Cool to 4°C	EPA 310.2
Common anions (chloride [Cl], sulfate [SO4], nitrate [NO3], nitrite	250 mL polyethylene bottles	28 days (Cl/SO4) and 48 hours (individual NO3 and NO2)	Cool to 4°C	EPA 300.0
Nitrate/nitrite as N	500 mL polyethylene bottles	28 days	pH<2 H2SO4, Cool to 4°C	EPA 353.2
Sulfide	250 mL polyethylene bottles	7 days	pH>9 zinc acetate plus NaOH, Cool to 4°C	EPA 376.1
Total organic carbon (TOC)	125 mL polyethylene bottles	28 days	pH<2 H2SO4 or HCl, Cool to 4°C	EPA 415.1
Dissolved iron and manganese	500 mL polyethylene bottles	6 months	pH<2 HNO3, Cool to 4°C	6010B
Phosphorus, total	100 mL polyethylene bottles	28 days	pH<2 H2SO4, Cool to 4°C	EPA 365.4
Carbon dioxide and dissolved gases (methane/ethane/ethene)	3x40 mL glass vial with PTFE septa cap	14 days	Cool to 4°C	RSK 175
Iron and thallium, Total	500 mL polyethylene bottles	6 months	pH<2 HNO3, Cool to 4°C	6010B/6020A
Ferrous iron	NA	Immediately in field	NA	NA
**Ferric iron	NA	NA	NA	NA

Notes and Abbreviations:

The above listed volumes provide an adequate quantity of samples to anaylyze a matrix spike (MS) and matrix spike duplicate (MSD).

** Ferric Iron is difference between total iron and ferrous iron

°C - degrees centigrade
H2SO4 - sulfuric acid
HCl - hydrochloric acid
HNO_3 - nitric acid
L - liter
mL - milliliter
PTFE - polytetrafluoroethylene

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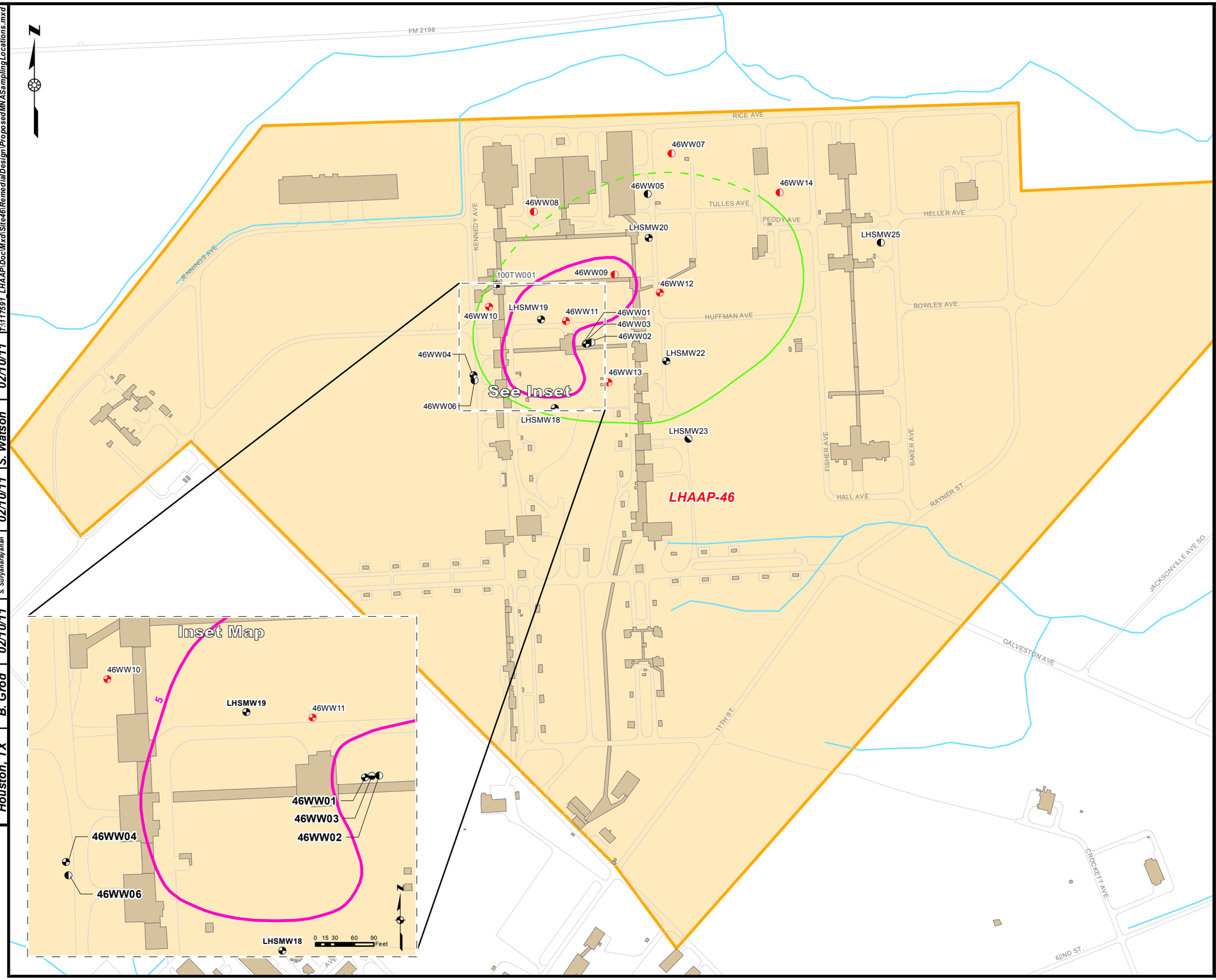
CHECKED BY	S. Suryanarayanan 02/10/11
DRAWN BY	B. Grod 02/10/11
OFFICE	Houston, TX



LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Temporary Monitoring Well
- Proposed Shallow Monitoring Well
- Proposed Intermediate Monitoring Well
- Intermediate Zone TCE Plume (5 µg/L) *Dashed where inferred*
- Shallow Zone TCE Plume (5 µg/L)
- Stream
- Road
- Former Building or Concrete Slab
- Site

Note:

1. TCE - Trichloroethene

2. 46WW07, 46WW08, 46WW09, 46WW10, and 46WW11 are the proposed monitoring well locations.

3. Monitoring wells within the plumes (LHSMW19, 46WW11, 46WW02, 46WW05, and 46WW09) will be sampled for MNA parameters in addition to TCE.

0 200 400 800 Feet

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FIGURE 5-1

PROPOSED WELLS FOR MNA SAMPLING
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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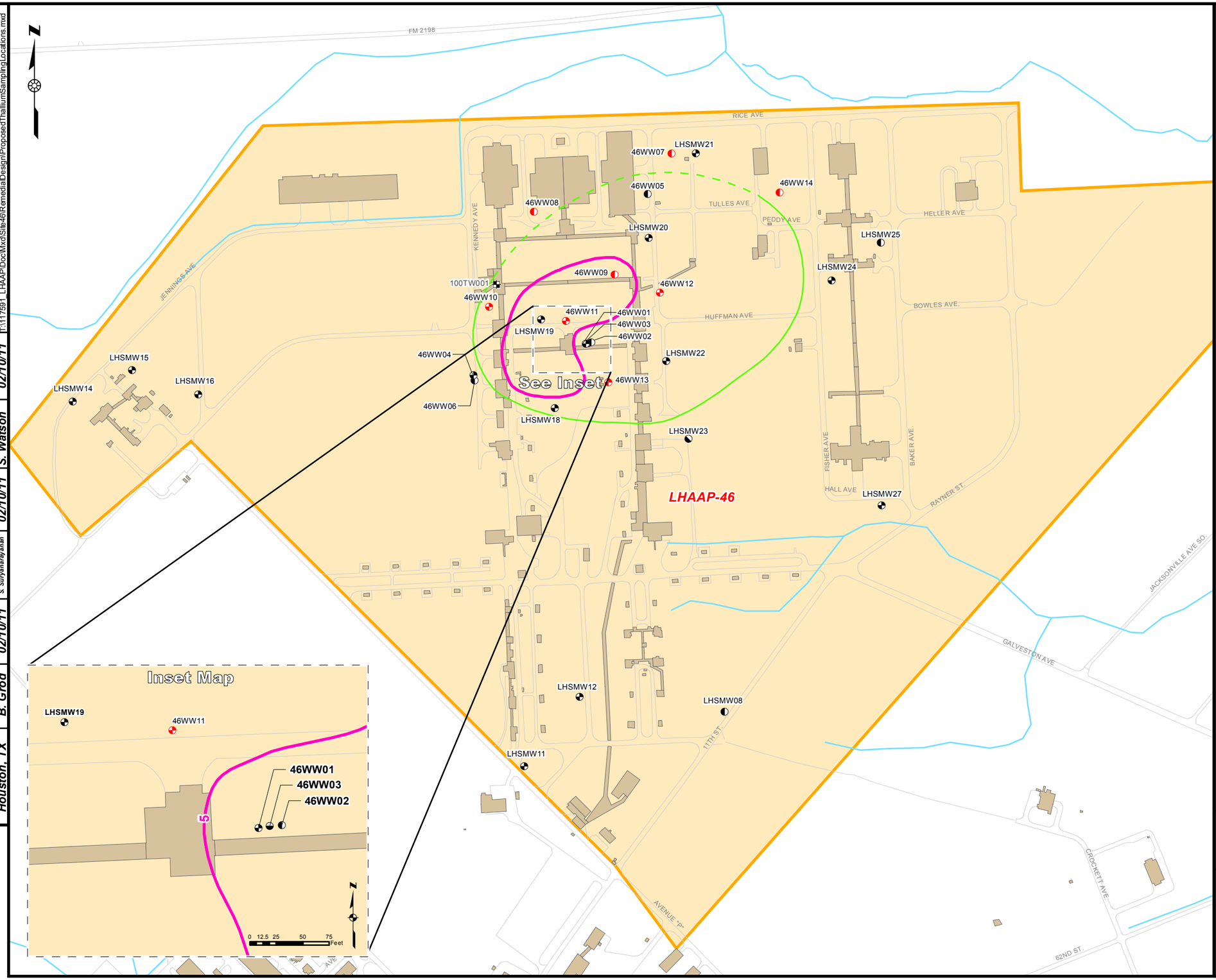
DRAWN BY	B. Grod	02/10/11
OFFICE	Houston, TX	



LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Temporary Monitoring Well
- Proposed Shallow Monitoring Well
- Proposed Intermediate Monitoring Well
- Intermediate Zone TCE Plume (5 µg/L) *Dashed where inferred*
- Shallow Zone TCE Plume (5 µg/L)
- Stream
- Road
- Former Building or Concrete Slab
- Site

Note:

1. TCE - Trichloroethene

2. 46WW07, 46WW08, 46WW09, 46WW10, and 46WW11 are the proposed monitoring well locations.

0 200 400 800 Feet

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FIGURE 5-2

PROPOSED WELLS
FOR THALLIUM SAMPLING
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

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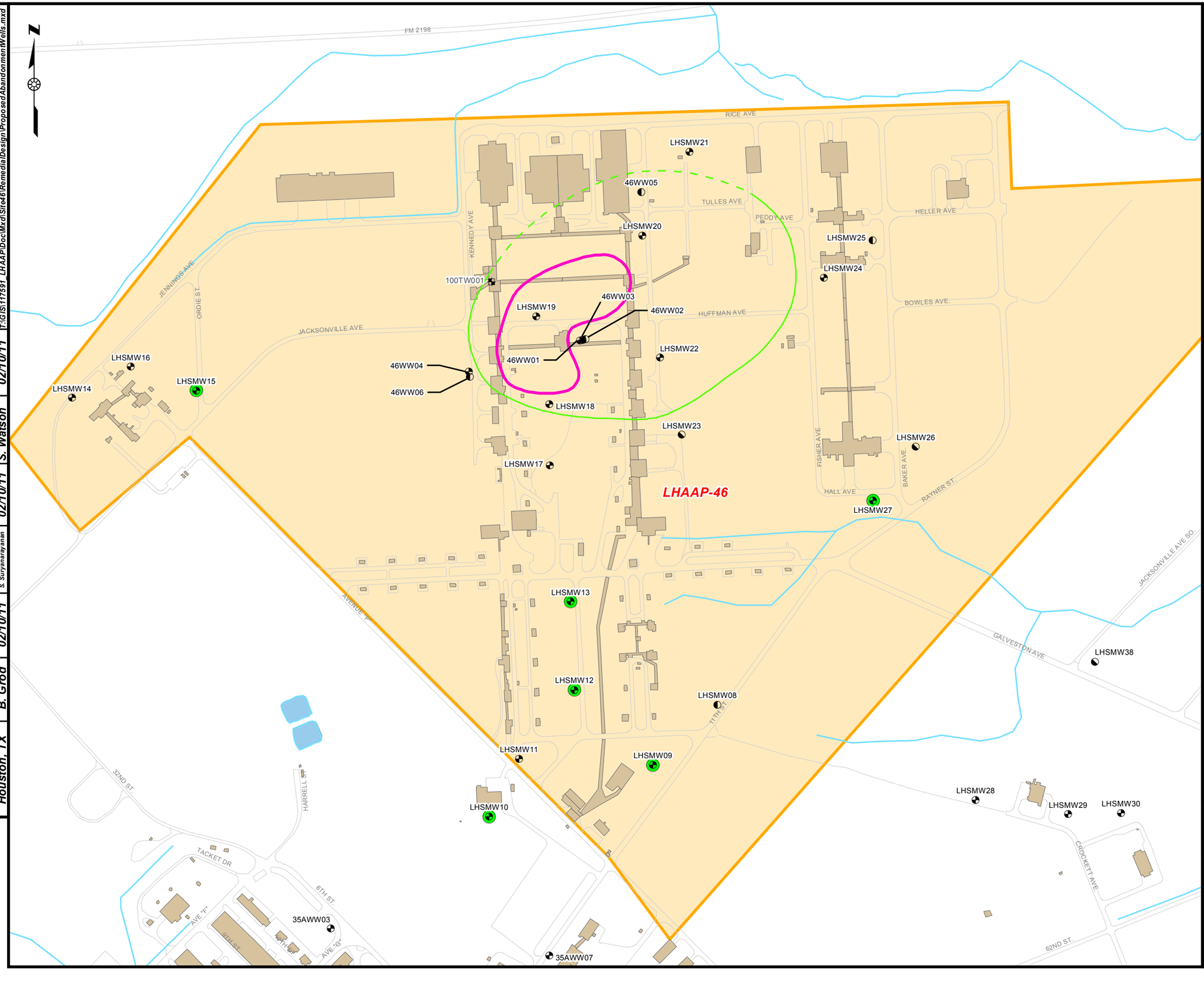

LEGEND

- Shallow Monitoring Well
- Shallow/Intermediate Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Temporary Monitoring Well
- Well Location to be Abandoned (6)
- Shallow Zone TCE Plume (5 µg/L)
- Intermediate Zone TCE Plume (5 µg/L) *Dashed where inferred*
- Stream
- Road
- Former Building or Concrete Slab
- Site

Note:

1. LHSMW012, LHSMW015, and LHSMW027, will be abandoned, if Thallium concentration in these wells are below MCL for the first four quarters.

0 200 400 800 Feet

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FIGURE 5-3

PROPOSED WELLS FOR ABANDONMENT
LHAAP-46, REMEDIAL DESIGN

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

6.0 REMEDY PERFORMANCE REPORTING

Reporting will consist of annual reports, an MNA evaluation report at the end of the eight quarters of sampling, and a five-year review report. Annual reports will be prepared at the end of each calendar year for every year in which groundwater samples are collected. The MNA evaluation will be prepared once, using the eight episodes of quarterly sampling results from the first two years combined with historical sampling results. The five-year reviews will be prepared once every five years for so long as groundwater sampling is required (until cleanup levels are achieved, see **Section 3.0**).

6.1 MNA Evaluation

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 6-1** Compilation of the information for the evaluation will occur throughout the first two years of quarterly groundwater monitoring. The MNA Evaluation Report will include:

- Figures of the site, wells, and groundwater level contours
- Tables of groundwater and surface water sample results
- Comparison of plume extent and concentration over time (**Table 6-1**, Performance Criteria 1)
- Consideration of the first and second lines of evidence for MNA and the third line of evidence if necessary (**Table 6-1**, Performance Criteria)
- An evaluation of the effectiveness of MNA at the site
- A recommendation for continued MNA, in situ bioremediation, or another remedy

6.1.1 Migration/Expansion

For the evaluation of MNA at LHAAP-46 to be favorable, the MNA evaluation should demonstrate plume stability. A groundwater plume is stable when pollutant concentrations and the plume's footprint are stable. A stable plume shows that pollutant migration in groundwater is under control. The determination of plume dynamics should be performed for all relevant contaminants and their biodegradation daughter compounds.

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. A decreasing plume supports natural attenuation as a viable remedial alternative.

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Table 6-1
MNA Evaluation Performance Criteria

Performance Criteria	Type	Expected Performance	Commentary
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
3) Aquifer Conditions	Qualitative	Conditions favorable for natural attenuation	Second Line of Evidence
4) Microcosm Studies	Qualitative	Detectable presence of appropriate microorganisms	Third Line of Evidence

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Monitoring must occur over a time period sufficient to demonstrate plume stability or decrease under natural conditions. This may take up to several years depending on site-specific conditions, including the monitoring data trend analysis, potential threats to beneficial uses, and other uncertainties. Specifically, the TCEQ recommends the non-parametric Mann-Kendall statistic be used to evaluate solute plume stability (with null hypotheses tested at $\alpha = 0.10$ and $\alpha = 0.20$). If monitoring data do not demonstrate plume stability/decrease, this may indicate that further plume remediation is necessary. The two years of quarterly sampling, combined with historic sampling data, will provide sufficient data for stability and trend analysis. MNA cannot continue as a sole remedy if the plume is clearly migrating.

6.1.2 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.

Concentrations of COCs 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. Monitoring wells LHSMW19, 46WW05, and 46WW02 are expected to be the primary focus of analysis at LHAAP-46 because they show the highest COC concentrations. Thus, the data from these wells will be evaluated to determine if there is a clear and meaningful trend of decreasing concentrations and/or mass.

6.1.3 Second Line of Evidence

Decreasing concentration trends by themselves are not sufficient evidence that COCs are being destroyed. 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 chlorinated solvent contaminants can occur.

The second line of evidence evaluates parameters such as nitrates, sulfates, ferrous iron, dissolved oxygen, 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).

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 should be evaluated as a contingency remedy.

6.1.4 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 (typically used to demonstrate biological degradation processes only).

For the MNA evaluation, the presence of microorganisms (DHC) in the groundwater capable of degrading the COCs would be favorable to continued MNA. If such organisms are completely absent, and the first two lines of evidence are not favorable, then more aggressive treatment should be evaluated as a contingency remedy. General microcosm studies are

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time-consuming and expensive. Performing analyses related to general microcosm studies will be deferred until such time as the initial two-year groundwater monitoring program is concluded and such a study is found to be necessary.

6.1.5 MNA Performance Evaluation Report

The completed Preliminary Draft Monitored Natural Attenuation Evaluation Report will be submitted to the U.S. Army for review and comment. Following this, a Draft Final Monitored Natural Attenuation Evaluation Report 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 Report will be issued. The Final Monitored Natural Attenuation Evaluation Report will determine whether MNA continues to be the remedial action applied at LHAAP-46, 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. This contingency remedy is expected to be a form of bioremediation as included in the ROD, but the final design of the contingency remedy will 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.

6.2 LTM Annual Reports

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

- A narrative of field activities
- Figures of the site and wells and groundwater levels
- Tables of groundwater and surface water sample results
- Copies of field paperwork, including disposal documentation
- Relevant photographs

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

6.3 Five-Year Review Reports

Five-year reviews will be performed for LHAAP-46 (U.S. Army, 2010). While the intent is to perform these reviews every 5 years after the implementation of the remedy (i.e., remedy in place), the performance of the first five-year review will be aligned with the first base-wide five-year review. The five-year review report will present summaries of information from the annual reports as 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 of the site and wells locations
- Summary of groundwater and surface water sample results
- Results and summary of the annual LUC inspections
- Site inspection with relevant photographs
- 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 report. The five-year review offers the periodic opportunity to declare the site successfully and completely remediated, progressing satisfactorily toward remediation, or in need of more aggressive remedy. When cleanup levels are reached, monitoring may cease as recommended in the five-year review.

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7.0 SCHEDULE

The estimated length of time for groundwater monitoring activities including site setup, clearing, groundwater sampling, waste management and site restoration is approximately one week for each sampling episode. 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 7-1** shows the anticipated duration for each of the major site activities. Shaw's mobilization to LHAAP-46 for the first round of MNA performance sampling is anticipated to begin in June 2011 after final approval of the ROD and this document.

Table 7-1
Durations for Major Site Activities

Activities	Duration	Elapsed Time
Establish land use control	1 month	1 month
First quarterly sampling episode	3 months	3 months
Mobilization / Site setup	1 day	—
Monitoring well installation	3 days	—
Groundwater and surface water sampling	4 days	—
Demobilization	1 day	—
Estimated duration	6 days per episode	—
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	—	23 to 30 years

Notes:

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.

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8.0 REFERENCES

Jacobs Engineering, Inc. (Jacobs), 2002, *Final Remedial Investigation Report, Sites 35A, 35B, 35C, 46, 47, 48, 50, 60 and Goose Prairie Creek, Longhorn Army Ammunition Plant, Karnack, Texas*, January.

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

Shaw, 2009, *Final Feasibility Study, LHAAP-46, Plant 2 Area, Group 4, Longhorn Army Ammunition Plant, Karnack, Texas*, October.

U.S. Army, 2010, *Record of Decision, LHAAP-46, Plant 2 Area, Group 4, Longhorn Army Ammunition Plant, Karnack, Texas*, September.

U.S. Army Corps of Engineers (USACE), 2008, *Safety and Health Requirements Manual, EM 385-1-1*, September.

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, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

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Appendix A

Inspection/Certification Form

Sample Annual Land Use Control Compliance Certification Documentation

In accordance with the Remedial Design dated _____ for LHAAP-46 a certification of 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-46]

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-46

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-46**

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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 B

Site-Specific Supplement to Health and Safety Plan

Appendix B
Site-Specific Supplement to Health and Safety Plan

Final
Remedial Design
LHAAP-46, Plant 2 Area, Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers – Tulsa District
1645 South 101st, East Avenue
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Acronyms and Abbreviations

ANSI	American National Standards Institute
DPT	direct-push technology
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

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1.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) LEVELS

1.1 LHAAP-46 – Direct Push Technology (DPT) Operations/Monitoring Well Sampling/Well Installation/Well Abandonment

1.1.1 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).

1.2 LHAAP-46 – Brush Clearing for Access

1.2.1 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).

2.0 AIR MONITORING

2.1 Particulates

2.1.1 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.

2.1.2 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.

2.2 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 on the next page:

Direct Reading Air Monitoring Summary for Volatiles/Oxygen

Monitoring Device	Monitoring Location/Personnel	Monitoring Frequency	Action Level [a]	Action
PID/OVA (breathing zone)	Groundwater sampling and well installation	At start-up, minimum four times daily in work area and breathing zone	>5 ppm	Test for vinyl chloride (VC) (colorometric detector tubes)
LEL/O2 meters	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

LEL/O2 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.

3.0 MEDICAL SURVEILLANCE

3.1 LHAAP-46

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.

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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 HASP • Review site-specific AHA with all task personnel. • Safe driver's training (HS800)

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ACTIVITY HAZARD ANALYSIS FOR BRUSH CLEARING PREPARATION				
Principle Steps	Potential Safety/Health Hazards	Hazard Control Measures	Personal Protective Equipment	Monitoring Devices
Clearing Brush		• De-energize or shut off utility lines at their source before work begins • Use double insulated or properly grounded electric power-operated tools • Maintain tools in a safe condition • Provide an equipment-grounding conductor program or employ ground-fault circuit interrupters • Use qualified electricians to hook up electrical circuits • Inspect extension cords daily for structural integrity, ground continuity, and damaged insulation • Cover or elevate electric wire or flexible cord passing through work areas to protect from damage • Keep all plugs and receptacles out of water • Use approved waterproof, weather-proof equipment if exposure to moisture is likely • Inspect electrical power circuits prior to commencing work • Follow lockout-tagout procedures in accordance with Shaw Health & Safety Program, Volumes I & II, HS315	—	—
	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	—
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	—	—

ACTIVITY HAZARD ANALYSIS FOR BRUSH CLEARING PREPARATION				
Principle Steps	**Potential Safety/Health Hazards**	**Hazard Control Measures**	**Personal Protective Equipment**	**Monitoring Devices**
Mobilization / Site setup and survey / Layout (*cont.*)	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 Site Safety and Health Plan (HASP) • Review site-specific Activity Hazard Analysis (AHA) with all task personnel. • Review equipment safety operations manual • Safe driver's training (HS800)

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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	—	—
	Eye injuries	• Wear face shield, goggles when operating powered clearing / grubbing equipment	Face shield, goggles, safety glasses	—
	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	—	—

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	• Wear reflective warning vests when exposed to vehicular traffic • Isolate equipment swing areas • Make eye contact with operators before approaching equipment • 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 • Insure 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	—

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.)*	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	—	—
	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
—	• Daily heavy equipment inspections • Daily Drill Rig Inspections • Small equipment as specified by operations manual	• 40 hour Hazardous Waste Training • Review SSHP • Review site-specific AHA with all task personnel. • Review equipment safety operations manual • Safe driver's training (HS 800)

Appendix C

Contractor Quality Control Plan

Appendix C
Contractor Quality Control Plan

Final
Remedial Design
LHAAP-46, Plant 2 Area, Group 4
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared for U.S. Army Corps of Engineers – Tulsa District
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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 No. 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-46.

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-46. 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-46, including the major definable features of site work (or major project tasks) identified below:

Task 1 – Mobilization/Site Setup/Site Clearing
Task 2 – Direct-Push Technology (DPT) Operations
Task 3 – Monitoring Well Installation
Task 4 – Groundwater Sampling
Task 5 – Waste Management
Task 6 – Monitoring Well Abandonment
Task 7 – Surveying
Task 8 – Site Restoration and Demobilization

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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.

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/Site Safety Officer (SSO) 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-46, the CQCSM may also serve as the 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 HASP and the Supplement provided as Appendix B of the Remedial Design/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:	June 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-46 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

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 – Mobilization/Site Setup/Site Clearing
Task 2 – DPT Operations
Task 3 – Monitoring Well Installation
Task 4 – Groundwater Sampling
Task 5 – Investigation-Derived Waste Management
Task 6 – Monitoring Well Abandonment
Task 7 – Surveying
Task 8 – Site Restoration and 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 – Mobilization and Site Setup

Following approval of the Remedial Design, Shaw will mobilize the necessary personnel and equipment to prepare the site for remedial activities. 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.

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

5.2 Task 2 – Direct Push Technology Operations

The field work involves DPT operations by a drilling subcontractor. 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 DPT operations.
- Personnel associated with this task have applicable OSHA training and medical surveillance certifications.
- Worker protection is adequate for the associated task hazards.
- DPT 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.
- DPT 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.
- Borings are abandoned.
- Waste generated during activities is handled and disposed according to the waste management plan.

5.3 Task 3 – 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.

5.4 Task 4 – 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 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.
- 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.

5.5 Task 5 – Investigation-Derived 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.

5.6 Task 6 – Monitoring 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.

5.7 Task 7 – Surveying

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.

5.8 Task 8 – Site Restoration and 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.

5.9 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-46

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.

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: _____

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)

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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.)

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							
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18							
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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:

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