LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 6 of 10

1997

Bate Stamp Numbers
020628 - 020852

Prepared for:

Department of the Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671

1997

Volume 6 of 10

1997

A. Title: Letter, Subject: Longhorn Army Ammunition Plant Group I - Final Remedial Investigation Report
Group(s): I
Site(s): 1, 11, 27 and XX
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Diane R. Poteet, Project Manager RI/FS Unit
Recipient: James A. McPherson, Commander's Representative, LHAAP
Date: May 28, 1997
Bate Stamp: 020628

B. Title: Letter, Subject: Longhorn Army Ammunition Plant Final Remediation Investigation Report Group 1 Sites (Sites 1, 11, 27 and XX)
Attachs: EPA's Comments on the above report
Group(s): I
Site(s): 1,11,27 and XX
Location: Dallas, Texas
Agency: United States Environmental Protection Agency
Author: Chris G. Villarreal
Recipient: James A. McPherson, Commander's Representative, LHAAP
Date: May 28, 1997
Bate Stamp: 020629 - 020630

C. Title: FAX, Copy of letter A Above to James A. McPherson dtd May 28, 1997
Group(s): I
Site(s): 1, 11, 27 and XX
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Diane Poteet, Project Manager, RI/FS II Unit
Recipient: Yolane Hartsfield, USACE, Tulas District
Date: 5-28-97
Bate Stamp: 020631 - 020632

D. Title: Minutes - Technical Review Committee Meeting
Group(s): All
Site(s): All
Location: Longhorn Army Ammunition Plant
Date: 02 June 1997
Bate Stamp: 020633 - 020639

E. Title: Letter - Subject: Final Site Characterization Report - Groups 5 Sites at the Longhorn Army Ammunition Plant, Karnack, Texas
Attachs: Copy of Report - Final Site Characterization Investigation Report Group 5 Sites (50, 52, 60, and 63) Site Investigation
Group(s): 5
Site(s): 50, 52, 60 and 63

Location: Tulsa, Oklahoma
Agency: U.S. Army Corps of Engineers
Author: Burl D. Ragland, Lead Project Manager, Army Team
Recipient: David Tolbert, SIOLH-OR, Longhorn AAP
Date: 12 June 1997
Bate Stamp: 020640 - 020791

F. Title: Letter, Subject: Longhorn Army Ammunition Plant Final Remediation Investigation Report Group I Sites (Sites 1, 11, 27, XX)
Attachs: EPA's Comments on this report
Group(s): I
Site(s): 1, 11, 27, XX
Location: Dallas, Texas
Agency: United States Environmental Protection Agency
Author: Chris G. Villarreal
Recipient: James A. McPherson, Commander's Representative, Longhorn AAP
Date: June 23, 1997
Bate Stamp: 020792 - 020796

G. Title: FAX - EPA's Comments on the Group I Baseline Risk Assessment Document
Group(s): I
Site(s) 1, 11, 27 and XX
Location: Dallas, Texas
Agency: US Environmental Agency
Author: Chris G. Villareal, Project Manager
Recipient: David Tolbert, SIOLH-OR, Longhorn AAP
Date: June 23, 1997
Bate Stamp: 020797 - 020802

H. Title: FAX - EPA's Comments on the draft Group I Proposed Plan
Group(s): I
Site(s) 1, 11, 27 and XX
Location: Dallas, Texas
Agency: US Environmental Protection Agency
Author: Chris G. Villarreal, Project Manager
Recipient: David Tolbert, SIOLH-OR, Longhorn AAP
Date: June 24, 1997
Bate Stamp: 020803 - 020806

I. Title: Letter - Subject: Memorandum of Agreement for Natural Resource Issues at Longhorn Army Ammunition Plant
Attach: Memorandum of Agreement for the Natural Resource Issues at the Longhorn Army Ammunition Plant
Group(s): All
Site(s): All
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Ginny King, Project Manager, Natural Resource Trustee Program
Recipient: David Tolbert, SIOLH-OR, Longhorn AAP
Date: July 2, 1997
Bate Stamp: 020807 - 020814

J.
Title: Letter - Subject: Longhorn Army Ammunition Plant Group I - Proposed Plan of Action
Group(s): I
Site(s): 1, 11, 27 and XX
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Diane R. Poteet, Project Manager, RI/FS II Unit
Recipient: James A. McPherson, Commander's Representative, Longhorn AAP
Date: July 7, 1997
Bate Stamp: 020815 - 020821

K.
Title: Letter - Subject: Longhorn Army Ammunition Plant Group 5 - Final Site Characterization Report
Attach: EPA's Comments on Report
Group(s): 5
Site(s): 52, 63
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Diane R. Poteet, Project Manager, RI/FS II Unit
Recipient: James A. McPherson, Commander's Representative, Longhorn AAP
Date: July 14, 1997
Bate Stamp: 020822 - 020823

L.
Title: FAX - Group 5 Site Characterization Report
Group(s): 5
Site(s): 52, 63
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Diane Poteet, Project Manager, RI/FS
Recipient: David Tolbert, Project Manager, Longhorn AAP
Date: 7-14-97
Bate Stamp: 020824 - 020825

M.
Title: Minutes - Monthly Managers' Meeting, Longhorn AAP
Group(s): General
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: All Involved
Author: Yolane Hartsfield, USACE, Tulsa District
Recipient: All Parties
Date: 16 July 1997
Bate Stamp: 020826 - 020828

N.
Title: Minutes - Monthly Manager's Meeting, Longhorn AAP
Group(s): General
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: All Involved
Author: Yolane Hartsfield, USACE, Tulsa
Recipient: All Parties
Date: 16 July 1997
Bate Stamp: 020829

O.
Title: Public Meeting - Subject: No Further Action at the Group I Sites at Longhorn Army Ammunition Plant
Enclosure: Proposed Plan of Action for Group I Sites
Group(s): I
Site(s): I, 11, 27 and XX
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: Dept of the Army, Longhorn Army Ammunition Plant
Author: James A. McPherson, Commander's Representative, Longhorn AAP
Recipient: General Public
Date: July 21, 1997
Bate Stamp: 020830 - 020848

P.
Title: Minutes - Monthly Manager's Meeting, Longhorn AAP
Group(s): General
Site(s): General
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Agency: All Involved
Author: Yolane Hartsfield, USACE, Tulsa District
Recipient: All Parties
Date: 7 August 1997
Bate Stamp: 020849 - 020851

Q.
Title: Letter - Subject: Longhorn Army Ammunition Plant Group 2 - Use of Treated Ground Water for Dust Control
Group(s): 2
Site(s): Landfill 12 and Landfill 16
Location: Austin, Texas
Agency: Texas Natural Resource Conservation Commission
Author: Timothy G. Dobbs for Diane Poteet, Project Mgr, RI/FS II Unit
Recipient: James A. McPherson, Commander's Representative, Longhorn AAP
Date: August 22, 1997
Bate Stamp: 020852

020628

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

May 28, 1997 Rec'd per D.P.

CERTIFIED MAIL
P 746 032 992
RETURN RECEIPT REQUESTED

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Group 1 - Final Remedial Investigation Report

Dear Mr. McPherson:

In accordance with Section VIII. G. 2 of the Federal Facility Agreement, the TNRCC staff is notifying the Army that a twenty-day extension will be needed to provide a more thorough review of the above referenced document, which was received on May 1, 1997. If you have any further questions regarding this matter, please call me at (512) 239-2502.

Sincerely,

Diane R Poteet

Diane R. Poteet
Project Manager (MC-143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

cc: Chris Villarreal, EPA Region 6 (6SF-AP)
Yolane Hartsfeld, COE Tulsa District (CESWT-PP-EA)
Warren Sayes, COE Eastern Area Office (CESWF-AD-E)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

020629

May 28, 1997

VIA REGULAR MAIL AND FACSIMILE

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Final Remedial Investigation Report
Group 1 Sites (Sites 1, 11, 27, XX)

Dear Mr. McPherson:

In accordance with the Federal Facility Agreement (FFA) for the Longhorn Army Ammunition Plant, the Environmental Protection Agency (EPA) has reviewed the *Final Remedial Investigation Report Group 1 Sites (Sites 1, 11, 27, and XX) Volume 1* (U.S. COE, May 1997). Enclosed please find EPA's comments on this report. The report is herein approved provided that EPA's enclosed comments are incorporated into the report.

Pursuant to Section VIII. G of the FFA (Consultation with EPA and [TNRCC] Review and Comment on Draft Reports), EPA is herein providing notice that a 20 day extension of the comment period is required for EPA to complete it's review of the *Final Remedial Investigation Group 1 Sites Volume II Baseline Risk Assessments (Site 1, 11, 27, and XX)* (U.S. COE, May 1997). If you have any questions, please contact me at (214) 665-6758.

Sincerely,

Chris G. Villarreal

Chris G. Villarreal
Project Manager

Enclosure

cc: Warren Sayes, COE Eastern Area Office (CESWF-AD-E)
Yolane Hartsfield, COE Tulsa District (CESWT-PP-ME)
Diane Poteet, TNRCC (MC-143)

EPA's Comments on the Final Remedial Investigation Report Group 1 Sites (Site 1, 11, 27, and XX) Volume 1

1. Section 1.3 Report Organization:

Text states "References are given in Section 14."

Comment References are given in Section 13.

2. Section 2.2.1 Plant History, page 2-3:

Text states "Because of suspected environmental concerns associated with past production practices, LHAAP was placed on the National Priorities List on August 30, 1990."

Comment LHAAP was not placed on the NPL because of suspected environmental concerns. LHAAP was placed on the NPL because hazardous substances, pollutants, or contaminants were identified as being release or potentially released from identified areas of LHAAP. Modify the quoted sentence to read:

LHAAP was placed on the National Priorities List on August 30, 1990.

3. Section 8.1.2 Groundwater Investigations, page 8-9:

Text states "Results of groundwater sampling are summarized in Table 8-5."

Comment Results of groundwater sampling are summarized in Table 8-6.

4. Section 8.1.3 Surface Water and Sediment Investigations, page 8-9:

Text states "Surface water and sediment analytical results are summarized in Table 8-6."

Comment Surface water and sediment analytical results are summarized in Table 8-7.

020631

Texas Natural Resource Conservation Commission

Superfund Investigation Section
P. O. Box 13087
Austin, Texas 78711-3087

To: Yolanie Hartsfeld	From : Diane R. Poteet
Fax Number : -918-669-7532	Company : TNRCC - Superfund Investigation Section
Date : 5/28/97 Time : 17:43:26	For Information Call: (512) 239-2502
Subject : WordPerfect - [Document1]	Fax Number : (512) 239-2471

Please see the attached letter regarding the Group 1 Remedial Investigation Report.

020632

May 28, 1997

CERTIFIED MAIL
P 746 032 992
RETURN RECEIPT REQUESTED

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn. SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Group 1 - Final Remedial Investigation Report

Dear Mr. McPherson,

In accordance with Section VIII. G. 2 of the Federal Facility Agreement, the TNRCC staff is notifying the Army that a twenty-day extension will be needed to provide a more thorough review of the above referenced document, which was received on May 1, 1997. If you have any further questions regarding this matter, please call me at (512) 239-2502.

Sincerely,

///signed\\\

Diane R. Poteet
Project Manager (MC-143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

cc: Chris Villarreal, EPA Region 6 (6SF-AP)
Yolane Hartsfeld, COE Tulsa District (CESWT-PP-EA)
Warren Sayes, COE Eastern Area Office (CESWF-AD-E)

020833

Longhorn Army Ammunition Plant
Technical Review Committee Meeting
Karnack, Texas
02 June 1997

1300 hours

Agenda

Introduction and Welcome Attendees (James McPherson)

Review Last Meeting's Minutes

Review Executive Summary

Schedule date and location

Adjourn

020634

Monthly Managers' Meeting
Longhorn Army Ammunition Plant
15 May 1997
Region 6, EPA Offices
Dallas, Texas

1. The participants were:

Ira Nathan, LHAAP	Chris Villarreal, EPA
David Tolbert, LHAAP	Diane Wyatt, GLO
Wilma Subra, Uncertain Aud.	Jeff Armstrong, AEC
Matt McAtee, CHPPM	Steve Nolen, Tulsa District
Cliff Murray, Tulsa District	Oscar Linebaugh, EAO
Dudley Beene, EAO	Diane Poteet, TNRCC
Raenell Silcox, TPWD	Yolane Hartsfield, Tulsa District
Don Pitts, TPWD	Ginny King, TNRCC/NRTP
Dave Bockelmann, Sverdrup	Susan Roddy, EPA
Eva Timmer, Weston	

2. David Tolbert opened the meeting and thanked all the participants for attending.

3. The minutes of the previous meeting were reviewed and accepted with minor changes.

4. There was discussion of how to include the effluent standards for mercury and high explosives to the ROD for Burning Grounds No. 3 Groundwater Treatment Plant. Initially it was discussed to do so by means of a memorandum to the "post decision file." A draft of the letter to be reviewed for comments by TNRCC, EPA, LHAAP, and Tulsa District prior to being formally attached to the ROD. Later discussion in the meeting resulted in a recommendation by the regulators to use a fact sheet attached to the project files in lieu of a memorandum to the "post decision file."

5. Cliff Murray presented a briefing on the resistivity study at Site 16 (Landfill 16) by Sverdrup Environmental. He also discussed the up-coming groundwater sampling event to be conducted in May at the perimeter wells, Goose Prairie Creek, and Harrison Bayou. Wilma Subra queried when data from February 1997 sampling round would be available. She wants the data notated as to whether it was an "after rain" event or not.

6. The Texas Trustees were introduced and Ms. Ginny King briefed the team on the involvement of the Trustees in the Longhorn Environmental Program. She discussed in detail the differences between injury and remediation as understood and defined by the Trustees. She stated that the Trustees are offering a cooperative process to LHAAP and would be sending a "draft" MOA shortly. Ms. Subra asked to be informed when we meet with the Trustees outside the Monthly Managers' and Technical Review Committee meetings. LHAAP agreed to notify her.

7. Management of the soils from the excavation for the Interceptor/Collection Trenches was discussed. The ROD provides for the treatment of all soils from the excavation effort. LHAAP proposed to the team to test the soils prior to treatment and treat only those soils that are found to be contaminated at levels above the treatment goals for the LTTD process. Soil samples from one trench were collected and analyzed for volatile organic compounds with results distributed to the team members. There was discussion regarding how the samples were collected and the chemical data results. Future sampling protocol, number of requisite samples, and chemical compounds to be analyzed were discussed. It was decided that boreholes along the trench line would be collected and analyzed for volatile organic compounds. The number of samples required will be provided by the EPA and TNRCC staff. There was discussion as to whether this activity would require an Explanation of Significant Difference (ESD) to the ROD. The regulators held that a Fact Sheet at the end of the project stating how much soil was actually treated would suffice.

8. Ms. Hartsfield briefed the team on projects' status using the Executive Summary.

9. The team discussed the Site 16 revised project schedule. The regulator's noted that the schedule was for project guidance and not to be construed as an inflexible timeline. They also noted that currently anticipated schedule dates will be impacted by risk assessment needs and other project related activities. The team concurred.

10. The next meeting (TRC) will be at Longhorn AAP on 2 June beginning at 1300 hours (1:00 pm).

11. There being no further business, the meeting was adjourned.

Yolane Hartsfield
Project Manager

020636

Pre-planning Risk Assessment Meeting
Longhorn Army Ammunition Plant
15 May 1997
Region 6, EPA Offices
Dallas, Texas

1. The participants were:

Ira Nathan, LHAAP	Chris Villarreal, EPA
David Tolbert, LHAAP	Diane Wyatt, GLO
Wilma Subra, Uncertain Aud.	Jeff Armstrong, AEC
Matt McAtee, CHPPM	Steve Nolen, Tulsa District
Cliff Murray, Tulsa District	Oscar Linebaugh, EAO
Dudley Beene, EAO	Diane Poteet, TNRCC
Raenell Silcox, TPWD	Yolane Hartsfield, Tulsa District
Don Pitts, TPWD	Ginny King, TNRCC/NRTP
Dave Bockelmann, Sverdrup	Susan Roddy, EPA
Eva Timmer, Weston	Ghassan Khoury, EPA
Steve Mitchell, Weston	Tom Hoskings, Weston

2. The monthly managers' meeting was suspended to provide time for this meeting. David Tolbert opened the meeting and thanked all the participants for being present, noting the severely inclement weather.

3. Mr. Cliff Murray provided a short briefing on the history of Site 16, prior investigations, and contaminants of concern as a review to current members and as an introduction to the site/project to the new members of the risk assessment team. He presented print-outs and data results from the resistivity study Sverdrup has recently performed at the site.

4. Mr. Murray continued his briefing to update the participants as to where we are currently at the Site. Ms. Hartsfield supported this briefing with information about contractual actions. There was much general discussion about the work plans/comments which were addressed by LHAAP, Tulsa District, Sverdrup and Weston personnel.

5. Ms. Wilma Subra queried the team about the "yellow water" issue. Mr. Khoury wished further information about the tentative identification of the compound. Ms. Hartsfield to provide.

6. There was discussion about the Group 1,2 and 4 Workplans and Risk Assessment efforts. Ms Roddy reviewed her comments with team members.

7. It was decided based upon the general discussion not to immediately set a date for a follow-up meeting.

8. There being no further business, the meeting was adjourned.

Yolane Hartsfield, Project Manager

LONGHORN ARMY AMMUNITION PLANT
IRP STATUS SUMMARY

As Of 28 May 1997

PROJECT NAME	PROJECT PHASE	PROJECT STATUS	NEXT MAJOR MILESTONE(S)
Group #1 (Sites 1, 11, XX, and 27)	Remedial Investigation/ Feasibility Study	Remedial Investigation with Risk Assessment Report is complete and is to be submitted for review and response 29 April 1997. Preparing Proposed Plan. Regulators requesting more time to submit review comments.	Receipt of comments to RI w/Risk Assessment Report. Issue Final RI 1 June 1997. Submit Draft Proposed Plan for review and response 1 June 1997. ROD is scheduled to be submitted for signatures 30 September 1997.
Group # 2 (Sites 12, 17, 18, 24, 29, and 32)	Remedial Investigation/ Feasibility Study	Contract awarded April 1997.	Submission of contractor work schedule and draft work plan documentation.
Group # 4 Wastewater Sumps and Sites 50 and 60	Remedial Investigation/ Feasibility Study	Scope of work amended to include Sites 50 and 60. Contract negotiated 31 March 1997. Funding withdrawn 28 April 1997.	Awaiting funds availability to award.
Group # 5 (Sites 52 and 63)	Site Investigation	-Comments on Draft Site Investigation Report submitted to Sverdrup to incorporate and resolve. -Sites 50 and 60 moved into Group 4 for further investigation as part of Group 4, Phase III, RI/FS effort. Sites 52 and 63 site investigation conclusions and recommendations are no further action.	Submittal of Final Site Investigation Report from Sverdrup due 31 May 1997.
Burning Grounds #3 (Group # 2, Sites 18 and 24)	Interim Remedial Action	- Groundwater Treatment Plant is operational. The Low Temperature Thermal Desorbers are operating and currently treating interceptor/collection trench (ICT) excavation material. - Approved treated water and soil management changes are being implemented. - Contract modification negotiated 21 April 1997.	- Received draft Radian Proof of Performance Test Results Soil Treatment Plant Report 22 April 1997. - Awaiting funds availability to award.

LONGHORN ARMY AMMUNITION PLANT
IRP STATUS SUMMARY

As Of 28 May 1997

PROJECT NAME	PROJECT PHASE	PROJECT STATUS	NEXT MAJOR MILESTONE(S)
Landfill Caps (Group # 2, Sites 12 and 16)	Interim Remedial Action	Work on Landfill 12 Cap underway; completion date scheduled for 12/97. Completion of Landfill 16 Cap scheduled for 10/98.	- Capping of both landfills scheduled to be complete in October 1998.
Landfill Site 16 Accelerated RI	RI/FS	- Quarterly sampling is being conducted in Harrison Bayou, Goose Prairie Creek, and the Perimeter wells in May. - Contract for RI/FS with treatability study awarded 16 April 1997. - Field work underway.	- Field work completion by Sverdrup. - Installation of pipeline by Radian.
DERA SUMPS	Removal Action	- Sump contents have been removed and disposed per TNRCC approval. - Sump removal complete. Final report received 22 April 1997.	Awaiting regulatory approval of report.

SCHEDULED MEETINGS AND VISITS TO LHAAP		
Date / Time	**Purpose of Meeting / Visit**	**Location**
02June/1300	TRC/Monthly Managers' Meeting	Karnack, Texas

0206638

020639

IAAP, GROUP 1, RI/ROD; as of 13 May 1997

Task #	Task Name	Duration	Sched Start	Sched Finish		Actual Start	Actual Finish	
1	Review Draft RI	30d	05-01-97	05-30-97		29-April-97		
2	Prepare Proposed Plan	30d	05-01-97	05-30-97		29-April-97		
3	Finalize RI	30d	05-01-97	05-30-97				
4	Issue Final RI	1d	06-01-97					
5	Review Proposed Plan	30d	06-01-97	06-30-97				
6	Revise Proposed Plan	7d	07-01-97	07-08-97				
7	Issue Proposed Plan to Public	30d	07-09-97	08-07-97				
8	Public Meeting	–	07-28-97	07-31-97				
9	Prepare ROD and Responsiveness Summary	15d	08-08-97	08-21-97				
10	Review ROD	30d	08-22-97	09-20-97				
11	Revise ROD	7d	09-21-97	09-27-97				
12	Issue ROD for Signatures		09-28-97					

DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121-0061

020640

REPLY TO
ATTENTION OF:

CESWT-PP-ME (200-1c)

12 June 1997

MEMORANDUM FOR Commander, Longhorn/Louisiana Army Ammunition Plants, ATTN: SIOLH-OR (Mr. David Tolbert), Post Office Box 658, Doyline, LA 71023

SUBJECT: Final Site Characterization Report - Groups 5 Sites at the Longhorn Army Ammunition Plant, Karnack, Texas

1. Please find enclosed four copies of the subject document.

2. If you have any questions, please contact Ms. Yolane Hartsfield at 918-669-7530.

FOR THE COMMANDER:

Burl D Ragland

BURL D. RAGLAND
Lead Project Manager
Army Team

Encls

020641

FINAL
SITE CHARACTERIZATION INVESTIGATION REPORT

for the

GROUP 5 SITES (50, 52, 60, AND 63)

at the

LONGHORN ARMY AMMUNITION PLANT (LHAAP)
KARNACK, TEXAS

Submitted to

U.S. ARMY CORPS OF ENGINEERS - TULSA DISTRICT
Contract No. DACA56-93-D-0002

Prepared by

SVERDRUP ENVIRONMENTAL, INC.
St. Louis, Missouri

June 1997

Table of Contents

Table of Contents (Continued)

List of Appendices

Tables

List of Figures (Appendix I)

LIST OF ACRONYMS/ABBREVIATIONS

bgs	below ground surface
I.D.	Interior Diameter
LHAAP	Longhorn Army Ammunition Plant
MCL	Maximum Contaminant Level
NGVD	National Geodetic Vertical Datum
O.D.	Outside Diameter
QC	Quality Control
SB	Soil Boring
SCI	Site Characterization Investigation Report
SD	Sediment
SI	Site Investigation
SS	Surface Sample
SSLs	Soil Screening Levels
SvE	Sverdrup Environmental, Inc.
SVOCs	Semivolatile organic compounds
TAL	Target Analyte List
USACE	U.S. Army Corps of Engineers
USAMCCOM	U.S. Army Armament, Munitions, and Chemical Command
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound
cis-1,2-DCE	cis-1,2-dichloroethene
Silvex	2-(2,4,5-trichlorophenoxy) propionic acid
TCE	trichloroethene

EXECUTIVE SUMMARY

Site Investigation (SI) activities for the Group 5 Sites (Sites 50, 52, 60, and 63) at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas were conducted on 9 - 18 October 1995, 29 November 1995, and 19 - 20 February 1996. A summary of the SI activities for the Group 5 Sites is as follows (Site specific details are included in Sections 2.0 through 6.0):

Site 50 - Sump Water Storage Tank

- The collection and chemical analysis of 2 sediment samples.
- The collection and chemical analysis of 5 surface soil samples.
- The collection and chemical analysis for explosive compounds of 5 surface soil samples to confirm previous surface soil sample results.
- The drilling and logging of 4 soil borings.
- The collection and chemical analyses of 12 subsurface soil samples.

Site 52 - Magazine Area Washout

- The collection and chemical analysis of 5 surface soil samples.
- The collection and chemical analysis for explosive compounds of 5 surface soil samples to confirm previous surface soil sample results.
- The drilling and logging of 3 soil borings.
- The collection and chemical analyses of 9 subsurface soil samples.

Site 60 - Former Storage Buildings 411, 411A and 714

- The collection and chemical analysis of 15 surface soil samples.
- The drilling and logging of 9 soil borings.
- The collection and chemical analyses of 27 subsurface soil samples.

Site 63 - Former Burial Pits

- The collection and chemical analysis of 5 surface soil samples.
- The collection and chemical analysis for explosive compounds of 5 surface soil samples to confirm previous surface soil sample results.
- The drilling and logging of 5 soil borings.
- The collection and chemical analyses of 15 subsurface soil samples.

A summary of the results of the SI activities for the Group 5 Sites is provided in the following paragraphs.

Site 50 - Sump Water Storage Tank

Sediment samples from Site 50 were found to contain two volatile organic compounds (VOCs), cis-1,2-dichloroethene (cis-1,2-DCE) and trichloroethene (TCE).

Surface soil samples from Site 50 were found to contain one VOC, TCE, and four SVOCs, benzoic acid, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butylphthalate.

Subsurface soil samples from Site 50 were found to contain five VOCs, 1,2,3-trichlorobenzene, cis-1,2-DCE, n-butylbenzene, naphthalene, and TCE, and four SVOCs, benzoic acid, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butylphthalate.

Site 52 - Magazine Area Washout

Surface soil samples from Site 52 were found to contain one VOC, acetone, and one SVOC, di-n-butylphthalate.

Subsurface soil samples from Site 52 were found to contain two VOCs, p-isopropyltoluene and acetone, and three SVOCs, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butylphthalate.

Site 60 - Former Storage Buildings 411 and 714

Surface soil samples from Site 60 were found to contain three pesticides, 4,4'-DDE, 4,4'-DDT, and dieldrin, and one herbicide, 2-(2,4,5-trichlorophenoxy)propionic acid (silvex).

Subsurface soil samples from Site 60 were found to contain three pesticides, aldrin, dieldrin, and endosulfan sulfate.

Site 63 - Former Burial Pits

Surface soil samples from Site 63 were found to contain two VOCs, acetone and naphthalene, and one SVOC, di-n-butylphthalate.

Subsurface soil samples from Site 63 were found to contain two SVOCs, bis(2-ethylhexyl)phthalate and di-n-butylphthalate.

1.0 INTRODUCTION

This Site Characterization Investigation Report (SCI) summarizes the findings from the Site Investigation (SI) for the Group 5 Sites (Sites 50, 52, 60, and 63) at Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. The U.S. Army Corps of Engineers (USACE), Tulsa District, on behalf of LHAAP, contracted (under Contract No. DACA56-93-D-0002) with Sverdrup Environmental, Inc. (SvE) for the execution and completion of the SI activities. SvE conducted the field activities of the SI at LHAAP on 9 - 18 October 1995, 29 November 1995, and 19 - 20 February 1996. The Group 5 Sites SI activities were carried out to evaluate areas of potential contamination.

1.1 Scope

This document is a summary of information obtained during the Group 5 Sites SI performed by SvE. Analytical and geologic information resulting from the Group 5 Sites SI are presented for the four sites investigated by SvE at LHAAP. Matrices investigated at these four sites included sediment, surface soil, and subsurface soil.

1.2 Report Organization

Section 2.0 presents a discussion of LHAAP on a installation-wide and regional basis. Topics addressed include: location, history, meteorology and climate, topography and hydrology, regional geology and soils, and regional hydrogeology.

Sections 3.0 through 6.0 contain specific details on each of the four Group 5 sites investigated. Information presented for each site includes: site background, Group 5 Sites SI activities, surface topography, geology, nature and extent of contamination, and conclusions and recommendations.

- Appendix I - Figures that are referenced within the text.
- Appendix II - Sampling chain of custody forms.
- Appendix III - Soil boring logs, field notes, and surveying data for soil boring and sampling point locations.
- Appendix IV - Summary of the detected chemical analytical data from the Group 5

Sites SI. The data is arranged in tabular form and is organized by site and sample type.

2.0 FACILITY DESCRIPTION AND BACKGROUND

This section presents a regional physical description of LHAAP and presents background history on the installation. Subjects addressed include installation location, history, meteorology and climate, topography and hydrology, regional geology and soils, and hydrogeology. Information presented in this section is based on reports published from previous investigations and data obtained from the Group 5 Sites SI conducted by SvE.

2.1 Site Location

LHAAP is located in central east Texas in the northeast corner of Harrison County. The installation occupies 8,493 acres between State Highway 43 at Karnack, Texas and the western shore of Caddo Lake, as shown in Figure 2-1 (Appendix I). The nearest major cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the east. State Highways 43 and 134 provide access to the installation. LHAAP is bounded to the north and east by Caddo Lake, a large fresh water lake situated on the Texas-Louisiana state line. The eastern fence of LHAAP is 3-½ miles from the Texas-Louisiana state border. The small incorporated city of Uncertain and the non-incorporated community of Karnack, Texas, are located immediately north and west of the installation boundary, respectively. The remaining surrounding area is sparsely populated and is known as the Pineywoods of east Texas.

The four Group 5 sites addressed in this report are listed below and their locations are presented in Figure 2-2 (Appendix I).

- Site 50 - Sump Water Storage Tank
- Site 52 - Magazine Area Washout
- Site 60 - Former Storage Buildings 411 and 714
- Site 63 - Former Burial Pits

The site histories at each site are presented in Sections 3.0 through 6.0.

2.2 Site History

LHAAP is a government-owned, contractor-operated industrial facility under the jurisdiction of the U.S. Army Armament, Munitions and Chemical Command (USAMCCOM). Figure 2-2, (Appendix I) is a location map for LHAAP which illustrates the locations of the plant areas and the four Group 5 sites. LHAAP was established in October 1942 with the primary mission to produce 2,4,6-trinitrotoluene (TNT) flake (Plant 1 area). Monsanto Chemical Company was the first contractor-operator of the plant. TNT flake production continued through World War II until August 1945 when Monsanto Chemical Company's role ended and the plant went on standby status until February 1952. From 1952 until 1956, Universal Match Corporation was the contractor-operator, producing such pyrotechnic ammunition as photoflash bombs, simulators, hand signals, and 40-mm tracers. In November 1955, Thiokol Corporation began operation of the rocket motor facility (Plant 3 area). Thiokol Corporation assumed responsibility for total operation of the plant with the departure of Universal Match Corporation in 1956. Production of rocket motors continued to be the primary operation at LHAAP until 1965, when the production of pyrotechnic and illuminating ammunition was re-established.

Current operations consist of compounding pyrotechnic and propellant mixtures; load, assembly and pack activities; accommodating receipt and shipment of containerized cargo; and the maintenance and/or layaway of standby facilities and equipment as they apply to mobilization planning. The installation has also been responsible for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force Treaty in effect between the United States and the former Union of Soviet Socialist Republics.

2.3 Meteorology and Climate

LHAAP is located in a moist, subhumid to humid, mild climate. The average annual rainfall is 46 inches. Precipitation is fairly evenly distributed throughout the year, although summer and fall are frequently drought seasons, and December through May are often the wettest months. Precipitation is usually in the form of rain and on rare occasions as snow.

2.4 Surface Features and Surface Hydrology

LHAAP is characterized by mixed pine-hardwood forests that cover gently rolling to hilly terrain with an average slope of 3 percent towards the northeast. Most of the terrain at LHAAP slopes 3 percent or less, but slopes as steep as 12 percent are common in the western and northwestern portions of the installation and along the Harrison Bayou floodplain. LHAAP is surrounded by pine-hardwood forests and agricultural land. The northeastern border is formed by Caddo Lake and Goose Prairie Bayou. Ground surface elevations on LHAAP vary from 170 ft to 335 ft National Geodetic Vertical Datum (NGVD), 1929.

All surface water from LHAAP drains northeastwardly into Caddo Lake via four drainage systems: Saunder's Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. Caddo Lake is a part of Big Cypress Bayou, into which a small portion of the northwest corner of the installations drains. Saunder's Branch of Martin's Creek flows onto LHAAP near the southeast corner of the installation and flows northward into Caddo Lake. Approximately 11 percent of the heavily wooded eastern section of the plant is drained by this system. Harrison Bayou enters LHAAP on the southern edge of the installation. The bayou carries 30 percent of the surface drainage of LHAAP and bisects the installation in a northeasterly direction. Central Creek enters LHAAP on its western edge just south of the town of Karnack. Approximately 29 percent of the surface drainage from the installation is carried to Caddo Lake via this drainage course. The headwaters of Goose Prairie Creek are located near the northwest corner of the plant and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows across the northern edge of the installation and drains approximately 30 percent of LHAAP.

Caddo Lake is created by Caddo Dam, constructed on the Big Cypress Bayou in Caddo Parish, Louisiana. The original dam was constructed in 1914 for local navigation purposes and was reconstructed in 1971. The spillway elevation of the lake is 168.9 ft NGVD. Big Cypress Bayou resumes east of Caddo Lake and joins the Red River at Shreveport, Louisiana. The Red River flows southeast across Louisiana and joins the Mississippi River at Simmesport, Louisiana.

2.5 Regional Geology

The background information contained in this section was excerpted, in part, directly from "Longhorn Army Ammunition Plant Remedial Investigation/Feasibility Study (RI/FS) Work Plan, Volume 1", U.S. Army Corps of Engineers, June 1992.

LHAAP is situated on a deep inland extension of the Gulf Coastal Plain Section of the Coastal Plain Physiographic Province, commonly referred to as the Pineywoods. The area is characterized by mixed pine-hardwood forests that cover gently rolling to hilly terrain. The installation lies on the northern flank of the Sabine Uplift, which is bordered on the west by the East Texas Basin.

LHAAP is situated on an outcrop of the Wilcox Group, which crops out over a large part of the eastern half of Harrison County (Figure 2-3, Appendix I). The base of the Wilcox Group slopes westward and ranges in elevation from +193 ft NGVD in the central part of the county to -70 ft NGVD in the northwest corner of the county. In the LHAAP vicinity, the elevation of the Wilcox Group base is approximately +50 ft NGVD, making the Wilcox Group approximately 120 - 300 ft thick beneath the installation. The Wilcox Group consists mostly of fine- to medium-grained sands interbedded with a considerable amount of silt and clay, and occasional seams of lignite. Although sand beds up to 50 ft thick are present locally, individual beds are generally lenticular, with lenses of clay, sand, and silt pinching out or grading into each other over very short distances, making correlation difficult. The Wilcox Group is underlain conformably by the predominantly calcareous clay of the Midway Group. Regional dip of the Wilcox Group is to the northwest into the East Texas syncline, while the ground surface generally dips to the southeast.

Soil types encountered in borings during the spring of 1993 and 1995 field investigations at LHAAP are generally clays, silts, and fine-grained sands in varying combinations. These occur as residuum, unweathered Wilcox Group materials, or alluvium associated with the drainage systems crossing the installation. Residual soils typically consist of silty or sandy clay occasionally interbedded with sand strata. Alluvial soils occur as interbedded clays, silts, and fine-grained sands.

2.6 Regional Hydrogeology

This section of the report was derived principally from the report, "Ground-Water Resources of Harrison County", Texas Water Development Board, Report 27, August 1966.

The Wilcox Group was identified by the Texas Water Development Board as the basal unit of the regional Cypress Aquifer, also known as the Carrizo-Wilcox Aquifer. The Cypress Aquifer outcrops over most of Harrison County and is comprised of, in ascending order, the Wilcox Group, The Carrizo Sand, the Reklaw Formation, and the Queen City Sand. All units are believed to be hydraulically connected. These units all dip to the northwest into the East Texas Syncline.

The availability of groundwater in Harrison County is largely dependent on the hydrologic characteristics of the units comprising the Cypress Aquifer. The Wilcox Group, outcropping in the area of LHAAP, yields small (<50 gpm) to moderate (50 - 500 gpm) quantities of fresh water to wells throughout the county. As the basal unit of the Cypress Aquifer, the Wilcox Group is also considered as the base of fresh water in the area, conformably overlying the Midway Group, which does not yield usable quantities of water but tends to serve as a relatively impermeable base to the overlying water-bearing Wilcox Group.

Groundwater at LHAAP generally occurs under unconfined to semi-confined conditions, whether in alluvium or Wilcox Group materials, and can be encountered from within 1 ft to 20-30 ft or more below the ground surface. Perched and locally confined conditions frequently occur withing the Wilcox Group due to its highly variable stratigraphy with frequent clay lenses. Recharge is primarily by precipitation infiltration from the surface. Depth to groundwater in the Wilcox Group has been observed to fluctuate as much as 2 ft within a 6-month period in some areas of the installation. These fluctuations are most likely due to seasonal variations in rainfall.

2.7 Group 5 Sites SI

SvE retained the services of Phillip Environmental, Inc. and UXB International, Inc. (UXB) to assist in the field investigation. Phillip Environmental, Inc. was responsible for drilling activities, UXB

was responsible for clearing sites of unexploded ordnance and surveying. Field activities performed by SvE and its subcontractors as part of the Group 5 Sites SI were conducted in accordance with the Field Work Plan, Chemical Data Acquisition Plan, and the Site Safety and Health Plan. Samples of the site media collected during the SI were sent to the following three analytical laboratories validated by the USACE Missouri River Division. PDP Analytical Services, of Spring, Texas, performed chemical analyses and quality control (QC) testing of samples. The analysis of samples for explosive compounds and QC testing was performed by Pace Environmental Laboratories, Inc. of Denver, Colorado. The samples collected for reanalysis for explosive compounds were analyzed by Environmental Science & Engineering, Inc. of Gainesville, Florida. USACE Southwest Division Laboratories of Dallas, Texas performed chemical analyses and quality assurance testing of samples.

The following is a summary of the field activities conducted during the Group 5 Sites SI:

Site 50 - Sump Water Storage Tank

- The collection of two sediment samples from Goose Prairie Creek for chemical analyses.
- The collection of five surface soil samples for chemical analyses.
- The recollection of five surface soil samples for analysis for explosive compounds.
- The drilling and logging of four soil borings (total depth of 17 ft below ground surface (bgs)).
- The collection of 12 subsurface soil samples from soil borings for chemical analyses.

Site 52 - Magazine Area Washout

- The collection of five surface soil samples for chemical analyses.
- The recollection of five surface soil samples for analysis for explosive compounds.
- The drilling and logging of three soil borings (total depth of 14 ft bgs).
- The collection of nine subsurface soil samples from soil borings for chemical analyses.

Site 60 - Former Storage Buildings 411 and 714

- The collection of 15 surface soil samples for chemical analyses.
- The drilling and logging of nine soil borings (total depth of 9 ft bgs).
- The collection of 18 subsurface soil samples from soil borings for chemical analyses.

Site 63 - Former Burial Pits

- The collection of five surface soil samples for chemical analyses.
- The recollection of five surface soil samples for analysis for explosive compounds.
- The drilling and logging of five soil borings (total depth of 17 ft bgs).
- The collection of 15 subsurface soil samples from soil borings for chemical analyses.

Sediment and surface soil samples were collected using a hand-driven one-foot long stainless steel auger and placed in a stainless steel bowl. Soil samples for volatile organic compound (VOC) analysis were immediately placed into sample jars using a stainless steel spoon. Remaining sample material was composited in the stainless steel bowl using a stainless steel spoon and then placed into sample jars. In cases where additional sample material was needed to obtain an adequate quantity for analysis or reanalysis, material was collected within one foot of the original sample location.

Subsurface soil borings were advanced using a Central Mining Equipment 550 all-terrain vehicle mounted drill rig with 4.25 in. outside diameter (O.D.) hollow stem augers. Subsurface soil samples were collected with either a 2-ft long 2-in. inside diameter (I.D.) split barrel sampler or a 5-ft long continuous-core sampler, from within the 4.25 in. O.D. hollow stem augers. Soil samples for VOC analysis were collected from the opened sampler and placed directly into sample jars using a stainless steel spoon. The remaining sample material was composited in a stainless steel bowl using a stainless steel spoon and placed into sample jars.

A description of lithologic conditions encountered in each boring was prepared and documented in the field by a SvE geologist or engineer. The boring logs from this SI are presented in Appendix III.

Quality Assurance/Quality Control sampling included the collection of field duplicate samples, split samples, equipment rinsates, trip blanks, and matrix spike/matrix spike duplicate analyses.

Metals data generated from the analysis of soil and sediment samples were compared to the maximum detected concentration for specific LHAAP soil background levels ("LHAAP Soil Background Concentration Report"; USACE-Tulsa District, May 1995).

3.0 SITE 50 - SUMP WATER STORAGE TANK

This section presents the results of the Group 5 Sites SI performed at Site 50 on 9 - 18 October 1995, 29 November 1995, and 19 - 20 February 1996. The purpose of this investigation was to evaluate the nature and extent of potential contamination of sediment, surface soil, and subsurface soil at the site.

3.1 Site Background

3.1.1 Site Description

The sump water storage tank site is located approximately 75 ft south of the bridge on South Crockett Avenue which crosses Goose Prairie Creek as shown on Figure 3-1 (Appendix I). A concrete ring, approximately 26 ft in diameter, marks the suspected location of the storage tank and is overgrown with vegetation including one large tree inside the concrete ring parameter. It is assumed that the concrete ring is the remains of the foundation for an above ground storage tank of unknown construction. No other concrete features, drains, or other facilities are observed at the site. No evidence of distressed vegetation or soil staining is observed at or near the storage tank site.

3.1.2 Site History

Site 50 was identified through historical records as an above ground storage tank for industrial waste water collected from industrial waste production sumps located at various sites throughout LHAAP. As described in the Longhorn Missile publication dated 15 September 1966, all operating buildings at the LHAAP installation were provided with individual concrete sumps to collect industrial waste water. If the nature of the operations were such that contamination was considered negligible, the sump was permitted to overflow and drain by its natural course into main drainage ditches that join Goose Prairie Creek. All other sumps were emptied and trucked to a 47,000-gal above ground storage tank located at Site 50. Discharges from this storage tank were made upstream of the bridge on South Crockett Avenue which crosses Goose Prairie Creek just south of 51st Street. According to the 15 September 1966 Longhorn Missile article, contents from this storage tank were emptied into Goose Prairie Creek after all solids were filtered out and the natural flow in the creek was sufficient to "dilute the waste to a level which is safe for fish and other aquatic life". If natural flow

in the creek was considered insufficient, clean water was apparently pumped into the creek to dilute the contents. Because the storage tank was described as holding industrial waste water collected from various process sump locations, a review of preliminary data from surface soil and water samples collect at Group 4 Sites was reviewed to identify potential contaminants.

3.2 Physical Characteristics of Site

This section presents a description of physical conditions at Site 50. Subjects addressed include surface topography and hydrology as well as site soils and geology. Information presented in this section is based on data obtained from the Group 5 Sites SI.

3.2.1 Surface Features and Surface Hydrology

Site 50 is located in the central portion of LHAAP and encompasses approximately 1+ acres as shown on Figure 3-1 (Appendix I). The northeast half of Site 50 is an open area of grass and brush bounded by South Crockett Avenue to the northeast and Goose Prairie Creek to the north. The southwest half of Site 50 is an area of heavy timber bounded by a drainage ditch to the west, a railroad spur to the south, and Goose Prairie Creek to the north. Two gravel access lanes connect Site 50 to South Crockett Avenue.

Runoff from the northeast half of Site 50 is generally toward the northeast and is primarily by sheet flow. Runoff is eventually collected by a drainage ditch to the northeast that runs parallel to South Crockett Avenue. This drainage ditch joins Goose Prairie Creek near the bridge that crosses the creek. Runoff from the remainder of the site is by sheet flow towards the north directly into Goose Prairie Creek and to the west. Runoff is collected to the west by a drainage ditch which carries the runoff north into Goose Prairie Creek. Runoff from the site eventually enters Caddo Lake via Goose Prairie Creek. The total flow distance from the site to lake is approximately 1.5 miles.

3.2.2 Geology and Soils

General soil and geologic maps indicate that the site is situated on the outcrop of the Wilcox Group. The Wilcox Group materials at the site generally consist of a few feet of residually-derived soils overlying silts and clays of the Wilcox Group.

Surficial soils range in thickness from 0 - 2 ft, and consist of brown, silty sand grading into a gray silt. This material is underlain by yellowish brown to gray silt and clay with few sand lenses. Moisture content of the soils increases with the depth. Water was observed in soil borings LH50SB01 and LH50SB03 at depths greater than 15 ft bgs.

3.3 Remedial Investigation Activities

The Group 5 Sites SI field activities performed at Site 50 included: collection of sediment samples from Goose Prairie Creek for chemical analyses; collection of surface soil samples for chemical analyses; and collection of subsurface soil samples for chemical analyses.

3.3.1 Contaminant Source Investigation

The primary sources of potential contaminants at Site 50 are industrial waste water that was stored in an above ground storage tank and discharged to Goose Prairie Creek. A media sampling and analysis program was developed for Site 50 to assist in determining if a release of potential contaminants from previous operations has impacted the area sediments and soils.

3.3.2 Sediment Investigation

A total of two sediment samples (LH50SD01 and LH50SD02) were collected on 11 November 1995 as part of the SI at the locations shown on Figure 3-1 (Appendix I). These samples were collected to determine if constituents of concern were released by previous operations or are moving offsite due to surface runoff. The area targeted for investigation was Goose Prairie Creek to the north of the site. Sediment samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), explosive compounds, and target analyte list (TAL) metals.

3.3.3 Surface Investigation

A total of five surface soil samples (LH50SS01 - LH50SS05) were collected on 14 October 1995 as part of the SI at the locations shown on Figure 3-1 (Appendix I). The areas targeted for investigation were the concrete ring marking the storage tank location, the outside parameter of the concert ring and the northern gravel access lane. Stainless steel hand auger equipment was used to

collect surface soil samples from the 0 - 1 ft depth interval at each sampling location. Surface soil samples were analyzed for VOCs, SVOCs, explosive compounds, and TAL metals.

A total of five surface soil samples (LH50SS01 - LH50SS05) were collected within 1-ft of the original sample locations on 20 February 1996 as part of the SI. These surface soil samples were analyzed for explosive compounds to confirm the previous surface soil sample results.

3.3.4 Subsurface Investigation

A total of four soil borings (LH50SB01 - LH50SB04) were advanced on 14 October 1995 as part of the SI at the locations shown on Figure 3-1 (Appendix I). The areas targeted for investigations were the concrete ring marking the storage tank location and the outside parameter of the concert ring. The soil borings were advanced to a total depth of 17 ft bgs. Soil samples for chemical analyses were collected from the soil borings at depth intervals of 5 - 7 ft, 10 - 12 ft, and 15 - 17 ft using either a 2-ft long 2-in. I.D. split barrel sampler or a 5-ft long continuous-core sampler, from within the 4.25 in. O.D. hollow stem augers. Soil samples were visually classified for lithologic characteristics using the Unified Soil Classification System (USCS) and recorded on the geologic boring logs presented in Appendix III. Soil samples were field screened with a photoionization detector to qualify the presence of volatile compounds in the soil gas. A total of 12 soil samples were submitted for laboratory chemical analyses which included VOCs, SVOCs, explosive compounds, and TAL metals.

3.4 Nature and Extent of Contamination

This section presents a summary of the analytical results for media sampled during the Group 5 Sites SI at Site 50.

3.4.1 Sediment Sample Results

One of the two sediment samples (LH50SD02) contained concentrations of cis-1,2-dichloroethene (cis-1,2-DCE) and trichloroethene (TCE) at concentrations of 115 µg/kg and 33 µg/kg, respectively.

SVOCs and explosive compounds were not detected in the sediment samples. Sediment sample locations are shown on Figure 3-1 (Appendix I).

Sixteen of the 23 metals analyzed for were detected in at least one of the sediment samples collected. Beryllium was detected in sediment sample LH50SD01 at a concentration of 1.9 mg/kg. There is no established LHAAP soil background level for beryllium. Calcium, copper, and magnesium were detected in sediment sample LH50SD01 at concentrations above LHAAP soil background levels. Nickel and zinc were detected in sediment samples LH50SD01 and LH50SD02 at concentrations above LHAAP background levels. Concentrations of the remaining ten detected metals were below LHAAP soil background levels. Analytical results for the sediment sample are summarized in Table 3.1 and Tables 1 and 2 (Appendix IV).

3.4.2 Surface Soil Sample Results

Two of the five surface soil samples [LH50SS02(000.0) and LH50SS04(000.0)] contained concentrations of TCE at 3 µg/kg and 5 µg/kg, respectively.

Benzoic acid was detected in one of the five surface soil samples [LH50SS02(000.0)] at a concentration of 388 µg/kg. Bis(2-ethylhexyl)phthalate and butyl benzyl phthalate were detected in three of the five surface soil samples [LH50SS02(000.0), LH50SS04(000.0), and LH50SS05(000.0)]. Di-n-butylphthalate was detected in each of the five surface soil samples with the results qualified as 'U'. The qualifier 'U' is defined in the LHAAP Group 5 Sites SI Laboratory Sampling and Data Results Report, in Part 2, Section 1.4 titled "Data Qualifier Definitions" as: "The material was analyzed for, but was determined to be not detected. The associated numerical value is to be considered the Quantitation Limit." Bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butylphthalate are chemicals that may be detected as the result of analytical contamination.

Explosive compounds were not detected in the surface soil samples. Surface soil sample locations are shown on Figure 3-1 (Appendix I).

TABLE 3.1
DETECTED COMPOUND COMPARISON
SEDIMENT SAMPLES
SITE 50

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
VOCs (ug/kg)						
cis-1,2-Dichloroethene	---	1/2	115	115	115	---
Trichloroethene	---	1/2	33	33	33	---
Metals (mg/kg)						
Aluminum	20700	2/2	3820	3820	2600 - 5040	---
Arsenic	29.7	2/2	2.1000	2.1000	1.3 - 2.9	---
Barium	287	2/2	53.9	53.9	19.8 - 88.0	---
Beryllium	---	1/2	1.9	1.9	1.9	---
Calcium	1090	2/2	1115	1115	480 - 1750	LH50SD01
Chromium	22.8	2/2	13.05	13.05	8.5 - 17.6	---
Cobalt	19.1	2/2	5.9	5.9	4.1 - 7.7	---
Copper	6.7	2/2	8.9	8.9	3.8 - 14.0	LH50SD01
Iron	31000	2/2	14250	14250	13000 - 15500	---
Lead	17.4	2/2	8.51	8.51	7.74 J - 9.28 J	---
Magnesium	474	2/2	1055	1055	450 - 1660	LH50SD01
Manganese	2330	2/2	101.9	101.9	72.8 J - 131.0 J	---
Nickel	6.3	2/2	15.7	15.7	6.4 - 25.0	LH50SD(01-02)
Sodium	---	1/2	230	230	230	---
Vanadium	---	2/2	21.7	21.7	21.4 - 22.0	---
Zinc	16.2	2/2	36	36	32 - 40	LH50SD(01-02)

J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Subsurface background analysis was performed on metal samples only.

Note: A primary and QC analysis was performed on sample LH50SD01(0-1). The highest concentration of the duplicate or primary result was used in all calculations.

Sixteen of the 23 metals analyzed for were detected in at least one of the surface soil samples collected. Calcium, chromium, copper, lead, magnesium, nickel, and zinc were detected at concentrations above LHAAP soil background levels in at least one of four surface soil samples (LH50SS02 - LH50SS05). Concentrations of the remaining nine detected metals were below LHAAP soil background levels. Analytical results for the surface soil sample are summarized in Table 3.2 and Tables 3, 4, and 5 (Appendix IV).

3.4.3 Subsurface Soil Sample Results

1,2,3-Trichlorobenzene, n-butylbenzene, and naphthalene were detected in one soil sample [LH50SB01(5-7)] at concentrations of 4 µg/kg, 4 µg/kg, and 9 µg/kg, respectively. Cis-1,2-DCE was detected in one soil sample [LH50SB01(15-17)] at a concentration of 156 µg/kg. Two soil samples [LH50SB01(15-17) and LH50SB02(15-17)] contained concentrations of TCE at 6 µg/kg and 519 µg/kg, respectively.

Bis(2-ethylhexyl)phthalate was detected in six of the 12 soil samples at concentrations ranging from 195 µg/kg to 398 µg/kg. Butyl benzyl phthalate was detected in five of the 12 soil samples at concentrations ranging from 200 µg/kg to 817 µg/kg. Di-n-butylphthalate was detected in each of the 12 soil samples with the results qualified as 'U'. The qualifier 'U' is defined in the LHAAP Group 5 Sites SI Laboratory Sampling and Data Results Report, in Part 2, Section 1.4 titled "Data Qualifier Definitions" as: "The material was analyzed for, but was determined to be not detected. The associated numerical value is to be considered the Quantitation Limit." Bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butylphthalate are chemicals that may be detected as the result of analytical contamination.

TABLE 3.2
DETECTED COMPOUND COMPARISON
SURFACE SOIL SAMPLES
SITE 50

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
VOCs (ug/kg)						
Trichloroethene	---	2/5	4	5	(3) J - (5)	---
SVOCs (ug/kg)						
Benzoic acid	---	1/5	388	388	(388)	---
Bis(2-ethylhexyl)phthalate	---	4/5	284	250.5	(206) - 421	---
Butyl benzyl phthalate	---	3/5	847	949	(386) - 1206	---
Di-n-butylphthalate	---	5/5	2614	2272	1545 U - 3561 U	---
Metals (mg/kg)						
Aluminum	20700	5/5	5978	6310	290 - 11100	---
Arsenic	29.7	4/5	4.75	5.05	3.6 - 5.3	---
Barium	287	5/5	67.8	73.9	4.1 - 109.0	---
Beryllium	---	2/5	0.60	0.60	0.57 - 0.62	---
Calcium	1090	4/5	1380	1820	1000 - 2160	LH50SS(02, 03, 05)
Chromium	22.8	5/5	17.16	17.00	2.5 - 29.5	LH50SS(03, 05)
Cobalt	19.1	4/5	5.73	5.65	3.1 - 8.5	---
Copper	6.7	4/5	6.3	6.4	4.3 - 7.9	LH50SS(04, 05)
Iron	31000	5/5	17010	18400	10500 - 35600	---
Lead	17.4	5/5	20.8	24.0	3.1 J - 30.0 J	LH50SS(02, 03, 04, 05)
Magnesium	474	4/5	523	395	310 - 990	LH50SS05
Manganese	2330	5/5	223.5	187.0	3.3 - 463.0	---
Nickel	6.3	5/5	5.32	5.10	1.1 - 9.9	LH50SS(03, 05)
Potassium	481	1/5	670	670	670	---
Vanadium	---	5/5	27.4	31.0	3.3 - 48.3	---
Zinc	16.2	4/5	27	28	22 - 30	LH50SS(02, 03, 04, 05)

() - Less than the Detection Limit. U - Not detected at the reported Quantitation Limit.
J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Background analysis was performed on metal samples only. Maximum background level is used.

Note: A primary and QC analysis was performed on sample LH50SS03 and LH50SS05. The highest concentration of the duplicate or primary result was used in all calculations.

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Explosive compounds were not detected in the soil samples. Soil boring locations are shown on Figure 3-1 (Appendix I).

Seventeen of the 23 metals analyzed for were detected in at least one of the soil samples collected. Beryllium was detected in four soil samples [LH50SB01(10-12), LH50SB02(10-12), LH50SB02(15-17), and LH50SB03(10-12)] at concentrations ranging from 1.7 mg/kg to 2.7 mg/kg. There is no established LHAAP soil background level for beryllium. Chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, and zinc were detected at concentrations above LHAAP soil background levels in at least one soil sample collected from soil borings LH50SB01 - LH50SB04. Concentrations of the remaining five detected metals were below LHAAP soil background levels. Analytical results for the soil sample are summarized in Table 3.3 and Tables 6, 7, and 8 (Appendix IV).

TABLE 3.3
DETECTED COMPOUND COMPARISON
SOIL BORING SAMPLES
SITE 50

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
VOCs (ug/kg)						
1,2,3-Trichlorobenzene	---	1/12	4	4	(4)	---
cis-1,2-Dichloroethene	---	1/12	156	156	156 J	---
n-Butylbenzene	---	1/12	4	4	(4)	---
Naphthalene	---	1/12	9	9	9	---
Trichloroethene	---	2/12	262.5	262.5	6 - 519	---
SVOCs (ug/kg)						
Bis(2-ethylhexyl)phthalate	---	6/12	269	257	(195) - 398	---
Butyl benzyl phthalate	---	5/12	550	589	(200) - 817	---
Di-n-butylphthalate	---	12/12	2241	2327	1029 U - 3121 U	---
Metals (mg/kg)						
Aluminum	23900	12/12	7452	7205	4450 - 11400	---
Arsenic	36.8	9/12	2.2	2.3	(0.59) - 4.9	---
Barium	138	12/12	204	115	43.2 - 871	LH50SB(01(10-12), 02(5-7), 04(10-12), 04(15-17))
Beryllium	---	9/12	1.4	1.2	0.083 - 2.7	---
Calcium	2740	12/12	1605	1715	960 - 2370	---
Chromium	26.2	12/12	13.0	12.2	7 - 27.2	LH50SB02(15-17)
Cobalt	12.5	12/12	16.5	11.8	7.3 - 45.1	LH50SB(01(5-7), 01(10-12), 02(5-7), 02(15-17), 03(10-12), 03(15-17))
Copper	10.7	12/12	11.2	8.3	5.8 - 26.5	LH50SB(01(10-12), 02(10-12), 02(15-17), 03(10-12), 03(15-17))
Iron	42300	12/12	13933	10850	4340 - 47800	LH50SB02(15-17)
Lead	13	12/12	11.57	8.7	4.86 - 33 J	LH50SB(01(10-12), 02(15-17))
Magnesium	2240	12/12	1890	1825	1340 - 2590	LH50SB(02(15-17), 03(10-12), 03(15-17))
Manganese	376	12/12	158	126	30.2 - 420	LH50SB(02(15-17))
Nickel	19.1	12/12	22.7	19.8	11 - 59.5	LH50SB(01(10-12), 01(15-17), 02(10-12), 02(15-17), 03(10-12), 03(15-17))
Potassium	887	10/12	640	640	600 - 900	LH50SB02(15-17)
Sodium	1.6	12/12	472	540	130 - 780	LH50SB(01-04)
Vanadium	---	12/12	21.18	18.95	9.2 - 49.9	---
Zinc	84.5	12/12	44	38	17 - 103	LH50SB02(15-17)

() - Less than the Detection Limit. U - Not detected at the reported Quantitation Limit.
J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Subsurface background analysis was performed on metal samples only.

4.0 SITE 52 -MAGAZINE AREA WASHOUT

This section presents the results of the Group 5 Sites SI performed at Site 52 on 9 - 18 October 1995 and 19 - 20 February 1996. The purpose of this investigation was to evaluate the nature and extent of potential contamination of surface soil and subsurface soil at the site.

4.1 Site Background

4.1.1 Site Description

The magazine area washout site is located at the northeast corner of the Avenue E and 19th Street intersection as shown on Figure 4-1 (Appendix I). The site consists of a grassy area surrounding a water hydrant with an attached standpipe. Drainage at the area is provided by an open ditch located approximately 19 ft from, and parallel to, the Avenue E and 19th Street.

4.1.2 Site History

Site 52 was a washout area for transport vehicles operating in the Magazine Area located near Plant 1. The Magazine Area contains 58 Richmond-type magazines and two above ground magazines, all of which have been used for the storage of TNT. The standpipe at this location was presumed to have provided a water source for the washout of trucks used to transport TNT to and from this area. It is unknown if solvents were used in truck washout activities. Washout waste waters from these activities were reported to have been discharged onto the ground surface.

4.2 Physical Characteristics of Site

This section presents a description of physical conditions at Site 52. Subjects addressed include surface topography and hydrology as well as site soils and geology. Information presented in this section is based on data obtained from the Group 5 Sites SI.

4.2.1 Surface Features and Surface Hydrology

Site 52 is located in the central portion of LHAAP and encompasses approximately ¼ of an acre as shown on Figure 4-1 (Appendix I). The Site 52 is an open area of grass bounded by 19th Street to

the southeast, Avenue E to the southwest, and an area of heavy timber to the northeast. A water hydrant and fixed-boom stand pipe are located at the site on the corner of Avenue E and 19th Street.

Runoff from Site 52 is generally toward the southeast and southwest by sheet flow. Runoff is collected by a drainage ditch that runs parallel to Avenue E and 19th Street. This drainage ditch carriers runoff northeast and into a tributary of the diversion channel that joins with Central Creek. Runoff from the site eventually enters Caddo Lake via Central Creek. The total flow distance from the site to lake is approximately 3.5 miles.

4.2.2 Geology and Soils

General soil and geologic maps indicate that the site is situated on the outcrop of the Wilcox Group. The Wilcox Group materials at the site generally consist of a few feet of residually-derived and fill soils overlying silts, clays, and sands of the Wilcox Group.

Surficial soils range in thickness from 0.0 - 2.5 ft, and consist of brown, silty sand grading into a grayish brown silt. This material is underlain by gray silt and clay layer to a depth of 7 - 12 ft bgs. Beneath the silt and clay is a brown to yellowish brown silty sand to a depth greater than 14 ft bgs. The soils encountered in the soil borings were dry.

4.3 Remedial Investigation Activities

The Group 5 Sites SI field activities performed at Site 52 included: collection of surface soil samples for chemical analyses; and collection of subsurface soil samples for chemical analyses.

4.3.1 Contaminant Source Investigation

The primary sources of potential contaminants at Site 52 are washout waste waters that were discharged to the ground surface. A media sampling and analysis program was developed for Site 52 to assist in determining if a release of potential contaminants from previous operations has impacted the area surface and subsurface soils.

4.3.2 Surface Investigation

A total of five surface soil samples (LH52SS01 - LH52SS05) were collected on 16 October 1995 as part of the SI at the locations shown on Figure 4-1 (Appendix I). The area targeted for investigations was the drainage ditch parallel to Avenue E and 19th Street. Stainless steel hand auger equipment was used to collect surface soil samples from the 0 - 1 ft depth interval at each sampling location. Surface soil samples were analyzed for VOCs, SVOCs, explosive compounds, and TAL metals.

A total of five surface soil samples (LH52SS01 - LH52SS05) were collected within 1-ft of the original sample locations on 19 February 1996 as part of the SI. These surface soil samples were analyzed for explosive compounds to confirm the previous surface soil sample results.

4.3.3 Subsurface Investigation

A total of three soil borings (LH52SB01 - LH52SB03) were advanced on 16 October 1995 as part of the SI at the locations shown on Figure 4-1 (Appendix I). The area targeted for investigation was the grassy area adjacent to the water hydrant. The soil borings were advanced to a total depth of 14 ft bgs. Soil samples for chemical analyses were collected from the soil borings at depth intervals of 2 - 4 ft, 7 - 9 ft, and 12 - 14 ft using either a 2-ft long 2-in. I.D. split barrel sampler or a 5-ft long continuous-core sampler, from within the 4.25 in. O.D. hollow stem augers. Soil samples were visually classified for lithologic characteristics using the USCS and recorded on the geologic boring logs presented in Appendix III. Soil samples were field screened with a photoionization detector to qualify the presence of volatile compounds in the soil gas. A total of nine soil samples were submitted for laboratory chemical analyses which included VOCs, SVOCs, explosive compounds, and TAL metals.

4.4 Nature and Extent of Contamination

This section presents a summary of the analytical results for media sampled during the Group 5 Sites SI at Site 52.

4.4.1 Surface Soil Sample Results

Acetone was detected in one [LH52SS05(000.0)] of the five surface soil samples at a concentration of 15 µg/kg. Acetone is a chemical used in laboratory analytical procedures and its presence is generally considered to be the result of laboratory induced contamination.

Di-n-butylphthalate was detected in each of the five surface soil samples with the results qualified as 'U'. The qualifier 'U' is defined in the LHAAP Group 5 Sites SI Laboratory Sampling and Data Results Report, in Part 2, Section 1.4 titled "Data Qualifier Definitions" as: "The material was analyzed for, but was determined to be not detected. The associated numerical value is to be considered the Quantitation Limit." Di-n-butylphthalate is a chemical that may be detected as the result of analytical contamination.

Explosive compounds were not detected in the surface soil samples. Surface soil sample locations are shown on Figure 4-1 (Appendix I).

Fifteen of the 23 metals analyzed for were detected in at least one of the surface soil samples collected. Magnesium was detected at concentrations above the LHAAP soil background level in surface soil samples LH52SS01, LH52SS03, LH52SS04, and LH52SS05. Zinc was detected at a concentration above the LHAAP soil background level in surface soil sample LH52SS04. Concentrations of the remaining 13 detected metals were below LHAAP soil background levels. Analytical results for the surface soil sample are summarized in Table 4.1 and Tables 9, 10, and 11 (Appendix IV).

4.4.2 Subsurface Soil Sample Results

One soil sample [LH52SB02(2-4)] contained a detectable concentration of p-isopropyltoluene at 16 µg/kg. Acetone was detected in one soil sample [LH52SB01(7-9)] at a concentration of 20 µg/kg. Acetone is a chemical used in laboratory analytical procedures and its presence is generally considered to be the result of laboratory induced contamination.

Bis(2-ethylhexyl)phthalate was detected in four of the nine soil samples at concentrations ranging from 197 µg/kg to 878 µg/kg. Butyl benzyl phthalate was detected in one soil sample

TABLE 4.1
DETECTED COMPOUND COMPARISON
SURFACE SOIL SAMPLES
SITE 52

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
VOCs (ug/kg)						
Acetone	---	1/5	15.0	15	15	---
SVOCs (ug/kg)						
Di-n-butylphthalate	---	5/5	899	955	423 U - 1400 U	---
Metals (mg/kg)						
Aluminum	20700	5/5	11572	12300	8460 - 13300	---
Arsenic	29.7	5/5	2.82	2.70	1.9 - 4.3	---
Barium	287	5/5	69.9	59.7	50.4 - 112	---
Calcium	1090	4/5	460	335	180 - 990	---
Chromium	22.8	5/5	16.3	13.3	12.4 - 22.7	---
Cobalt	19.1	5/5	2.8	3.1	2.0 - 3.4	---
Copper	6.7	5/5	3.6	3.8	2.8 - 4.0	---
Iron	31000	5/5	11672	11600	8780 - 15100	---
Lead	17.4	5/5	8.26	7.83	6.63 - 9.94	---
Magnesium	474	5/5	528	570	340 - 600	LH52SS(01, 03, 04, 05)
Manganese	2330	5/5	128.1	76.7	20.7 - 368	---
Nickel	6.3	5/5	4.0	3.7	3.1 - 5.5	---
Selenium	---	3/5	0.63	0.60	0.6 - 0.7	---
Vanadium	---	5/5	29.3	24.8	23.8 - 40.2	---
Zinc	16.2	5/5	13.6	13	9.9 - 19	LH52SS04

() - Less than the Detection Limit. U - Not detected at the reported Quantitation Limit.
J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Background analysis was performed on metal samples only. Maximum background level is used.

Note: A primary and QC analysis was performed on sample LH52SS05. The highest concentration of the duplicate or primary result was used in all calculations.

020671

[LH52SB01(12-14)] at a concentration of 392 µg/kg. Di-n-butylphthalate was detected in seven of the nine soil samples with the results qualified as 'U'. The qualifier 'U' is defined in the LHAAP Group 5 Sites SI Laboratory Sampling and Data Results Report, in Part 2, Section 1.4 titled "Data Qualifier Definitions" as: "The material was analyzed for, but was determined to be not detected. The associated numerical value is to be considered the Quantitation Limit." Bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butylphthalate are chemicals that may be detected as the result of analytical contamination.

Explosive compounds were not detected in the soil samples. Soil boring locations are shown on Figure 4-1 (Appendix I).

Seventeen of the 23 metals analyzed for were detected in at least one of the soil samples collected. Barium, cobalt, and manganese were detected at concentrations above LHAAP soil background levels in soil sample LH52SB03(7-9). Cobalt was detected at a concentration above the LHAAP soil background level in soil sample LH52SB03(12-14). Sodium was detected at a concentration above the LHAAP soil background level in soil samples collected from soil borings LH52SB01 - LH52SB03. Concentrations of the remaining 13 detected metals were below LHAAP soil background levels. Analytical results for the soil sample are summarized in Table 4.2 and Tables 12, 13, and 14 (Appendix IV).

TABLE 4.2
DETECTED COMPOUND COMPARISON
SOIL BORING SAMPLES
SITE 52

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
VOCs (ug/kg)						
p-Isopropyltoluene	---	1/9	16	16	16	---
Acetone	---	1/9	20	20	20	---
SVOCs (ug/kg)						
Bis(2-ethylhexyl)phthalate	---	4/9	339	218	(197) - 877	---
Butyl benzyl phthalate	---	1/9	392	392	(392)	---
Di-n-butylphthalate	---	7/9	1464	1535	380 U - 2448 U	---
Metals (mg/kg)						
Aluminum	23900	9/9	8031	7850	1350 - 16800	---
Arsenic	36.8	9/9	2.5	2.3	1.5 - 4.8	---
Barium	138	9/9	120.5	114	58.8 - 268	LH52SB03(7-9)
Beryllium	---	7/9	0.62	0.71	0.66 - 0.92	---
Calcium	2740	9/9	771	800	430 - 1320	---
Chromium	26.2	9/9	12.4	12.3	9.3 - 15.8	---
Cobalt	12.5	9/9	8.7	7.1	4.6 - 15.4	LH52SB(03(7-9), 03(12-14))
Copper	10.7	9/9	7.5	7.9	4.6 - 9.7	---
Iron	42300	9/9	14714	13800	9030 - 21000	---
Lead	13	9/9	9.92	8.10	4.6 - 29.4	LH52SB02(7-9)
Magnesium	2240	9/9	1514	1460	1000 - 2100	---
Manganese	376	9/9	194.4	76.9	18.8 - 867	LH52SB03(7-9)
Nickel	19.1	9/9	13.4	14.3	6.1 - 17.8	---
Potassium	887	5/9	397	640	640 - 760	---
Sodium	1.6	9/9	562	490	320 - 780	LH52SB(01-03)
Vanadium	---	9/9	22.0	20.9	15.7 - 30.8	---
Zinc	84.5	9/9	31	30	16 - 42	---

() - Less than the Detection Limit. U - Not detected at the reported Quantitation Limit.
J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Subsurface background analysis was performed on metal samples only.

Note: A primary and QC analysis was performed on sample LH52SB02(7-9). The highest concentration of the duplicate or primary result was used in all calculations.

5.0 SITE 60 - FORMER STORAGE BUILDINGS 411 AND 714

This section presents the results of the Group 5 Sites SI performed at Site 60 on 9 - 18 October 1995. The purpose of this investigation was to evaluate the nature and extent of potential contamination of surface soil and subsurface soil at the site.

5.1 Site Background

5.1.1 Site Description

Site 60 consists of three buildings (411, 411A, and 714) and a shed (TS-80) as shown on Figures 5-1 and 5-2 (Appendix I). These buildings were reportedly used for the storage of pesticides and herbicides. Buildings 411 and 411A and shed TS-80 are located on the west side of Avenue T. Building 714 is located on 9th Street and is currently used for the storage of drummed products and other materials. The three buildings have concrete floors with no curbs present at entryways and the shed has an earthen floor.

5.1.2 Site History

Records indicated that pesticides and herbicides were originally stored in building 714 and that, in 1970, the stock was moved to building 411. A site visit and communications with LHAAP personnel indicated building 411A and shed TS-80, not building 411, may have been used as a pesticide and herbicide storage area.

At the time of the LHAAP installation assessment in 1980, 386 kilograms of 10 percent chlordane was present at the installation. Because pesticides and herbicides were indicated as stored at one or more of the buildings, these chemicals are the potential contaminants of concern at Site 60.

5.2 Physical Characteristics of Site

This section presents a description of physical conditions at Site 60. Subjects addressed include surface topography and hydrology as well as site soils and geology. Information presented in this section is based on data obtained from the Group 5 Sites SI.

5.2.1 Surface Features and Surface Hydrology

Site 52 is located in the northwestern portion of LHAAP near the steam plant and shops buildings area. Buildings 411 and 411A and shed TS-80 encompasses approximately 1+ acres as shown on Figure 5-1 (Appendix I). Building 714 encompasses approximately ¼ of an acre as shown on Figure 5-2 (Appendix I). The Area around the buildings is open, with grass lined drainage ditches and a graveled fenced-in storage area. The building is bounded by paved roads and other buildings.

Runoff from the area of building 411 is generally by sheet flow into grated culverts around the building. Runoff from the area of building 411A and shed TS-8 is generally toward the southeast by sheet flow. Runoff and culvert discharge is collected by a drainage ditch that arcs between areas of buildings 411 and 411A. This drainage ditch carriers runoff southwest, parallel to 6th Street, into Goose Prairie Creek. Runoff from the site eventually enters Caddo Lake via Goose Prairie Creek. The total flow distance from the site to lake is approximately 2.5 miles.

Runoff from the area of building 714 is generally by sheet flow into grass lined drainage ditch parallel to 9th Street and Avenue G. This drainage ditch carriers runoff southwest, parallel to Avenue G, into a tributary of Goose Prairie Creek. Runoff from the site eventually enters Caddo Lake via Goose Prairie Creek. The total flow distance from the site to lake is approximately 2.75 miles.

5.2.2 Geology and Soils

General soil and geologic maps indicate that the site is situated on the outcrop of the Wilcox Group. The Wilcox Group materials at the site generally consist of a few feet of residually-derived and fill soils overlying silts, clays, and sands of the Wilcox Group.

Surficial soils in the area of buildings 411 and 411A range in thickness from 0.0 - 1.9 ft, and consist of brown, silty sand grading into a gray to brown silt and clay. This material is underlain by gray clay, silt and silty sand layers to a depth greater than 9 ft bgs. The soils encountered in the soil borings were generally moist, with some thin saturated zones.

Surficial soils in the area of building 714 range in thickness from 0.0 - 1.0 ft, and consist of brown, silty sand grading into a gray clay. This material is underlain by gray clay layer with few silty sand zones to a depth greater than 9 ft bgs. The soils encountered in the soil borings were generally moist.

5.3 Remedial Investigation Activities

The Group 5 Sites SI field activities performed at Site 60 included: collection of surface soil samples for chemical analyses; and collection of subsurface soil samples for chemical analyses.

5.3.1 Contaminant Source Investigation

The primary sources of potential contaminants at Site 60 are the buildings used for pesticides and herbicides storage as well as any material that may have been spilled during operations. A media sampling and analysis program was developed for Site 60 to assist in determining if a release of potential contaminants from previous operations has impacted the area soils.

5.3.2 Surface Investigation

A total of 15 surface soil samples (LH60SS01 - LH60SS15) were collected on 14 - 15 October 1995 as part of the SI at the locations shown on Figures 5-1 and 5-2 (Appendix I). The areas targeted for investigation were building entryways and drainage ditches. Stainless steel hand auger equipment was used to collect surface soil samples from the 0 - 1 ft depth interval at each sampling location. Surface soil samples were analyzed for pesticides and herbicides.

5.3.3 Subsurface Investigation

A total of nine soil borings (LH60SB01 - LH60SB03, LH60SB06 - LH60SB08, and LH60SB11 - LH60SB13) were advanced on 14 - 15 October 1995 as part of the SI at the locations shown on Figures 5-1 and 5-2 (Appendix I). The areas targeted for investigations were building entryways and drainage ditches. The soil borings were advanced to a total depth of 9 ft bgs. Soil samples for chemical analyses were collected from the soil borings at depth intervals of 1 - 3 ft, 3 - 5 ft, and 7 - 9 ft using either a 2-ft long 2-in. I.D. split barrel sampler or a 5-ft long continuous-core sampler, from within the 4.25 in. O.D. hollow stem augers. Soil samples were visually classified for lithologic characteristics using the USCS and recorded on the geologic boring logs presented in

Appendix III. A total of 27 soil samples were submitted for laboratory chemical analysis for pesticides and herbicides.

5.4 Nature and Extent of Contamination

This section presents a summary of the analytical results for media sampled during the Group 5 Sites SI at Site 60.

5.4.1 Surface Soil Sample Results

4,4'-DDE was detected in five of the 15 surface soil samples [LH60SS01(000.0), LH60SS11(000.0), LH60SS12(000.0), LH60SS14(000.0), and LH60SS15(000.0)] at concentrations ranging from 18.73 µg/kg to 203.00 µg/kg. 4,4'-DDT was detected in three of the 15 surface soil samples [LH60SS01(000.0), LH60SS12(000.0), and LH60SS15(000.0)] at concentrations ranging from 16.07 µg/kg to 458.00 µg/kg. Dieldrin was detected in one of the 15 surface soil samples [LH60SS03(000.0)] at a concentration of 25,404 µg/kg.

Two of the 15 surface soil samples [LH60SS02(000.0) and LH60SS07(000.0)] contained detectable concentrations of 2-(2,4,5-trichlorophenoxy)propionic acid (silvex) at 4.18 µg/kg and 6.02 µg/kg, respectively. Surface soil sample locations are shown on Figure 5-1 (Appendix I). Analytical results for the surface soil samples are summarized in Table 5.1 and Tables 15 and 16 (Appendix IV).

5.4.2 Subsurface Soil Sample Results

Aldrin and endosulfan sulfate were detected in one of the 27 soil samples [LH60SB13(1-3)] at concentrations of 2.4 µg/kg and 0.7 µg/kg, respectively. Dieldrin was detected in two of the 27 soil samples [LH60SB03(1-3) and LH60SB03(3-5)] at concentrations of 11.55 µg/kg and 6.30 µg/kg, respectively.

Herbicides were not detected in the 27 soil samples. Soil boring locations are shown on Figure 5-1 (Appendix I). Analytical results for the soil samples are summarized in Table 5.2 and Table 17 (Appendix IV).

TABLE 5.1
DETECTED COMPOUND COMPARISON
SURFACE SOIL SAMPLES
SITE 60

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
Pesticides (ug/kg)						
4,4' - DDE	---	5/15	84.29	40.00	18.73 J - 203	---
4,4' - DDT	---	3/15	220.45	185.00	16.07 J - 458 J	---
Dieldrin	---	1/15	25404	25404	25404	---
Herbicides (ug/kg)						
2,4,5 - (Silvex)	---	3/15	15	6	4.18 - 33.96	---

J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Background analysis was performed on metal samples only. Maximum background level is used.

Note: A primary and QC analysis was performed on sample LH60SS10 and LH60SS15. The highest concentration of the duplicate or primary result was used in all calculations.

020678

TABLE 5.2
DETECTED COMPOUND COMPARISON
SOIL BORING SAMPLES
SITE 60

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY					
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above Soil Screening Levels	Samples w/ Concentrations Above LHAAP Background Levels
Pesticides (ug/kg)							
Aldrin	---	1/27	2.4	2.4	2.4 J	---	---
Dieldrin	---	2/27	8.9	8.9	6.3 - 11.55	---	---
Endosulfan sulfate	---	1/27	0.7	0.7	(0.7)J	---	---

() - Less than the Detection Limit.
J - The analyte was positely identified; the associated numerical value is the approximate concentration of the analyte in the sample.

[1] Subsurface background analysis was performed on metal samples only.

Note: A primary and QC analysis was performed on sample LH60SB02(7-9), LH60SB06(7-9) and LH60SB11(7-9). The highest concentration of the duplicate or primary result was used in all calculations.

020679

6.0 SITE 63 - FORMER BURIAL PITS

This section presents the results of the Group 5 Sites SI performed at Site 63 on 9 - 18 October 1995 and 19 - 20 February 1996. The purpose of this investigation was to evaluate the nature and extent of potential contamination of surface soil and subsurface soil at the site.

6.1 Site Background

6.1.1 Site Description

The suspected burial pits are located adjacent to Bobby Jones Road, beginning at the intersection of Long Point Road and extending north approximately 165 ft on both sides of the roadway as shown on Figure 6-1 (Appendix I).

6.1.2 Site History

LHAAP Site 63 was identified as pits that were used for the detonation and burial of Plant 3 reject materials of unknown composition. It is assumed that no burning occurred within the pits, therefore, fuels or solvents normally used to burn materials are not anticipated to be contaminants of concern. A review of aerial photography of LHAAP taken in 1954, 1958, 1963 and 1970 revealed indications of surface soil disturbance. It is assumed that the burial pits area was developed sometime between May 1954 and March 1958. The period of operational history is unknown.

6.2 Physical Characteristics of Site

This section presents a description of physical conditions at Site 63. Subjects addressed include surface topography and hydrology as well as site soils and geology. Information presented in this section is based on data obtained from the Group 5 Sites SI.

6.2.1 Surface Features and Surface Hydrology

Site 63 is located in the eastern portion of LHAAP and encompasses approximately 9.5 acres as shown on Figure 6-1 (Appendix I). Site 63 is an area of heavy brush and timber that bounds Bobby Jones Road. Access paths have been cleared along Bobby Jones Road.

Runoff from Site 63 is generally toward the east by sheet flow into Saunder's Branch. Runoff from the site eventually enters Caddo Lake via Saunder's Branch. The total flow distance from the site to lake is approximately 1.65 miles.

6.2.2 Geology and Soils

General soil and geologic maps indicate that the site is situated on the outcrop of the Wilcox Group. The Wilcox Group materials at the site generally consist of a few feet of residually-derived overlying silts, clays, and sands of the Wilcox Group.

Surficial soils range in thickness from 0.0 - 2.75 ft, and consist of brown, silty sand grading into a gray to reddish brown silt. This material is underlain by a yellowish brown to gray silt and clay layer to a depth of 13.8 - 16.5 ft bgs. Beneath the silt and clay is a yellow to yellowish brown silty sand to a depth greater than 16.7 ft bgs. No debris or indication of burial activities were observed in the soils recovered from soil borings. The soils encountered in the soil borings were dry.

6.3 Remedial Investigation Activities

The Group 5 Sites SI field activities performed at Site 63 included: collection of surface soil samples for chemical analyses; and collection of subsurface soil samples for chemical analyses.

6.3.1 Contaminant Source Investigation

The primary sources of potential contaminants at Site 63 are the former burial pits. A media sampling and analysis program was developed for Site 63 to assist in determining if a release of potential contaminants from previous operations has impacted the area soils.

6.3.2 Surface Investigation

A total of five surface soil samples (LH63SS01 - LH63SS05) were collected on 11 - 12 October 1995 as part of the SI at the locations shown on Figure 6-1 (Appendix I). The areas targeted for investigations were suspected burial pit locations east and west of Bobby Jones Road. Stainless steel hand auger equipment was used to collect surface soil samples from the 0 - 1 ft depth interval at each

sampling location. Surface soil samples were analyzed for VOCs, SVOCs, explosive compounds, and TAL metals.

A total of five surface soil samples (LH63SS01 - LH63SS05) were collected within 1-ft of the original sample locations on 19 February 1996 as part of the SI. These surface soil samples were analyzed for explosive compounds to confirm the previous surface soil sample results.

6.3.3 Subsurface Investigation

A total of five soil borings (LH63SB01 - LH63SB03) were advanced as part of the SI at the locations shown on Figure 6-1 (Appendix I). The areas targeted for investigations were suspected burial pit locations east and west of Bobby Jones Road. The soil borings were advanced to a total depth of 17 ft bgs. Soil samples for chemical analyses were collected from the soil borings at depth intervals of 5 - 7 ft, 10 - 12 ft, and 15 - 17 ft using either a 2-ft long 2-in. I.D. split barrel sampler or a 5-ft long continuous-core sampler, from within the 4.25 in. O.D. hollow stem augers. Soil samples were visually classified for lithologic characteristics using the USCS and recorded on the geologic boring logs presented in Appendix III. Soil samples were field screened with an photoionization detector to qualify the presence of volatile compounds in the soil gas. A total of 15 soil samples were submitted for laboratory chemical analyses which included VOCs, SVOCs, explosive compounds, and TAL metals.

6.4 Nature and Extent of Contamination

This section presents a summary of the analytical results for media sampled during the Group 5 Sites SI at Site 63.

6.4.1 Surface Soil Sample Results

Acetone was detected in one of the five surface soil samples [LH63SS04(000.0)] at a concentration of 31 µg/kg. Naphthalene was detected in one of the five surface soil samples [LH63SS01(000.0)] at a concentration of 6 µg/kg. Acetone is a chemical used in laboratory analytical procedures and its presence is generally considered to be the result of laboratory induced contamination. Naphthalene is a chemical that may be detected as the result of analytical contamination.

Di-n-butylphthalate was detected in three of the five surface soil samples with the results qualified as 'U'. The qualifier 'U' is defined in the LHAAP Group 5 Sites SI Laboratory Sampling and Data Results Report, in Part 2, Section 1.4 titled "Data Qualifier Definitions" as: "The material was analyzed for, but was determined to be not detected. The associated numerical value is to be considered the Quantitation Limit." Di-n-butylphthalate is a chemical that may be detected as the result of analytical contamination.

Explosive compounds were not detected in the surface soil samples. Surface soil sample locations are shown on Figure 6-1 (Appendix I).

Sixteen of the 23 metals analyzed for were detected in at least one of the surface soil samples collected. Magnesium and zinc were detected at concentrations above LHAAP soil background levels in surface soil samples LH63SS01, LH63SS03, and LH63SS04. Nickel was detected at a concentration above the LHAAP soil background level in surface soil sample LH63SS04. Concentrations of the remaining 13 detected metals were below LHAAP soil background levels. Analytical results for the surface soil sample are summarized in Table 6.1 and Tables 18, 19, and 20 (Appendix IV).

6.4.2 Subsurface Soil Sample Results

Bis(2-ethylhexyl)phthalate was detected in nine of the 15 soil samples at concentrations ranging from 206 µg/kg to 890 µg/kg. Di-n-butylphthalate was detected in eight of the 15 soil samples with the results qualified as 'U'. The qualifier 'U' is defined in the LHAAP Group 5 Sites SI Laboratory Sampling and Data Results Report, in Part 2, Section 1.4 titled "Data Qualifier Definitions" as: "The material was analyzed for, but was determined to be not detected. The associated numerical value is to be considered the Quantitation Limit." Bis(2-ethylhexyl)phthalate and di-n-butylphthalate are chemicals that may be detected as the result of analytical contamination.

VOCs and Explosive compounds were not detected in the soil samples. Soil boring locations are shown on Figure 6-1 (Appendix I).

Seventeen of the 23 metals analyzed for were detected in at least one of the soil samples collected. Beryllium was detected in four soil samples [LH63SB01(15-17), LH63SB02(5-7), LH63SB03(5-7), and LH63SB04(15-17)] at concentrations ranging from 1.3 mg/kg to 1.5 mg/kg. There is no established LHAAP soil background level for beryllium. Barium, cobalt, copper, lead, magnesium, manganese, nickel, potassium, and sodium were detected at concentrations above LHAAP soil background levels in at least one soil sample collected from soil borings LH63SB01 - LH63SB04. Concentrations of the remaining eight detected metals were below LHAAP soil background levels. Analytical results for the soil sample are summarized in Table 6.2 and Tables 21 and 22 (Appendix IV).

TABLE 6.1
DETECTED COMPOUND COMPARISON
SURFACE SOIL SAMPLES
SITE 63

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
VOCs (ug/kg)						
Naphthalene	---	1/5	6	6	6	---
Acetone	---	1/5	31	31	31	---
SVOCs (ug/kg)						
Di-n-butylphthalate	---	3/5	974	794	435 U - 1694 U	---
Bis (2-ethylhexyl) phthalate	---	1/5	216	216	(216)	
Metals (mg/kg)						
Aluminum	20700	5/5	8672	8370	3740 - 12100	---
Arsenic	29.7	5/5	3.1	3.3	1.9 - 3.6	---
Barium	287	5/5	114.6	124	59.7 - 182	---
Beryllium	---	1/5	0.740	0.740	0.740	---
Cadmium	---	1/5	1.0	1.0	1.0	---
Calcium	1090	5/5	382	310	290 - 630	---
Chromium	22.8	5/5	12.94	13.20	11 - 14.5	---
Cobalt	19.1	5/5	6.74	6.80	5.9 - 7.7	---
Copper	6.7	3/5	3.3	3.3	3 - 4.1	---
Iron	31000	5/5	9504	9730	6840 - 12000	---
Lead	17.4	5/5	12.3	9.6	9.0 - 18.0	---
Magnesium	474	5/5	530	580	220 - 710	LH63SS(01, 03, 04)
Manganese	2330	5/5	519	556	271 - 837	---
Nickel	6.3	5/5	5.7	5.9	3.9 - 7.1	LH63SS04
Vanadium	---	5/5	22.7	22.0	16.9 - 28.1	---
Zinc	16.2	5/5	15.7	18.0	8.4 - 19	LH63SS(01, 03, 04)

U - Not detected at the reported Quantitation Limit.

[1] Background analysis was performed on metal samples only. Maximum background level is used.

Note: A primary and QC analysis was performed on sample LH63SS01 and LH63SS02. The highest concentration of the duplicate or primary result was used in all calculations.

TABLE 6.2
DETECTED COMPOUND COMPARISON
SOIL BORING SAMPLES
SITE 63

COMPOUNDS	LHAAP Soil Background Concentration Levels[1]	DATA SUMMARY				
		Detection Frequency	Concentration Mean	Concentration Median	Concentration Range	Samples w/ Concentrations Above LHAAP Background Levels
SVOCs (ug/kg)						
Bis(2-ethylhexyl)phthalate	---	9/15	363	256	(206) - 890	---
Di-n-butylphthalate	---	8/15	1206	1331	496 U - 1733 U	---
Metals (mg/kg)						
Aluminum	23900	15/15	11461	11300	5350 - 1660	---
Arsenic	36.8	14/15	2.3	2.1	1.2 - 4	---
Barium	138	15/15	176.4	163.0	65.6 - 344	LH63SB(01(5-7), 01(10-12), 01(15-17), 02(5-7), 02(10-12), 03(5-7), 03(10-12), 04(5-7), 04(10-12), 04(15-17), 05(5-7))
Beryllium	---	13/15	0.95	0.90	0.8 - 1.5	---
Calcium	2740	15/15	1177	1100	550 - 1660	---
Chromium	26.2	15/15	15.1	14.8	9.7 - 20.7	---
Cobalt	12.5	15/15	13.5	10.0	3 - 39.8	LH63SB(01(10-12), 02(5-7), 03(5-7), 03(10-12), 04(10-12))
Copper	10.7	15/15	8.4	9.1	3.3 - 11	LH63SB(01(15-17), 03(5-7))
Iron	42300	15/15	15173	15300	5390 - 22300	---
Lead	13	15/15	8.94	9.30	4.84 - 16	LH63SB(02(5-7), 03(10-12))
Magnesium	2240	15/15	2135	2290	780 - 3250	LH63SB(01(5-7), 01(15-17), 02(5-7), 03(5-7), 03(10-12), 04(5-7), 04(15-17), 05(5-7))
Manganese	376	15/15	168.0	113.0	23.2 - 639	LH63SB01(10-12)
Nickel	19.1	15/15	17.3	16.7	5.9 - 24.6	LH63SB(01(5-7), 01(15-17), 02(5-7), 03(5-7), 04(15-17))
Potassium	887	14/15	813.33	870.00	670 - 1100	LH63SB(01(5-7), 01(15-17), 02(10-12), 03(5-7), 03(10-12), 04(5-7), 05(5-7))
Sodium	1.6	15/15	506	530	300 - 730	LH63SB(01-05)
Vanadium	---	15/15	25.0	25.0	11.5 - 36	---
Zinc	84.5	15/15	48.6	50.0	15 - 71.4	---

() - Less than the Detection Limit.
U - Not detected at the reported Quantitation Limit.

[1] Subsurface background analysis was performed on metal samples only.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on a review of the data and results from the SI activities for the Group 5 Sites at LHAAP, Karnack, Texas; the following conclusions and recommendations are made:

Site 50 - Sump Water Storage Tank

Based on analytical results VOCs are present in the sediment sample collected downstream of the site. No SVOCs or explosive compounds were detected in the sediment samples. Detectable concentrations of ten metals in the sediment samples are below established LHAAP soil background levels. Detectable concentrations of five metals in the sediment samples are above established LHAAP soil background levels. Beryllium was detected in the sediment samples. There is no established LHAAP soil background level for beryllium.

Further sediment samples should be collected and analyzed for VOCs to determine the source and extent of the contaminants present in Goose Prairie Creek. Surface water samples should be collected and analyzed for VOCs to determine if the contaminants identified in the sediment sample are impacting surface water quality. Background soil samples should be collected and analyzed for beryllium to establish a LHAAP soil background level. This will determine whether beryllium is naturally occurring in soils at LHAAP.

Based on analytical results VOCs, SVOCs, and metals were detected in the surface soil samples. No explosive compounds were detected in the surface samples. Detectable concentrations of metals are below established LHAAP soil background levels.

No additional surface soil sampling appears warranted at this site.

Based on analytical results VOCs are present in a deep soil sample collected in a soil boring situated downgradient of the assumed direction of shallow groundwater flow beneath the site. No explosive compounds were detected in the soil samples. Detectable concentrations of five metals in the soil samples are below established LHAAP soil background levels. Detectable concentrations of 11 metals in the soil samples are above established LHAAP soil background levels. Beryllium was

detected in four soil samples. There is no established LHAAP soil background level for beryllium.

Due to the proximity of groundwater to the soil sample containing cis-1,2-DCE and TCE a groundwater study should be conducted at the site to determine the nature and extent of VOCs in the shallow groundwater beneath the site. Background soil samples should be collected and analyzed for beryllium to establish a LHAAP soil background level. This will determine whether beryllium is naturally occurring in soils at LHAAP.

Site 52 - Magazine Area Washout

Based on analytical results VOCs, SVOCs, and metals were detected in the surface and subsurface soil samples. No explosive compounds were detected in the surface and subsurface samples. Detectable concentrations of 13 metals in surface soil samples and 13 metals in soil samples are below established LHAAP soil background levels. Detectable concentrations of two metals in surface soil samples and four metals in soil samples are above established LHAAP soil background levels.

Based on the data presented in Section 3, no further action is required at this site since no significant release of contaminants has been identified.

Site 60 - Former Storage Buildings 411 and 714

Based on analytical results pesticides and herbicides were detected in the surface and subsurface soil samples.

Additional surface soil samples should be collected and analyzed for pesticides in the area of buildings 411 and 411 to better determine the extent of contaminants present at the site.

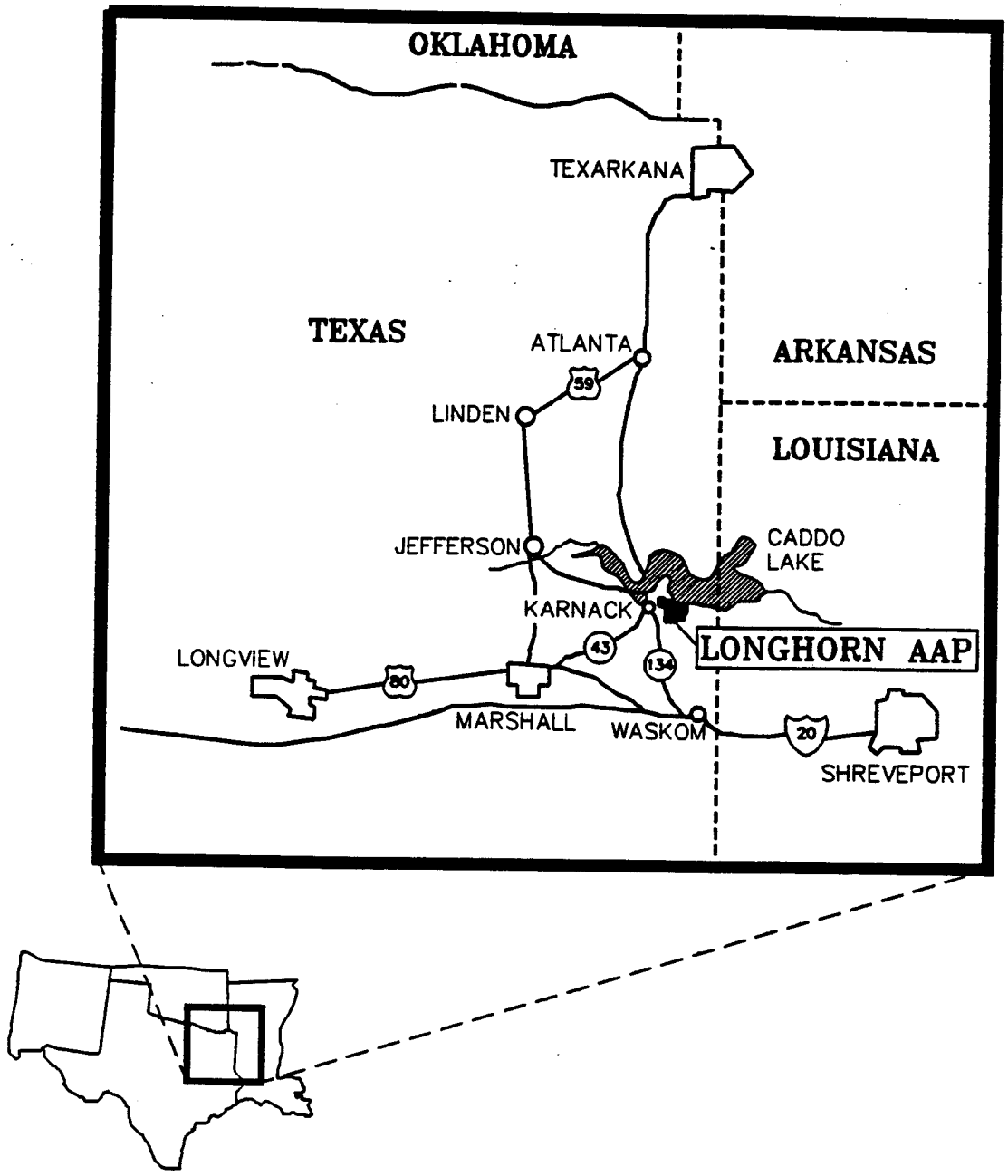
Site 63 - Former Burial Pits

Based on analytical results VOCs, SVOCs, and metals were detected in the surface and subsurface soil samples. No explosive compounds were detected in the surface and subsurface samples. Detectable concentrations of 13 metals in surface soil samples and eight metals in soil samples are

below the established LHAAP soil background levels. Detectable concentrations of three metals in surface soil samples and eight metals in soil samples are above established LHAAP soil background levels. Beryllium was detected in four soil samples. There is no established LHAAP soil background level for beryllium.

Based on the data presented in Section 6, no further action is required at this site since no significant release of contaminants has been identified. Background soil samples should be collected and analyzed for beryllium to establish a LHAAP soil background level. This will determine whether beryllium is naturally occurring in soils at LHAAP.

020690



US Army Corps of Engineers Tulsa District Sverdrup ENVIRONMENTAL	SITE VICINITY MAP LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS	DWN:	DES.:	PROJECT NO.: 000086
		CHKD:	APPD:	
		DATE: JULY 96	REV.:	FIGURE NO.: 2-1

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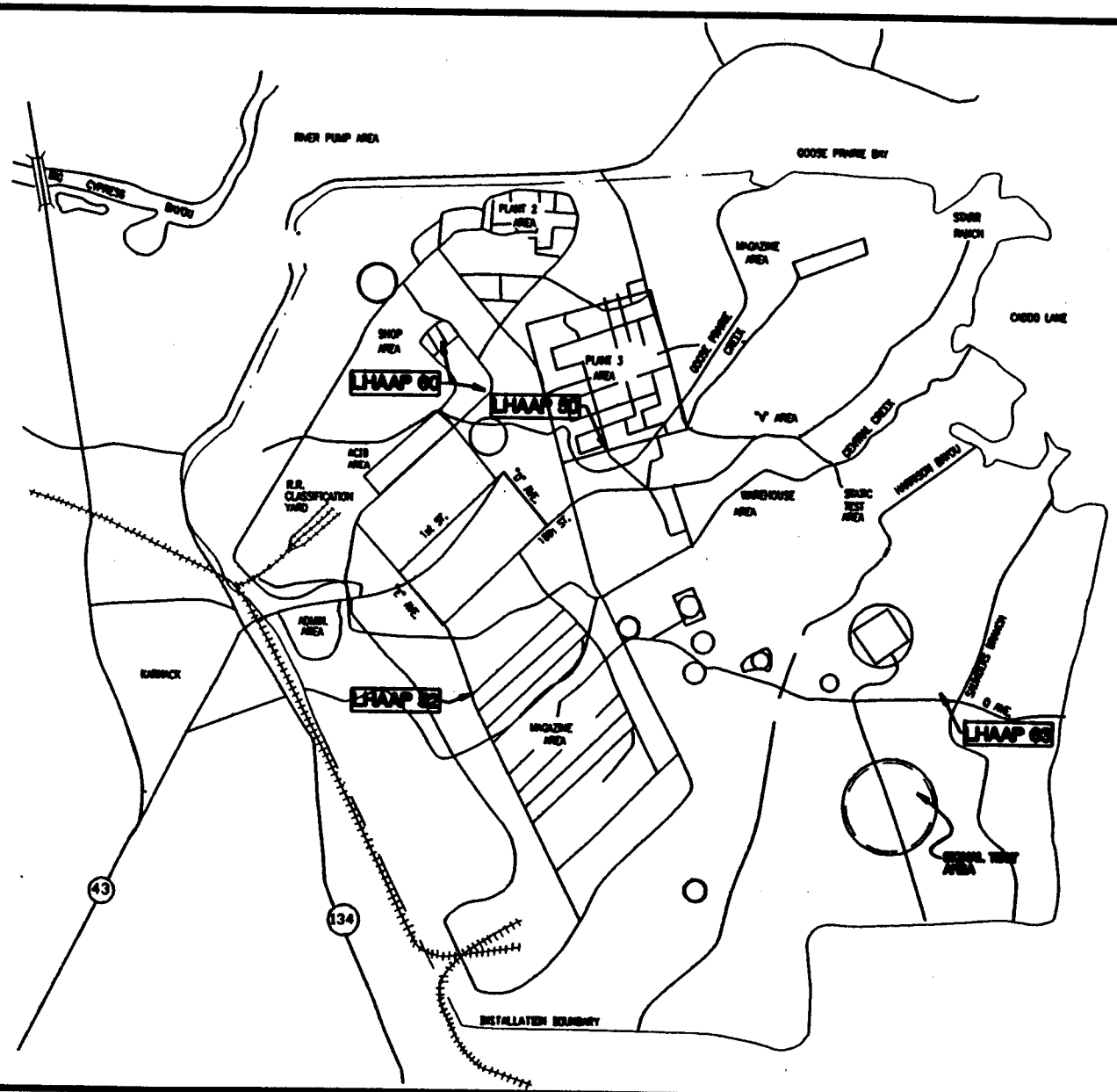

0220691

0 2000 4000
FEET

US Army Corps of Engineers Tulsa District

Sverdrup ENVIRONMENTAL

SITE LOCATION MAP LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS

DWN: BGC	DES.:	PROJECT NO.: 000086	
CHKD:	APPD:		
DATE: JULY 96	REV.:	FIGURE NO.: 2-2	

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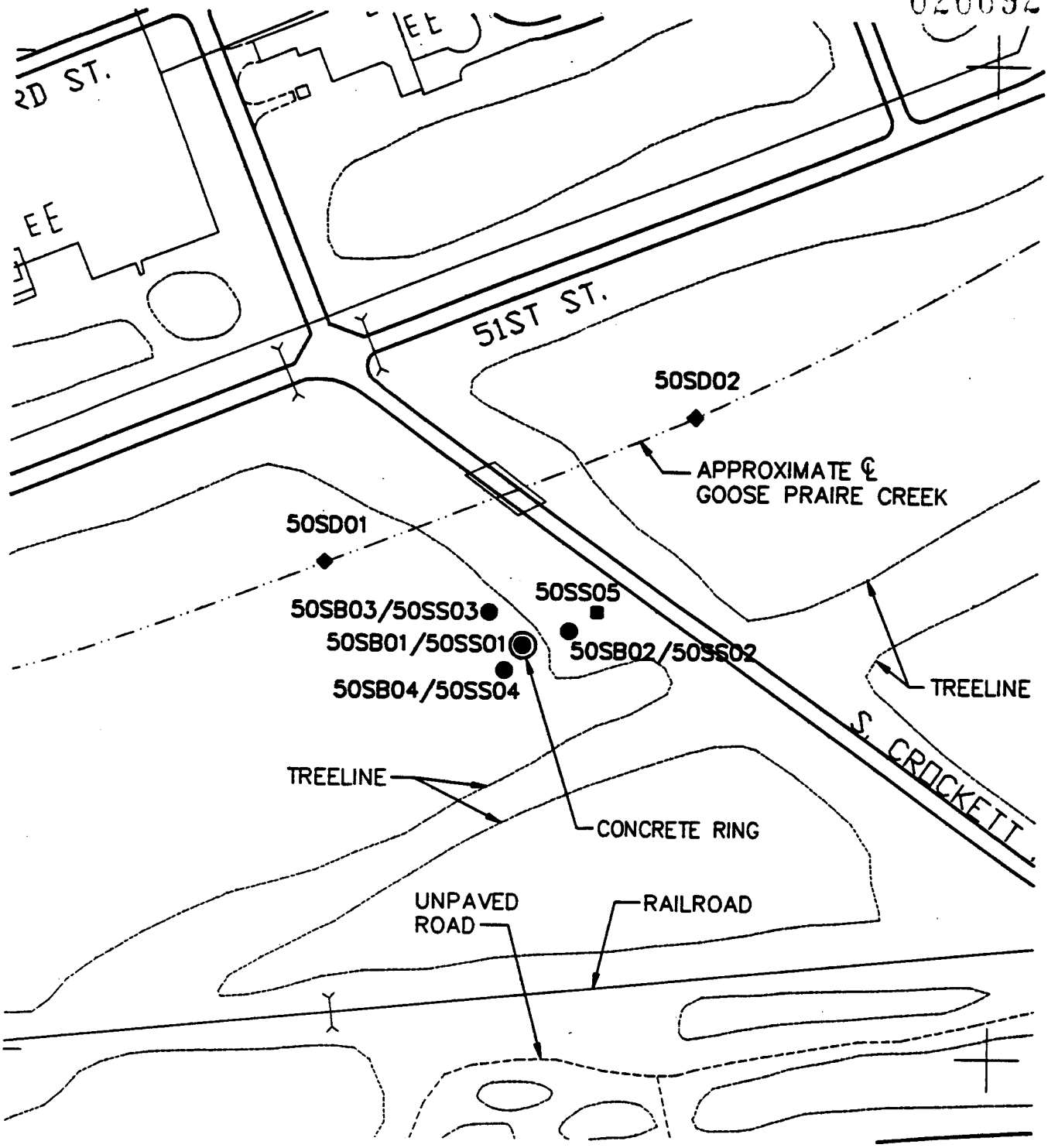


LEGEND

- ● SOIL BORING AND SURFACE SOIL SAMPLE
- ◆ SEDIMENT SAMPLE
- ■ SURFACE SOIL SAMPLE

N

0 75 150

FEET

US Army Corps of Engineers Tulsa District

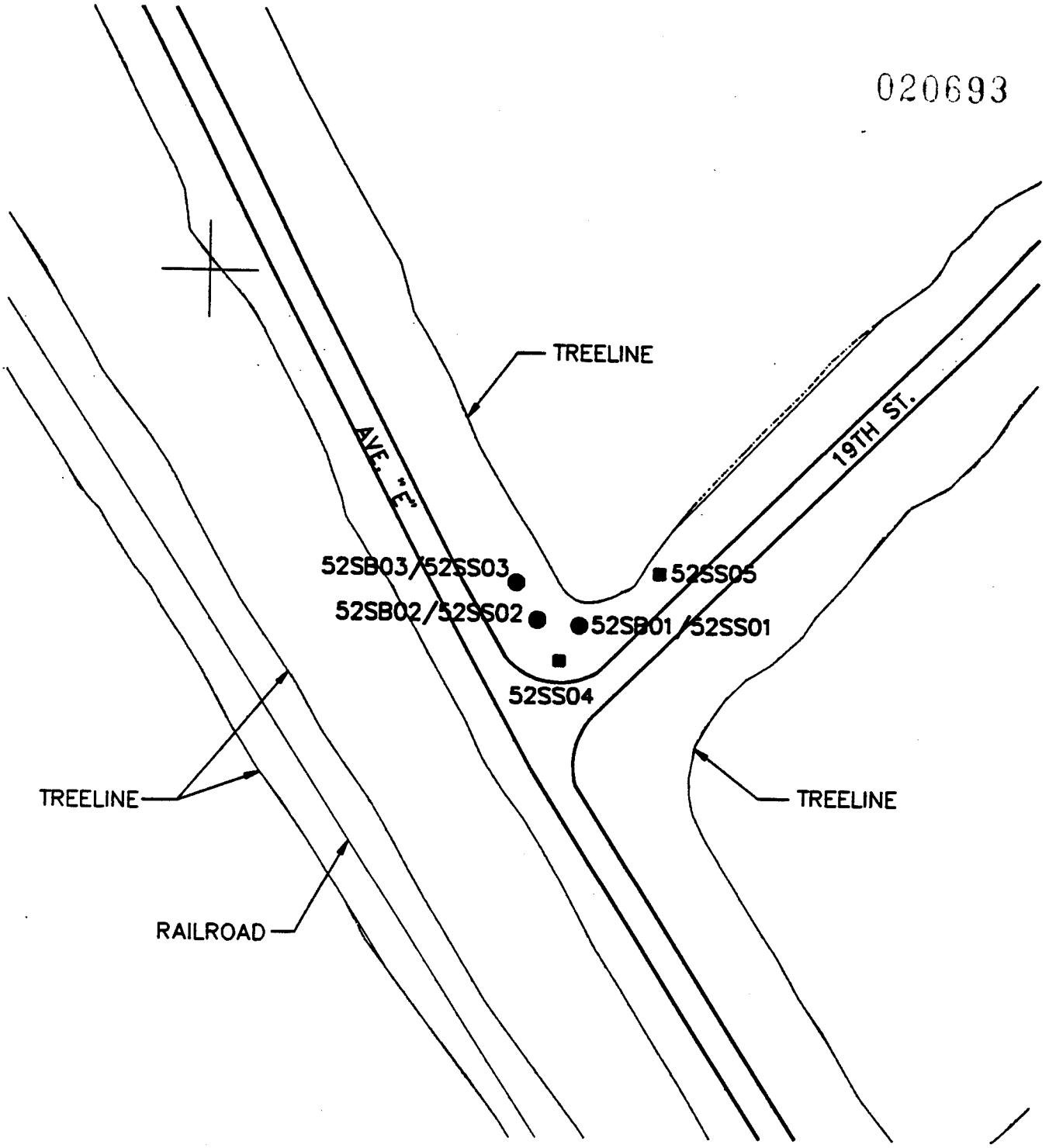
Sverdrup ENVIRONMENTAL

SITE 50
SITE MAP
LHAAP
KARNACK, TEXAS

DWN: BGC	DES.:	PROJECT NO.: 000086	
CHKD:	APPD:		
DATE: JULY 96	REV.: AUG 96	FIGURE NO.: 3-1	

S:\SVE_CLNT\TULSA\LH_02\GEO\MAPS\MLHN127

020693



LEGEND

- ● SOIL BORING AND SURFACE SOIL SAMPLE
- ■ SURFACE SOIL SAMPLE

N

0 50 100

FEET

US Army Corps of Engineers Tulsa District

Sverdrup ENVIRONMENTAL

SITE 52
SITE MAP
LHAAP
KARNACK, TEXAS

DWN: BGC	DES.:	PROJECT NO.: 000086
CHKD:	APPD:	
DATE: JULY 96	REV.: AUG 96	FIGURE NO.: 4-1

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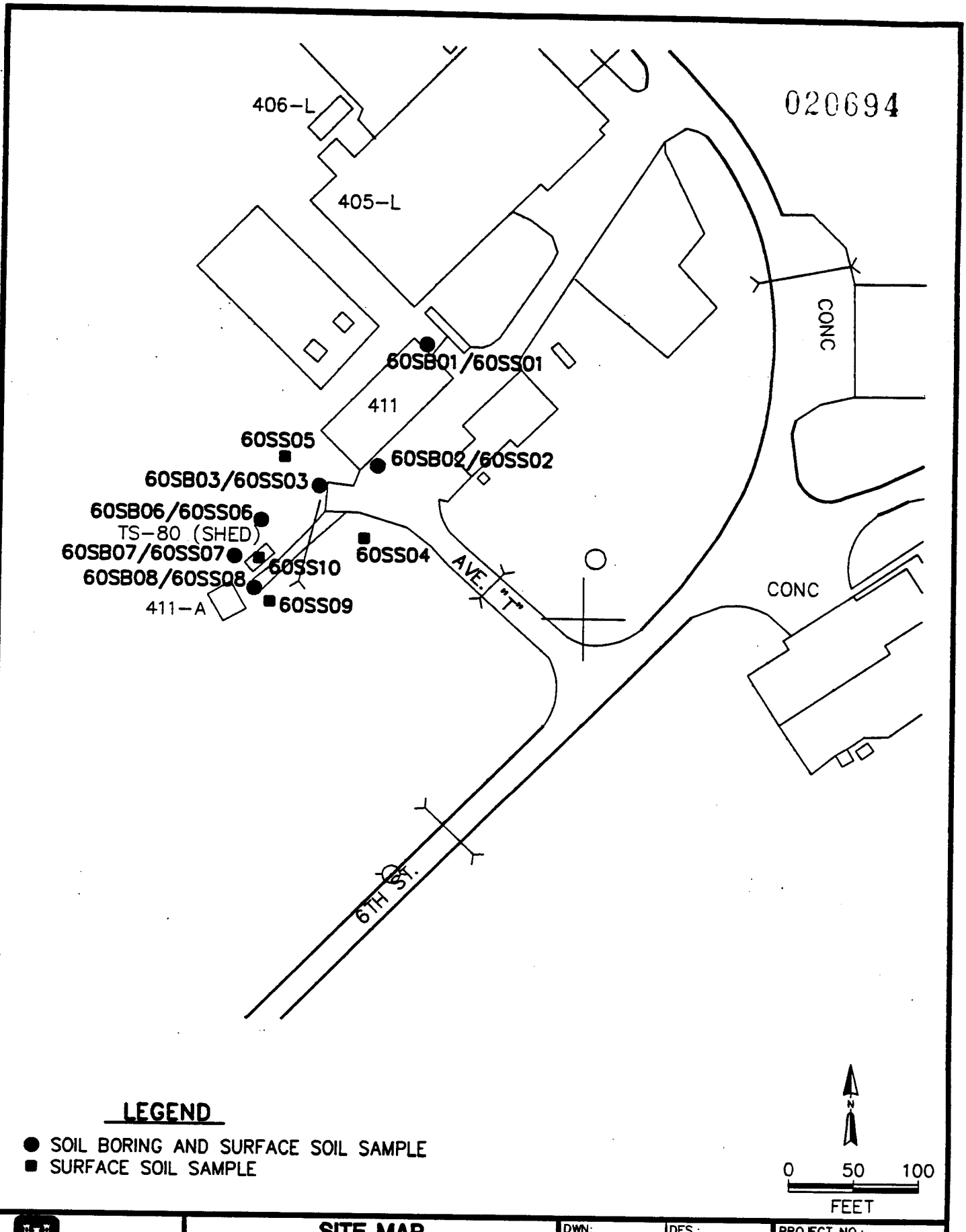
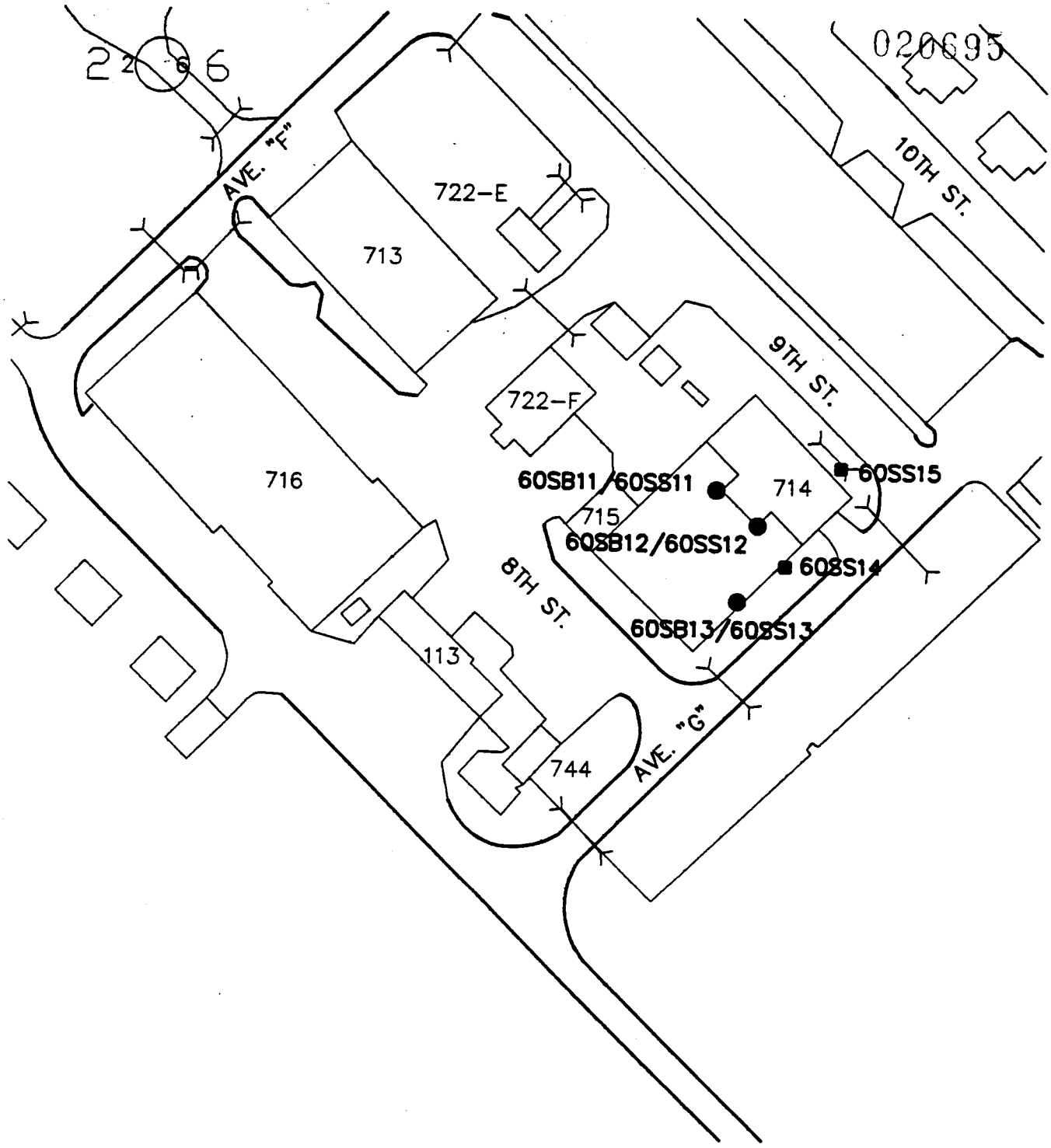


US Army Corps of Engineers Tulsa District Sverdrup ENVIRONMENTAL	**SITE MAP** **SITE 60 (BLDG 411)** **LHAAP** **KARNACK, TEXAS**	DWN: BGC	DES.:	PROJECT NO.: 000086
		CHKD:	APPD:	FIGURE NO.: 5-1
		DATE: JULY 96	REV.: AUG 96	

S:\SVE_CLNT\TULSA\LH_02\GEO\MAPS\MLHN124



LEGEND

- ● SOIL BORING AND SURFACE SOIL SAMPLE
- ■ SURFACE SOIL SAMPLE

US Army Corps of Engineers Tulsa District

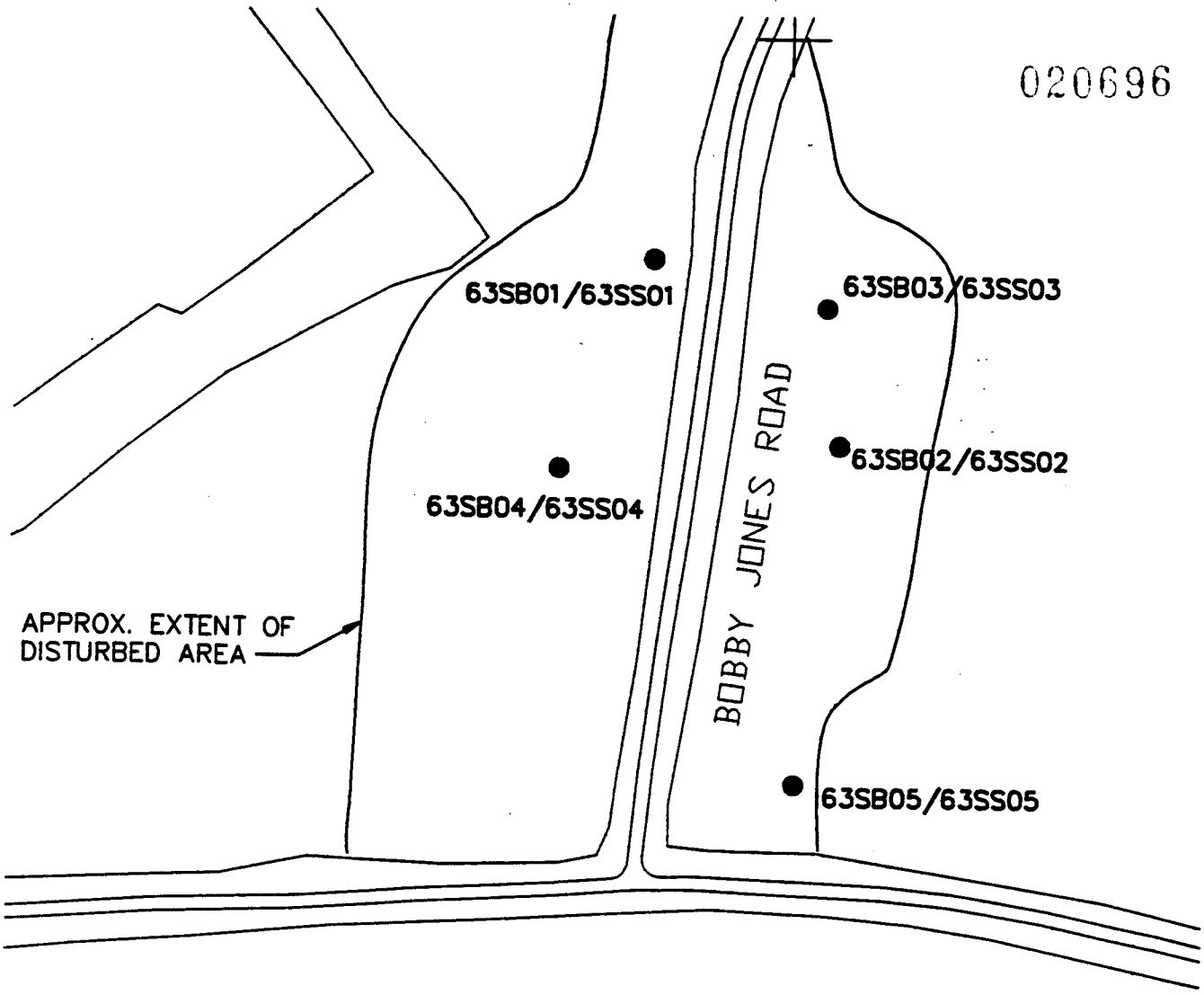
Sverdrup ENVIRONMENTAL

SITE 60 (BUILDING 714)
SITE MAP
LHAAP
KARNACK, TEXAS

DWN: BGC	DES.:	PROJECT NO.: 000086
CHKD:	APPD:	
DATE: JULY 96	REV.:	FIGURE NO.: 5-2

S:\SVE_CLNT\TULSA\LH_02\GEO\MAPS\MLHN129

020696



LEGEND

● SOIL BORING AND SURFACE SOIL SAMPLE

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0 75 150

FEET

US Army Corps of Engineers Tulsa District

Sverdrup ENVIRONMENTAL

SITE 63
SITE MAP
LHAAP
KARNACK, TEXAS

DWN:	DES.:	PROJECT NO.:
BGC		000086
CHKD:	APPD:	FIGURE NO.:
DATE: JULY 96	REV.: AUG 96	6-1

S:\SVE_CLNT\TULSA\LH_02\GEO\MAPS\MLHN132

C.O.C. ID: P2G5-1012A

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP Phase 2, Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: TPDI
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Area 63
Report Results to: Dave Backelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments:

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	5240 Volatile Organics Compounds	5290 Semi-Volatile Organics Compounds	5330 Explosives	TAL Metals	<--Pres./Filt. NOTES
HMS/STB	Soil	10/12	08:45	LH6355Ø3 (ØØØ.Ø)	5	X	X	X	X	
HMS/STB	Soil	10/12	09:10	LH635BØ3 (5-7)	5	X	X	X	X	
HMS/STB	Soil	10/12	09:25	LH635BØ3 (1Ø-12)	5	X	X	X	X	
HMS/STB	Soil	10/12	09:40	LH635BØ3 (15-17)	5	X	X	X	X	
HMS/STB	Soil	10/12	11:30	LH635BØ1 (5-7)	5	X	X	X	X	
HMS/STB	Soil	10/12	11:50	LH635BØ1 (1Ø-12)	5	X	X	X	X	
HMS/STB	Soil	10/12	11:57	LH635BØ1 (15-17)	5	X	X	X	X	
HMS/STB	Soil	10/12	12:20	LH6355Ø1 (ØØØ.Ø)	5	X	X	X	X	
HMS/STB	Soil	10/12	12:20	LH6355Ø1 (ØØØ.Ø) QC	5	X	X	X	X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Brunton	10/12/15 17:30			
Steve Brunton				

0206971

C.O.C. ID: P2G5-10NA

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP Phase 2, Group 5
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: TPDP
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Area 63
Report Results to: Dave Backelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments:

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	8240 Volatile Organic Compounds	8270 Semi-Volatile Compounds	8330 Explosives	TAL Metals	<--Pres./Filt. NOTES
AMS/SJB	Water	10/12	16:55	LH635B01(15-17)EB	3	X				
AMS/SJB	Water	10/12	16:55	LH635B01(15-17)EB	1		X			
AMS/SJB	Water	10/12	16:55	LH635B01(15-17)EB	1			X		
AMS/SJB	Water	10/12	16:55	LH635B01(15-17)EB	1				X	
AMS/SJB	Water	10/12	17:15	LH63TB	2	X				

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Brunton	10/12/95 17:30			
Steve Brunton				

020693

C.O.C. ID: P265-1012 B

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LWAAP Phase 2, Group 5 Sites
Location: ~~Kennedy, Tx~~ STB Longhorn Army Ammunition Plant
Lab_ID/Lab: PDP
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Area 63
Report Results to: Steve Brunton
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments:

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	8240 Volatile organic Compounds	8270 Semi-Volatile Organic Compounds	8330 Explosives	TAL Metals	<--Prsv./Filt. NOTES
~~AMS~~/SJB	Soil(s)	10/11	09:45	LH635SØ5 (ØØØ.Ø)	5	X	X	X	X	
~~AMS~~/SJB	Soil	10/11	10:10	LH635BØ5 (5-7)	5	X	X	X	X	
AMS/SJB	Soil	10/11	10:20	LH635BØ5 (10-12)	5	X	X	X	X	
AMS/SJB	Soil	10/11	10:55	LH635BØ5 (15-17)	5	X	X	X	X	
AMS/SJB	Soil	10/11	11:30	LH635SØ2 (ØØØ.Ø)	5	X	X	X	X	
AMS/SJB	Soil	10/11	11:30	LH635SØ2 (ØØØ.Ø) QC	5	X	X	X	X	
AMS/SJB	Soil	10/11	12:18	LH635BØ2 (5-7)	5	X	X	X	X	
AMS/SJB	Soil	10/11	12:18	LH635BØ2 (5-7) MS/MSD	6	X	X	X	X	
AMS/SJB	Soil	10/11	12:43	LH635BØ2 (10-12)	5	X	X	X	X	
AMS/SJB	Soil	10/11	13:05	LH635BØ2 (15-17)	5	X	X	X	X	
AMS/SJB	Soil	10/11	~~11:30~~	LH635BØ4 (5-7)	5	X	X	X	X	
AMS/SJB	Soil	10/11	14:50	LH635SØ4 (ØØØ.Ø)	5	X	X	X	X	
AMS/SJB	Soil	10/11	16:00	LH635BØ4 (10-12)	5	X	X	X	X	
AMS/SJB	Soil	10/11	16:13	LH635BØ4 (15-17)	5	X	X	X	X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Brunton	10/12/95 17:30			

020699

C.O.C. ID: P2G5-1016A

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP Phase 2, Group 5 sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: Southwest Division Labs
Lab Phone/Contact: 214 905-9130 Al, Tran
Field Contact: Steve Brighton
Field Batch: Group 5 Sites QA
Report Results to: David Backelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	8260 Volatile Organic Compounds	8270 Semi-Volatile Organic Compounds	6330 Explosives	TAL Metals	8080 Pesticides	8150 Herbicides	<--Pres./Filt. NOTES
AMIS/SJB	Soil	10/11	11:30	LH6355Ø2(ØØØ.Ø)QA	5	X	X	X	X			
AMIS/SJB	Soil	10/12	12:20	LH6355Ø1(ØØØ.Ø)QA	5	X	X	X	X			
AMIS/SJB	Soil	10/13	08:25	LH5Ø55Ø5(ØØØ.Ø)QA	5	X	X	X	X			
AMIS/SJB	Soil	10/13	13:45	LH5Ø55Ø3(ØØØ.Ø)QA	5	X	X	X	X			
AMIS/SJB	Soil	10/14	11:54	LH6Ø5BØ2(7-9)QA	2					X	X	
AMIS/SJB	Soil	10/14	15:00	LH6Ø5BØ6(7-9)QA	2					X	X	
AMIS/SJB	Soil	10/14	16:30	LH6Ø551Ø(ØØØ.Ø)QA	2					X	X	
AMIS/SJB	Soil	10/15	11:~~12~~ 10	LH6Ø5B11(7-9)QA	2					X	X	
AMIS/SJB	Soil	10/15	13:55	LH1Ø5515(ØØØ.Ø)QA	2					X	X	
AMIS/SJB	Soil	10/11	10:07	LH52SBØ2(7-9)QA	5	X	X	X	X			
~~AMIS/SJB~~	~~Soil~~	~~10/16~~	~~14:25~~	~~LH525B~~ SJB								
AMIS/SJB	Soil	10/16	14:25	LH5255Ø5(ØØØ.Ø)QA	5	X	X	X	X			

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
[signature]	10/12/15 08:54			

020700

C.O.C. ID: PZG5-1016A

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP - Phase 2, Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: PDP
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Site 50
Report Results to: Dave Bockelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: 5260 Volatile Organic Compounds; 5270 Semi-volatile Organic Compounds; 5330 Explosives; TAL Metals	<--Preservation NOTES
AMS/SJB	Soil	10/13	0825	LH50550S (0004.0)	5	X X X X	
AMS/SJB	Soil	10/13	0825	LH5055S (0004.0)QC	5	X X X X	
AMS/SJB	Soil	10/13	0900	LH50SS04 (0004.0)	5	X X X X	
AMS/SJB	Soil	10/13	0935	LH50SB04 (5-7)	5	X X X X	
AMS/SJB	Soil	10/13	0945	LH50SB04 (10-12)	5	X X X X	
AMS/SJB	Soil	10/13	1005	LH50SB04 (15-17)	5	X X X X	
AMS/SJB	Soil	10/13	1100	LH50SS01 (0004.0)	5	X X X X	
AMS/SJB	Soil	10/13	1100	LH50SS01 (0004.0) MS/MSD	6	X X X X	
AMS/SJB	Soil	10/13	1115	LH50SB01 (5-7)	5	X X X X	
AMS/SJB	Soil	10/13	1135	LH50SB01 (10-12)	5	X X X X	
AMS/SJB	Soil	10/13	1158	LH50SB01 (15-17)	5	X X X X	
AMS/SJB	Soil	10/13	1345	LH50SS03 (0004.0)	5	X X X X	
AMS/SJB	Soil	10/13	1345	LH50SS03 (0004.0)QC	5	X X X X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
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020701

C.O.C. ID: P265-1016B

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 660086
Project Name: LHAAP - Phase 2 Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: / PDP
Lab Phone/Contact: 713 314-2233 Mark Burgess
Field Contact: Steve Brunton
Field Batch: Site 50
Report Results to: Dave Bockelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: 5240 Volatile Organic Compounds; 5270 Semi-Volatile Organic Compounds; 5330 Explosives; TAL Metals	<-Pres./Filt. NOTES
MHS/SJB	Soil	10/13	14:20	LH50SB03 (5-7)	5	X X X X	
MHS/SJB	Soil	10/13	14:45	LH50SB03 (10-12)	5	X X X X	
MHS/SJB	Soil	10/13	14:55	LH50SB03 (15-17)	5	X X X X	
MHS/SJB	Soil	10/13	15:55	LH0055002 (000.0)	5	X X X X	
MHS/SJB	Soil	10/13	16:10	LH50SB02 (5-7)	5	X X X X	
MHS/SJB	Soil	10/13	16:25	LH50SB02 (10-12)	5	X X X X	
MHS/SJB	Soil	10/13	16:35	LH50SB02 (15-17)	5	X X X X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Brunton	10/16/95 19:20			

020702

C.O.C. ID: 12645-1616B

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LWAAP - Phase 2 Group 5 Sites
Location: Louisiana Army Ammunition Plant
Lab_ID/Lab: TDI
Lab Phone/Contact: 713-363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Site 50
Report Results to: Lee Eckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	8260 Volatile Organics	8270 Semi-volatile Organics	8330 Explosives	TAL Metals	<--Pres./Filt. NOTES
MHS/STB	Water	10/13/15	0820	LH50 SB02(15-17) EB	3	X				
MHS/STB	Water	10/13/15	0820	LH50 SB02(15-17) EB	2		X			
MHS/STB	Water	10/13/15	0820	LH50 SB02(15-17) EB	1			X		
MHS/STB	Water	10/13/15	0820	LH50 SB02(15-17) EB	1				X	
MHS/STB	Water	10/16	1735	LH50 TB	2	X				

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[signature]	10/16/15 19:20			

020703

C.O.C. ID: P265 - ~~1017~~ 1017A ~~SB~~

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP - Phase 2, Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: TPDP
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Site 52
Report Results to: Dave Backelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: 8260 Volatile Compounds; 8270 Semivolatile Organic Compounds; 8330 Explosives; TAL Metals	<--Pres./Filt. NOTES
AMS/SJB	Soil	10/16	0930	LH52550Z (0000.0)	5	X X X X	
AMS/SJB	Soil	10/16	0949	LH525B0Z (2-4)	5	X X X X	
AMS/SJB	Soil	10/16	1007	LH525B0Z (7-1)	5	X X X X	
AMS/SJB	Soil	10/16	1007	LH525B0Z (7-4) QC	5	X X X X	
AMS/SJB	Soil	10/16	1028	LH525B0Z (12-14)	5	X X X X	
AMS/SJB	Soil	10/16	1047	LH52550Ø3 (0000.0)	5	X X X X	
AMS/SJB	Soil	10/16	1047	LH52550Ø3 (0000.0) MS/MSD	5	X X X X	
AMS/SJB	Soil	10/16	1106	LH525B0Ø3 (2-4)	5	X X X X	
AMS/SJB	Soil	10/16	1120	LH525B0Ø3 (7-4)	5	X X X X	
AMS/SJB	Soil	10/16	1130	LH525B0Ø3 (12-14)	5	X X X X	
AMS/SJB	Soil	10/16	~~1250~~ 1250	LH52550Ø1 (0000.0)	5	X X X X	
AMS/SJB	Soil	10/16	1200	LH525B0Ø1 (2-4)	5	X X X X	
AMS/SJB	Soil	10/16	1215	LH525B0Ø1 (7-1)	5	X X X X	

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	10/17/95 9:10			

020704

C.O.C. ID: P2G5 -1016-SB -1017A

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP - Phase 2 Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: TIDI
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Site 52
Report Results to: Dave Beckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: 5260 Volatile Organic Compounds; 5270 Semi-Volatile Organic Compounds; 532 Explosives; TAL Metals	<--Pres./Filt. NOTES
MH/SJB	Soil	10/11	1240	LH52SB01 (12-14)	5	X X X X	
MH/SJB	Soil	10/16	1246	LH5255Ø4 (ØØØ.Ø)	5	X X X X	
MH/SJB	Soil	10/16	1425	LH5255Ø5 (ØØØ.Ø)	5	X X X X	
MH/SJB	Soil	10/16	1425	LH5255Ø5 (ØØØ.Ø)MS/MSD	5	X X X X	

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	10/17/95 9:10			

020705

C.O.C. ID: P2GS-~~1016~~ 1017B ~~SB~~

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Page: __ of __

Project #: 000086
Project Name: LHAAP Phase 2, Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: IDP
Lab Phone/Contact: 713-363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Site 52
Report Results to: Dave Feckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	5260 Volatile Organic Compounds (HCl)	5270 Semi-volatile Organic Compounds	5330 Explosives	TAL Metals (HNO_3)	<--Pres./Filt. NOTES
MMS/STB	Water	10/16	17:10	LH52SBØ1(12-14)EB	3	X				
MMS/STB	Water	10/16	17:10	LH52SBØ1(12-14)EB	3		X			
MMS/STB	Water	10/16	17:10	LH52SBØ1(12-14)EB	1			X		
MMS/STB	Water	10/16	17:10	LH52SBØ1(12-14)EB	1				X	
MMS/STB	Water	10/16	17:	LH52TB	2	X				

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020706

C.O.C. ID: ~~12~~ 12G5-1017

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000969
Project Name: LHAAP Phase 2, Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: / PDP
Lab Phone/Contact: 713-513-2233 Mark Bourgeois
Field Contact: Steve Burton
Field Batch: ~~LH6~~ Site 60
Report Results to: Dave Beckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	5150 Explosives	5150 Herbicides	<--Pres./Filt. NOTES
HMS/SJB	WATER	10/14	1415	LH60SB03(7-9)EB	2	X	X	
HMS/SJB	WATER	10/15	930	LH60SB08(7-9)EB	2	X	X	
HMS/SJB	WATER	10/15	1345	LH60SB13(7-9)EB	2	X	X	
~~HMS/SJB~~								

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Burton	10/17/95 0935			

020707

C.O.C. ID: P2G1 - 1017C 1016-SR

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP Phase 2 Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: TOP
Lab Phone/Contact: 713 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: Site 60
Report Results to: Dave Eckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: 8330 Explosives; 8151C Herbicides	<--Pres./Filt. NOTES
AMS/SJB	Soil	10/14	1010	LH60SS01 (0.0)	2	X X	
AMS/SJB	Soil	10/14	1024	LH60SB01 (1-3)	2	X X	
AMS/SJB	Soil	10/14	1037	LH60SB01 (3-5)	2	X X	
AMS/SJB	Soil	10/14		LH60SB01 (7-9)	2	X X	
AMS/SJB	Soil	10/14	1110	LH60SS02 (0.0)	2	X X	
AMS/SJB	Soil	10/14	1130	LH60SB02 (1-3)	2	X X	
AMS/SJB	Soil	10/14	1130	LH60SB02 (1-3) MS/MSD	3	X X	
AMS/SJB	Soil	10/14	1143	LH60SB02 (3-5)	2	X X	
AMS/SJB	Soil	10/14	1154	LH60SB02 (7-9)	2	X X	
AMS/SJB	Soil	10/14	1154	LH60SB02 (7-9) QC	2	X X	
AMS/SJB	Soil	10/14	1257	LH60SS03 (0.0)	2	X X	
AMS/SJB	Soil	10/14	1342	LH60SB03 (1-3)	2	X X	
AMS/SJB	Soil	10/14	1347	LH60SB03 (3-5)	2	X X	
AMS/SJB	Soil	10/14	1402	LH60SB03 (7-9)	2	X X	
AMS/SJB	Soil	10/14	1425	LH60SS06 (0.0)	2	X X	
AMS/SJB	Soil	10/14	1432	LH60SB06 (1-3)	2	X X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
[signature]	10/17/95 0930			

020708

C.O.C. ID: P265-1017-SK

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP Phase 2 Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: PDS
Lab Phone/Contact: 713-363-2233 Mark Bourgeois
Field Contact: Steve Burton
Field Batch: Site 66
Report Results to: Dave Feickelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been shelled out in coolers since collection

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: 6060 Total Cl; 5150 Herbicides	<--Pres./Filt. NOTES
MS/SJB	Soil	10/14	1440	LH66SB66(3-5)	2	X X	
MS/SJB	Soil	10/14	1440	LH66SB66(3-5)MS/MSD	3	X X	
MS/SJB	Soil	10/14	1500	LH66SB66(7-9)	2	X X	
MS/SJB	Soil	10/14	1510	LH66SB66(7-9)QC	2	X X	
MS/SJB	Soil	10/14	1518	LH66SB67(0.5-1.0)	2	X X	
MS/SJB	Soil	10/14	1530	LH66SB67(1-3)	2	X X	
MS/SJB	Soil	10/14	1538	LH66SB67(3-5)	2	X X	
MS/SJB	Soil	10/14	1546	LH66SB67(7-9)	2	X X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Burton	10/17/95 0930			

020709

C.O.C. ID: PZG5-1017

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000056
Project Name: LHAAP Phase 2 Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: PIDP
Lab Phone/Contact: 713-363-2233 Mark Burgess
Field Contact: Steve Fountain
Field Batch: Site 60
Report Results to: Dave Beckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers since collection.

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	5060 Pesticides	5151 Herbicides	<--Pres./Filt. NOTES
AMS/SJB	Soil	10/15	1135	LH60SB12(1-3)	2	X	X	
AMS/SJB	Soil	10/15	1141	LH60SB12(3-5)	2	X	X	
AMS/SJB	Soil	10/15	1150	LH60SB12(7-9)	2	X	X	
AMS/SJB	Soil	10/15	1308	LH60SB13(0.0-0.0)	2	X	X	
AMS/SJB	Soil	10/15	1315	LH60SB13(1-3)	2	X	X	
AMS/SJB	Soil	10/15	1324	LH60SB13(3-5)	2	X	X	
AMS/SJB	Soil	10/15	1332	LH60SB13(7-9)	2	X	X	
AMS/SJB	Soil	10/15	1348	LH60SS14(0.0-0.0)	2	X	X	
AMS/SJB	Soil	10/15	1355	LH60SS15(0.0-0.0)	2	X	X	
AMS/SJB	Soil	10/15	1355	LH60SS15(0.0-0.0)QC	2	X	X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Fountain	10/17/95 0930			

020710

C.O.C. ID: P165-1017D

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086
Project Name: LHAAP Phase 2 Group 5 Sites
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: TDP
Lab Phone/Contact: 713 363 2233 Mark Bourgeois
Field Contact: Steve Dunton
Field Batch: Site 60
Report Results to: Dave Bockelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments: All samples have been stored on ice in coolers.

EPA METHOD and PREPARATION/EXTRACTION ID: 8020 Pest./PCB's; 5150 Herbicides

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	<--Pres./Filt. NOTES
AMS/SJB	Soil	10/14	1604	LH60SS04 (0.0)	2	
AMS/SJB	Soil	10/14	1612	LH60SS05 (0.0)	2	
AMS/SJB	Soil	10/14	1620	LH60SS06 (0.0)	2	
AMS/SJB	Soil	10/14	1630	LH60SS10 (0.0)	2	
AMS/SJB	Soil	10/14	1630	LH60SS10 (0.0) QC	2	
AMS/SJB	Soil	10/15	0845	LH60SS08 (0.0)	2	
AMS/SJB	Soil	10/15	0858	LH60SB08 (1-3)	2	
AMS/SJB	Soil	10/15	0902	LH60SB08 (3-5)	2	
AMS/SJB	Soil	10/15	0912	LH60SB08 (7-9)	2	
AMS/SJB	Soil	10/15	1035	LH60SB11 (1-3)	2	
AMS/SJB	Soil	10/15	1037	LH60SS11 (0.0)	2	
AMS/SJB	Soil	10/15	1103	LH60SS11 (3-5)	2	
AMS/SJB	Soil	10/15	1103	LH60SS11 (3-5) MS/MSD		
AMS/SJB	Soil	10/15	1112	LH60SS11 (7-9)	2	
AMS/SJB	Soil	10/15	1112	LH60SS11 (7-9) QC	2	
AMS/SJB	Soil	10/15	1127	LH60SS12 (0.0)	2	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Dunton	10/17 95 0930			

020711

C.O.C. ID: 1128A

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Project #: 000086-5
Project Name: Group 5 Sites SI
Location: Longhorn Army Ammunition Plant
Lab_ID/Lab: PIDP
Lab Phone/Contact: (713) 363-2233 Mark Bourgeois
Field Contact: Steve Brunton
Field Batch: LH50
Report Results to: David Beckelmann
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments:

EPA METHOD and PREPARATION/EXTRACTION ID

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	8260 Volatile Organic Compounds	8270 Semi-Volatile Organic Compounds	8330 Explosives	TAL Metals	<--Pres./Filt. NOTES
SJB/PTS	SOIL	11/28	16:38	LH5ϕSDϕ2 (ϕ-1)	5	X	X	X	X	
SJB/PTS	SOIL	11/28	16:38	LH5ϕSDϕ2 MS/MSD(ϕ-1)	6	X	X	X	X	
SJB/PTS	SOIL	11/28	17:12	LH5ϕSDϕ1 (ϕ-1)	5	X	X	X	X	
SJB/PTS	SOIL	11/28	17:12	LH5ϕSDϕ1QC (ϕ-1)	5	X	X	X	X	
SJB/PTS	WATER	11/28	18:30	LH5ϕSDϕ2 EB	3	X				
SJB/PTS	WATER	11/28	18:30	LH5ϕSDϕ2 EB	2		X			
SJB/PTS	WATER	11/28	16:30	LH5ϕSDϕ2 EB	1			X		
SJB/PTS	WATER	11/28	16:20	LH5ϕTB	2	X				
SJB/PTS	WATER	11/28	16:30	LH5ϕSDϕ2 EB	1				X	

Relinquished by:	Date/Time	Received by:	Date/Time	Lab Instructions:
Steve Jon	11/28 20:05			

020712

C.O.C. ID: 11288

CHAIN OF CUSTODY RECORD -- SVERDRUP ENVIRONMENTAL, Inc.

Page: __ of __

Project #: 000086-5
Project Name: GROUP 5 SITES SI
Location: LONGHORN ARMY AMMUNITION PLANT
Lab_ID/Lab: SWD LAB
Lab Phone/Contact: 214-905-9130 MEI TRAN
Field Contact: STEVE PRUITT
Field Batch: LH50
Report Results to: DAVID ROCKELMAN
phone: (314) 436-7600; 13723 Riverport Drive, Maryland Heights, MO 63043
Comments:

Sampler(s)	Matrix/ Type	Date	Time	Sample-ID	# of bottles	EPA METHOD and PREPARATION/EXTRACTION ID: VOA 8260	VOA 8270	8330 EXPLOSIVES	TAL METALS	<--Preservation NOTES
SJB/PTS	SOIL	11/28/95	17:12	LH50SD01QA-(0-1')	1	X				
SJB/PTS					1	X				
SJB/PTS					1		X			
SJB/PTS					1			X		
SJB/PTS					1				X	

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[signature]	11/29/95 20:10			

020713

Chain of Custody Record

PDP Analytical Services
1680 Lake Front Circle, Suite B ▪ The Woodlands, Texas 77380 ▪ Phone (713) 363-2233 ▪ Fax (713) 298-5784

Client Name / Address: Sundance Environmental 15725 Sweetgrass Dr. Maryland Heights MO 63043

Send Report to: David Eckelman

Project Number: 000086-7

Project Name: Longhorn Army Ammunition Plant, Group V Sites RI-sample

Samplers (Signature):

P.O. Number:

Sta. No.	Date	Time	Comp.	Grab	Station Location	Number of Containers	Matrix	8330-Explosives	Remarks
63	2/11/96	10:03	X		LH6355Ø3	2	Soil	X	
		10:08	X		LH6355Ø1	2		X	
		10:13	X		LH6355Ø4	2		X	
		14:10	X		LH6355Ø2	2		X	
		14:10	X		LH6355Ø2QC	2		X	
		14:20	X		LH6355Ø5	2		X	
52		15:30	X		LH5255Ø3	2		X	
		15:33	X		LH5255Ø2	2		X	
		15:36	X		LH5255Ø4	2		X	
		15:36	X		LH5255Ø4 MS/MSD	2		X	
		11:10	X		LH5255Ø1	2		X	
		11:10	X		LH5255Ø1QC	2		X	
		11:20	X		LH5255Ø5	2		X	
		16:05	X		LH52RSØ1	2	Water	X	

Relinquished by (Signature)	Date / Time: 2/11/96 18:00	Received by (Signature)	Date / Time
Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time
Relinquished by (Signature)	Date / Time	Received for Laboratory by (Signature)	Date / Time

Method of Shipment: Fed Ex

Remarks: 020714

PDP Quote Number:

Distribution: Original accompanies shipment; Copy to coordinator and field files

Chain of Custody Record

PDP Analytical Services
1680 Lake Front Circle, Suite B ▪ The Woodlands, Texas 77380 ▪ Phone (713) 363-2233 ▪ Fax (713) 298-5784

Client Name / Address:	Send Report to:
Sverdrup Environmental Inc. 13723 Riverport Dr. Maryland Heights, MO 63043	USACE - Tulsa District

Project Number:	Project Name	P.O. Number
~~[illegible]~~ 55B	Longhorn Army Ammunition Plant - Group V Sites Resampling	

Samplers (Signature): [signature]

Sta. No.	Date	Time	Comp.	Grab	Station Location	Number of Containers	Matrix	8330 - Explosives	Remarks
63	2/11/96	1410	X		LH6355-12 QA	2	Soil	X	
52	2/11/96	1610	X		~~LH6355~~ LH5255-1QA	2	Soil	X	

Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	Remarks:
[signature]	2/11/96 1600			
Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	
Relinquished by (Signature)	Date / Time	Received for Laboratory by (Signature)	Date / Time	

Method of Shipment:

PDP Quote Number:

020715

Distribution: Original accompanies shipment; Copy to coordinator and field files

Chain of Custody Record

PDP Analytical Services
1680 Lake Front Circle, Suite B ▪ The Woodlands, Texas 77380 ▪ Phone (713) 363-2233 ▪ Fax (713) 298-5784

Client Name / Address:	Send Report to:
Sverdrup Environmental Inc. 15723 Rivergate Dr Houston TX 77058	David Bucklumann

Project Number:	Project Name	P.O. Number
000086-7	Longhorn Army Ammunition Plant - Group V Sites Resample	

Samplers (Signature):

Sta. No.	Date	Time	Comp.	Grab	Station Location	Number of Containers	Matrix	8330 - Explosives						Remarks
50	2/16/96	1505	X		LH50SS01	2	Soil	X						
50		1515	X		LH50SS02	2		X						
50		1455	X		LH50SS03	2		X						
50		1500	X		LH50SS04	2		X						
50		1520	X		LH50SS05	2		X						
50		1610	X		LH50RS01	2	Water	X						

Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	Remarks:
	2/20/96 1700			020716
Relinquished by (Signature)	Date / Time	Received by (Signature)	Date / Time	
Relinquished by (Signature)	Date / Time	Received for Laboratory by (Signature)	Date / Time	
Method of Shipment: Fed Ex				PDP Quote Number:

Distribution: Original accompanies shipment; Copy to coordinator and field files

Hole No. LH505B01

020717

DRILLING LOG	DIVISION USACE-Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2, Group 5 Sites		10. SIZE AND TYPE OF BIT 4 1/4" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and title number)	LH505B01	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/13/95	COMPLETED 10/13/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 16.8 Ft		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Steve Bunt	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SW 1.5	SAND - White to light Tan Fine to coarse grain, little or no Fines, loose, well graded, moist Note: Fill material for tank foundation	1.8/5	1 HSA 11:05 0-5	0-1.5 White to light tan Sand Fine to Coarse grained loose, well graded, moist. (SW) - Fill material within Tank Foundation
	2	ML 1.8	Fine sandy SILT - greyish brown to brown medium stiff, non-plastic, dry No Recovery 1.8-5 Ft			1.5-1.8 Greyish brown to brown Fine sandy silt, some Fines, Medium stiff, nonplastic, Dry (ML)
	3					
	4					
	5	5				
	5	CL 5.9	Fine sandy silty CLAY - Yellowish brown with gray silt inclusions, medium stiff, low to medium plasticity, dry to moist	5/5	2 HSA 11:13 5-10	5-5.9 Yellowish brown Fine sandy silty clay with gray silt inclusions, dry to moist low to medium plasticity, medium Stiff (CL)
	6	ML-SM 6.7	Fine sandy SILT - light gray to light brown medium stiff, non to slight plasticity dry to moist			5.9-6.7 Light gray to light brown Fine sandy silt, medium stiff, non to slightly plastic, dry to moist (ML/SM)
	7	CL	silty CLAY - Gray to yellowish brown, some fine sand and iron staining, some fine black root structures from 9.5-10 Ft, stiff Medium plasticity, dry			6.7-10 Gray to yellowish Brown silty clay, medium plasticity, stiff dry, (CL) some fine sand and iron staining. Some black material associated with fine root structures 9.5-10 Ft
	8					
	9					
	10	10				
	10	ML 11.5	clayey Fine sandy SILT - light yellowish gray, some iron staining along root structures, root material, stiff, slight plasticity, moist	5/5	3 HSA 11:36 10-15	10-15 Same as LH505B04
	11					
	12		silty CLAY - light greenish gray, some Fine sand, some iron staining and Fine black root structures, stiff, medium plasticity, moist with some thin (1mm) wet zones			
	13					
	14	CL				
	15					15-17 Same as above, some Fine gravel present 12.5 Ft
	16	16.8		1.8/2	4 SS 4,7,10,11 15-17 11:55	
	17		TD = 16.8 Ft			Note: Water present in boring after drilling to 15 Ft

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PROJECT Phase 2 Group 5 Sites LHAAP HOLE NO. LH505B01

Hole No. LH505B02

020718

DRILLING LOG	DIVISION USACE-Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2, Group 5 Sites		10. SIZE AND TYPE OF BIT 4 1/4" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH505B02		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/13/95	COMPLETED 10/13/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 17 Ft		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Steve Byrd	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM 1	silty Fine SAND - Dark brown to reddish brown, medium dense, poorly graded, dry		1 HSA 16:04 0-5	0-1 Dark Brown to Dark Reddish Brown silty fine sand, medium Dense, poorly graded, dry (SM)
		ML 1.8	Fine sandy SILT - Strong brown, medium stiff, non plastic, dry, trace fragments and gravel 1.5-1.8 Ft			1-1.8 Strong Brown Fine sandy silt, medium stiff non plastic, dry (ML) Rock Fragments and gravel from 1.5-1.8 ft.
	2	CL 2.7	Silty CLAY - gray with dusky red laminations, stiff, low to medium plasticity, dry	2.7/5		1.8-2.7 Gray silty clay with dusky red laminations stiff, low to medium plasticity, dry (CL)
	3		No Recovery 2.7-5 Ft			
	4					
	5	5				
		CL 6	~~Yellowish~~ Fine sandy silty CLAY - Yellowish brown, with gray silt inclusion medium stiff, low to medium plasticity, dry to moist	5/5	2 HSA 16:15 5-10	5-6 Same as SB01 (5-5.9) 6-6.7 Silty fine Sand, same as SB01 (5.9-6.7) ~~6.7-10~~ Moist to Wet (SM-ML).
	6		-decrease in sand content iron staining and fine black root structures			6.7-10 Same as SB01 (6.7-10) Black material associated with root structures through ~~out~~ 9 ft. No black material 9-10 ft.
	7					
	8					
	9		- no Fine black root structures			
	10	10				
		ML 11.5	Clayey Fine sandy SILT - light greenish gray, some iron staining along fine root structures, root material, stiff slight plasticity, moist		3 HSA 16:25 10-15	10-15 Same as SB04
	11			5/5		
	12		Silty CLAY - light greenish gray, some fine sand, some iron staining and fine black root structures, stiff, medium plasticity, moist with some thin (1 mm) wet zones.			
	13	CL				
	14					
	15				4 SS 3,4,4,8 15-17 16:30	15-17 Same as SB04
	16			2/2		
	17	17				
			TD = 17 Ft			

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PROJECT Phase 2 Group 5 Sites LHAAP | HOLE NO. LH505B02

Hole No. LH505B03

020719

DRILLING LOG	DIVISION USACE-Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2, Group 5 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number)	LH505B03	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/13/95 COMPLETED 10/13/95	
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 17 Ft		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Scott Lynn	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM	silty Fine SAND - Brown to grayish brown, medium dense, poorly graded, root material, dry	5/5	1 HSA 14:05 0-5	0-2 Brown Silty Fine Sand to Grayish Brown, Medium dense, poorly graded, dry (SM) Roots
	2					2-3 Light Brown grading to White Silt with some fine sand, stiff dry non plastic (ML) some iron staining and coarse sand size nodules
	3	ML	SILT - light brown grading to white, with some fine sand, some iron staining and coarse sand size nodules, stiff, non-plastic, dry			3-5 Gray with dusky red inclusions, silty Clay medium to High plasticity, dry Very stiff (CL-CH)
	4					
	5	CL-CH	silty CLAY - Gray with dusky red inclusions, very stiff, medium to high plasticity, dry			Dusky red inclusions diminish after 4 Ft and silt content increases
	5	SM	silty fine SAND - light gray to light yellowish brown dense, poorly graded, dry	4.7/5	2 HSA ~~10~~ DSB 5-10 14:21	5-5.5 light gray to ~~yellow~~ light yellowish brown silty Fine sand, Dense, poorly grade, dry (SM)
	5.5					5.5-10 Same as LH505B01 (6.7-10) No black material
	6	CL	silty CLAY - gray to yellowish brown, some Fine sand and iron staining, some Fine black root structures from 9.5-10 Ft. stiff medium plasticity, dry			
	7					
	8					
	9					
	10					
	10	ML	clayey fine sandy SILT - light greenish gray some iron staining along root structures, root material, stiff, slight plasticity, moist	4/5	3 HSA 10-15 14:45	10-14 Same as LH505B04 (11.5-15)
	11					
	11.5					
	12	CL	silty CLAY - light greenish gray, some Fine sand, some iron staining and fine black root structures, stiff, medium ~~dense~~ plasticity, moist with some thin (1mm) wet zones			
	13					
	14		No Recovery 14-15 Ft			
	14					
	15			2/2	3,4,7,10 4 SS 14:50 15-17	15-17 Same as above
	15					Note: Water in boring
	16					
	17					
	17		TD = 17 Ft			

Hole No. ~~SS~~LH505B04

020720

DRILLING LOG	DIVISION: USACE-Tulsa District	INSTALLATION: Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT: Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT: 4¼" HSA	
2. LOCATION (Coordinates or Station):		11. DATUM FOR ELEVATION SHOWN (TBM or MSL):	
3. DRILLING AGENCY: Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number): LH505B04		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER: Jerry Bignall		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 10/13/95	COMPLETED 10/13/95
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE:	
9. TOTAL DEPTH OF HOLE: 17 Ft		18. TOTAL CORE RECOVERY FOR BORING: %	
		19. SIGNATURE OF INSPECTOR: Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM 1	silty fine SAND - brown, loose, poorly graded, dry to moist	3/5	1 0925 HSA 0-5	0-1 Brown Silty Fine Sand loose, poorly graded, Dry to moist (SM)
	2	ML	SILT - light gray to gray, with some fine sand and dusky red clay inclusions, stiff, slightly plastic, dry			1-3 Light Gray to Gray Silt with some Fine Sand and Dusky red clay inclusions, dry, stiff, slight plasticity. (ML)
	3	3				
	4		No recovery 3-5 Ft			
	5	5				
	5	CL-ML 6	clayey SILT - gray to yellowish brown with some fine sand, stiff low to medium plasticity, dry	1/5	2 0932 HSA 5-10	5-6 Gray and Yellowish brown clayey silt with some Fine sand, stiff dry low to medium plasticity (ML-CL)
	6	SC	clayey SAND - light reddish brown, medium dense, poorly graded, dry			6-? Light reddish Brown clayey sand, medium dense, poorly graded Dry, ~~soft~~ (SC)
	7		Note: Above sand was in bottom of split spoon shoe. No Recovery from 6-10 ft			
	8					
	9					
	10	10				
	10	ML 11.5	clayey fine sandy SILT - light greenish gray, some iron staining along root structures, root material, stiff, slight plasticity, moist	5/5	3 0940 HSA 10-15	10-11.5 Light greenish gray clayey Fine Sandy silt, slight plasticity, moist, stiff, (ML) Some iron staining along root structures, root material
	11					11.5-15 light greenish gray silty clay, medium plasticity, stiff, moist, with some thin (1mm) wet zones around 14.5 Ft. (CL) some iron staining and black root structures some Fine sand
	12					
	13					
	14	CL				
	15					15-17 same as above
	16			20/2	4 10:06 SS 4,7,9,11	
	17	17				
	17		TD = 17 ~~Ft~~			

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PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH505B04

Hole No. LH52SB01

020721

DRILLING LOG	DIVISION USACE-Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 2 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (MSL or USC&GS)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH52SB01		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/16/95	COMPLETED 10/16/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 13.8 Ft		18. TOTAL CORE RECOVERY FOR BORING ____ %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Steve Burt	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		SM 0.5	silty, fine SAND - brown, loose, poorly graded, dry	1.5/1.5	1 MA 11:50	0-.5 same as SB02 (1-1.5)
	1	ML 1.2	Fine sandy SILT - grayish brown, with yellowish brown inclusions, soft non-plastic, moist		2 SS 11:54	.5-1.2 Same as SB02 (.7-1.5)
		1.6	silty CLAY - gray with dusky red inclusions, stiff, medium plasticity, dry	1.5	2.3.6	1.2-1.4 Same as SB02 (2.5-3.3)
	2	CL 2	No Recovery 1.6-2 Ft		3 MSA 12:08	2-3.4 Same as above
	3	3.4				3.4-6.8 Same as SB02 (3.3-7)
	4	ML-SM	clayey SILT - light gray to grayish brown with fine sand, sand content varies through out interval, some yellowish brown inclusions non to low plasticity, medium stiff, dry to moist	4.8/5	7-7	
	5					
	6					
	7	6.8 7	NO RECOVERY 6.8-7 Ft			7-10
	7	SM	silty fine SAND - light gray to light brown, loose to medium dense, poorly graded, dry		4 MSA 12:24	12-13.8 light gray to Light Brown fine sand with silt, poorly grade, loose to medium dense, dry. (SM) Silt content varies through out interval, thou general more silty between (12-13.5)
	8			3/5	7-12	
	9					
	10	10	No Recovery 10-12 Ft			
	11					
	12	12	-increasing silt content		5 SS 12:33	12-13.8 same as SB02
	13	13.8		1.8/2	3.4.5.4	
	14		TD = 13.8 ft			

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PROJECT Phase 2 Group 5 Sites LHAAP | HOLE NO. LH52SB01

Hole No. LH52SB02

020722

DRILLING LOG	DIVISION: USACE - Tulsa District	INSTALLATION: Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT: Phase 2, Group 5 Sites		10. SIZE AND TYPE OF BIT: 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (MSL or USL)	
3. DRILLING AGENCY: Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV	
4. HOLE NO. (As shown on drawing title and Site number): LH52SB02		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER: Jerry Bignall		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 10/16/95 / COMPLETED 10/16/95	
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE: 13.8 Ft		18. TOTAL CORE RECOVERY FOR BORING: %	
		19. SIGNATURE OF INSPECTOR: Sverdrup Environmental — Steve Bignall	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM	silty fine SAND - brown, loose, poorly graded, dry	.5/.5	NA 9:20	0-.7 Brown silty fine sand loose, poorly graded, dry (SM)
	1	ML	0.7 Fine sandy SILT - grayish brown, with yellowish brown inclusions, soft, nonplastic, moist	1/1.5	2 SS 09:34 .5-2 1,1,3	.7-1.5 Grayish brown Fine sandy silt, soft, non plastic, moist (ML) with yellowish brown inclusions
	1.5		No Recovery 1.5-2 Ft			
	2		-increase in fine sand content		3 HSA 09:45	2-2.5 Same as above (ML-SM) with increase in sand content
	2.5	CL	2.5 silty CLAY - gray with dusky red inclusions, stiff, medium plasticity, dry			2.5-3.3 Gray silty clay with dusky red inclusions stiff, medium plasticity dry, (CL)
	3		3.3			
	4	ML-SM	clayey SILT - light gray to grayish brown with fine sand, none to low plasticity, sand content varies through out interval, some yellowish brown inclusions, non-to low plasticity, medium stiff dry to moist	5/5	2-7	3.3-7 Light gray to grayish Brown clayey silt with fine sand, medium stiff, none to low plasticity, dry to moist, some yellowish brown inclusions (ML-SM) Sand content varies through out interval.
	5					
	6					
	7		7			
	7	ML-CL	-increase in clay content		4 HSA 10:05	7-8.8 Same as above with an increase in clay content (ML-CL)
	8					8.8-10.6 Same as above with black material in Fine root structures
	9			4.5/5		
	10		10.6		7-12	10.6-11.5 Predominantly Brownish Yellow silty fine sand with light gray inclusions, loose, poorly grade, dry to moist (SM) some iron staining
	11	SM	11.5 silty fine SAND - Yellowish brown with some light gray inclusions, loose, poorly graded, dry to moist, some iron staining			
	11.5		No Recovery 11.5-12 Ft			
	12		12		5 SS 10:23 12-14 2.4.4.5	12-12.8 same as above moist to wet (SM)
	12.8		- light gray, wet & saturated	1.8/2		12.8-13.8 Predominantly light gray silty Fine sand with yellowish brown inclusions, loose, poorly graded, wet to saturated. saturated zone ~ 1 inch thick (SM)
	13		13.8			
	14		TD = 13.8 Ft			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH52SB02

Hole No. LH52SB03

020723

DRILLING LOG	DIVISION USACE-Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2, Group 5 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH52SB03		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/16/95	COMPLETED 10/16/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 13.7 Ft		18. TOTAL CORE RECOVERY FOR BORING	%
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM 0.5	silty fine SAND - brown, loose, poorly graded dry	.5/.5	1 HA	0-.5 same as SB02 (0-.5)
	1	ML 1.4	Fine sandy SILT - grayish brown, with yellowish brown inclusions, soft non-plastic, moist	.9/1.5	2 SS 10:45 1,2,3 0.5-2	.5-1.4 same as SB02 (.7-1.5)
	2	2 2.2	No Recovery 1.4-2 Ft.			
		CL 3	silty CLAY - gray with dusky red inclusions, stiff, medium plasticity, dry		3 HSA 11:00	2-2.2 same as SB02 (2-2.5)
	3	ML-SM	clayey SILT - light gray to grayish brown, with fine sand, sand content varies through out interval, some yellowish brown inclusions, non- to low plasticity, medium stiff, dry to moist	4.8/5	2-7	2.2-3 same as SB02 (2.5-3.3) 3-7 same as SB02 (3.3-7)
	4					
	5					
	6	6.8 7				
	7	ML-CL	- increase in clay content		4 HSA 11:17	7-8.3 same as SB02 (7-8.9) with increased amount of yellowish brown inclusions and presence of fine black root structures (ML) laminations of the material present.
	8	8.3	NO RECOVERY 8.3-12 Ft.	1.3/5	7-12	
	9					
	10					
	11					
	12	12				
		SM 12.8	silty fine SAND - Yellowish brown with some light gray inclusions, loose, poorly graded, dry to moist, transitioning to light gray, wet to saturated	1.7/2	5 SS 11:27 2,4,4,4 12-14	12-13.7 same as SB02
	13					
	14		TD = 13.7 Ft			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Phase 2 Group 5 Sites, LHAAP | HOLE NO. LH52SB03

Hole No. LH605B01

020724

DRILLING LOG | DIVISION: USACE-Tulsa District | INSTALLATION: Longhorn Army Ammunition Plant | SHEET 1 OF 1 SHEETS

1. PROJECT: Phase 2 Group 5 Sites
2. LOCATION (Coordinates or Station):
3. DRILLING AGENCY: Philip Environmental
4. HOLE NO. (As shown on drawing title and file number): LH605B01
5. NAME OF DRILLER: Jerry Bignall
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NA
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 8 Ft
10. SIZE AND TYPE OF BIT: 4 1/4" HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: NA
16. DATE HOLE: STARTED 10/14/95 | COMPLETED 10/15/95
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: Sverdrup Environmental

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM-GM	silty Fine SAND and coarse GRAVEL Reddish brown, loose, Fairly well graded, dry (Fill Material)		1 HA 10:10 0-.5	0-.5 Reddish Brown silty Fine sand and coarse gravel, loose, Fairly graded, dry, Fill material (SM-GM)
	0.5		No Recovery 0.5-1 Ft			
	1	CL	silty CLAY - gray to reddish brown, with some Fine sand, some black nodules, medium stiff, low to medium plasticity, dry to moist	1.5/2	2 SS 2,2,3,3 10:27	1-2.5 Gray, reddish brown silty clay with Fine sand dry to moist, medium stiff low to medium plasticity (CL) some black nodules
	2					
	2.5		No Recovery 2.5-3 Ft			
	3		- gray with strong brown inclusions	1/2	3 SS 10:33 1,2,2,2	3-4 Predominantly Gray silty clay with strong brown inclusions and black nodules, medium stiff, dry to moist, low to medium plasticity, (CL) some Fine sand
	4		No Recovery 4-5 Ft			
	5		- dusky red inclusions	1/2	4 SS 10:40 1,2,2,3	5-6 Same as above with some dusky red clay inclusions and little to no black material (CL)
	6		No Recovery 6-7 Ft			
	7	CL-ML	- increase in silt content	1/2	5 SS 10:45 2,1,1,3	7-8 Same as above increasing silt content moist to wet (CL-ML)
	8		TD = 8 Ft			
	9					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH605B01

Hole No. LH605B02

020725

DRILLING LOG	DIVISION USACE-Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Stations)		11. DATUM FOR ELEVATION SHOWN (MSL or USL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH605B02		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/14/95 COMPLETED 10/15/95	
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 9 Ft		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Jerry Bignall	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM	silty Fine SAND - brown, loose, poorly graded, some surface fill gravel, dry	1/1	1 HA 0-1	0-1 silty Fine sand, Brown loose, poorly graded, dry (SM) Some gravel from surface
	1	SP 1.9	Fine SAND - Brown, some fines, loose, poorly graded, dry	1.5/2	2 SS 11:25 3,5,4,9	1-1.9 Brown Fine Sand some Fines, poorly Graded, Loose, dry (SP)
	2	CL 2.2	silty CLAY - gray, medium stiff, medium plasticity, moist			1.9-2.2 Gray silty clay, Medium stiff, medium plasticity, moist, (CL)
		SW 2.5	silty SAND - grayish brown, fine to medium grained, loose, fairly well graded, dry to moist			2.2-2.5 Grayish brown silty sand, Fine to medium grained, loose, Fairly well graded dry to moist, (SW)
			No Recovery 2.5-3 Ft			
	3	SM 3.5	silty Fine SAND - Brown, loose, poorly graded, moist	1.6/2	3 SS 11:31 6,4,4,4	3.5-4.6 Grayish brown silty clay with reddish brown inclusions, medium dense, low Plasticity, moist, (CL)
		CL	silty CLAY - grayish brown with reddish brown inclusions, medium stiff, low plasticity, moist			3.5-3.5 light Brown silty Fine sand, loose, poor graded, moist (SP)
	4	4.6	No Recovery 4.6-5 Ft			
	5	SM	silty Fine SAND - Brown, loose, poorly graded, moist	1.7/2	4 SS 11:47 2,4,4,5	5-5.2 Brown Fine sand, loose, poorly graded moist (SP)
		ML-SM	Fine sandy SILT - Gray with some reddish brown clay inclusions and black nodules (5.2-6 Ft), medium stiff, non- to slight plasticity, moist			5.2-6.7 Predominantly Gray Fine sandy silt with some clay, medium stiff, none to slight plastic moist, with reddish brown inclusions, Black nodules to 6 Ft, (ML-SM)
	6	6.7	No Recovery 6.7-7 Ft			
	7		-light gray, a few black nodules	2/2	5 SS 11:53 3,6,8,9	7-9 Light Gray Fine sandy silt with some clay, mne to low plasticity, moist, medium stiff, a few black nodules (ML)
	8					
	9		TD=9 Ft			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Phase 2 Group 5 Sites LHAAP | HOLE NO. LH605B02

Hole No. LH60SB03

020726

DRILLING LOG	DIVISION USACE - Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and Site number) LH60SB03		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE: STARTED 10/14/95	COMPLETED 10/15/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 9 Ft		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		SM	Silty Fine SAND - brown, loose, poorly graded, moist		1 HA 0-.5 12:55	
	1	ML	Fine sandy SILT - brown to tan, medium stiff, nonplastic, dry	.8/2	2 SS 13:40 4,5,6,6	1-1.8 Brown to tan Fine sandy silt, dry, medium dense to dens-. (ML) Some Fine "rooting" gravel present with tar coating. Spoon refused at ~ 1.8 Ft. Note: hit 36" Cast iron drain line. No Damage done. moved borin. ~4Ft. Resample same materia l
	1.8		No Recovery 1.8 - 3 Ft	resample 1.2/2		
	2					
	3	SM	Silty Fine SAND - Brown, loose, poorly graded, moist	1.3/2	3 SS 13:43 5,4,4,6	3-3.8 Same as SB02 (3-3.5) 3.8-4.3 Same as SB02 (3.5-4.6)
	3.8					
	4	CL	silty CLAY - grayish brown with reddish brown inclusions, medium stiff, low plasticity, moist			
	4.3		No recovery 4.3 - 5 Ft			
	5					
	5	SM	silty Fine SAND - Light gray to strong brown, medium dense, poorly graded, wet to saturated	1.5/2	4 SS 13:49 3,5,5,5	5-5.7 Same as SB02 (5-5.2) 5.1-6.5 ~~Same as SB02 SS13~~ Light Gray and strong Brown silty Sand, medium dense, poorly graded, wet to saturated
	6					
	6.5		No Recovery 6.5 - 7 Ft			
	7					
	7	ML	f.n. sandy SILT - light gray, a few black nodules ~~and clay inclusions~~, medium stiff, non to slight plasticity, moist	3,5,6,7 2/2	5 SS 13:54	7-9 Same as SB02 moist to wet.
	8					
	9		TD = 9 Ft			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Phase 2 Group 5 Sites LHAAP | HOLE NO. LH60SB03

Hole No. LH60SB06

020727

DRILLING LOG	DIVISION USACE - Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT 4 ¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH60SB06		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/14/95	COMPLETED 10/15/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 8.9 Ft		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM	Silty fine SAND - brown, loose, poorly graded, moist	1/1	1 HA 14:25 0-.5	
	1	CL 1.3	silty CLAY - Reddish brown, stiff, medium plasticity, dry	1.6/2	2 SS 14:28 3,4,5,3	1-1.3 Reddish brown silty clay, stiff, medium plasticity, dry, (CL) 1.3-1.75 Grayish Brown clayey silt, medium stiff slight plasticity, dry (ML) 1.75-2.6 Light Brown Silty fine sand, loose to medium dense, poorly graded, moist (SM)
		ML 1.75	clayey SILT - Grayish brown, medium stiff, slight plasticity, dry			
	2	SM 2.6	silty fine SAND - light brown, loose to medium dense, poorly graded, moist			
			No Recovery 2.6 - 3 Ft			
	3	3	- Brown	1.5/2	3 14:30 SS 2,3,2,3	3-3.6 same as above Darker Brown 3.6-4.5 Grayish brown silty clay, stiff, low plasticity, moist (CL) some iron staining and reddish brown inclusions
		3.6 CL 4.5	silty CLAY - grayish brown, stiff low plasticity, some iron staining and reddish brown inclusions, moist			
	4		No Recovery 4.5 - 5 Ft			
	5	5	- dusky red inclusions	1.4/2	4 14:50 SS 2,4,5,8	5-6.4 same as SB01 (3-4 Ft)
	6	6.4	No Recovery 6.4 - 7 Ft			
	7	7 ML	Fine Sandy SILT - light gray, some black nodules, medium stiff, non- to slight plasticity, moist	1.9/2	5 14:52 SS 4,5,5,7	7-8 Same as SB02 (7-9 Ft) wet 8-8.4 strong brown with gray fine sandy silt inclusions, silty clay (CL) stiff, low to medium plasticity, moist
	8		TD = 7.9 Ft			
	9					

Hole No. LH 6C SB07

020723

DRILLING LOG	DIVISION USACE - Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH60SB07		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/14/95	COMPLETED 10/15/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 9 Ft		18. TOTAL CORE RECOVERY FOR BORING	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Debe Buck	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0		silty fine SAND - brown, loose, poorly graded, moist	1/1	1 HA 0-.5	
	1	SM	- some clay, moist to saturated	1.5/2	1,5,4,2 15:25 2 SS	1-2.5 Brown silty fine Sand, loose, poorly grad., some clay, moist to saturated (SM) (Sat. at ~2.3 Ft)
	2.5		No recovery 2.5-3			
	3		- Saturated		3 SS WT,WT	3-3.7 same as above Saturated
	3.7	CL	silty CLAY - grayish brown, stiff, low plasticity, some iron staining and reddish brown inclusions, moist	1.2/2	1,2 15:31	3.7-4.2 Same as SB01 (3.6-4.5 Ft)
	4.2		No Recovery 4.2-5 Ft			
	5		- dusky red inclusions	1.2/2	4 SS 2,4,4,4 15:07	5-6.2 Same as SB01 (5-6 Ft)
	6.2		No Recovery 6.2-7 Ft			
	7	ML-CL	clayey SILT - Gray to strong brown with some fine sand, some laminated zones, medium stiff, non- to low plasticity, wet (some laminated zones saturated)	2/2	5 SS 15:43 2,3,4,9	7-9 Gray to strong brown clayey silt with fine sand moist to wet, none to low plasticity, medium stiff, some laminated zones and some of these zones saturated. (ml-CL)
	9		TD = 9 Ft			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Phase 2 Group 5 Sites LHAAP

HOLE NO. LH60SB07

Hole No. LH60SB08

020729

DRILLING LOG | DIVISION: USACE - Tulsa District | INSTALLATION: Longhorn Army Ammunition Plant | SHEET 1 OF 1 SHEETS

1. PROJECT: Phase 2 Group 5 Sites
2. LOCATION (Coordinates or Station):
3. DRILLING AGENCY: Philip Environmental
4. HOLE NO. (As shown on drawing title and file number): LH60SB08
5. NAME OF DRILLER: Jerry Bignall
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NA
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 8.1 Ft
10. SIZE AND TYPE OF BIT: 4¼" HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: NA
16. DATE HOLE: STARTED 10/15/95 | COMPLETED 10/16/95
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: ? %
19. SIGNATURE OF INSPECTOR: Sverdrup Environmental

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM	silty fine SAND - Brown, loose, poorly graded, moist	1 / ~~1.5~~ / ~~1.5~~ / 1	1 11A 0-.5	
	1					
	2	CL	Fine sandy silty CLAY - strong brown, some fine gravel, medium stiff to stiff, slight to medium plasticity, dry	1/2	2 SS 0853 2,5,6,7	1-2 Strong Brown fine sandy silty clay, slight to medium plasticity, medium stiff to stiff, Dry (cl) some fine gravel, Mixed colors of Dusky red, gray and black (fill)
	2		No Recovery 2-3 Ft		1-3	
	3					3-3.2 same as above
	3.2	ML	fine sandy SILT - Brown, medium stiff, slight Plasticity, dry	.6/2	3 SS 0858 2,3,3	3.2-3.6 Brown Fine sandy silt, dry, medium stiff, slight plasticity (ML)
	3.6		No Recovery 3.6 - 5 Ft		3-5	
	4					
	5	SM	silty fine SAND - gray to brownish gray with some iron staining and reddish brown inclusions, loose poorly graded, wet to saturated	1.2/2	4 SS 0904 2,1,1	5-6.2 Gray to Brownish gray silty fine sand, wet to saturated, Loose, poorly graded, (SM) some iron staining and reddish brown inclusions
	6				5-7	
	6.2		No Recovery 6.2-7			
	7					
	8	ML-SM	Fine sandy SILT - light gray, some black nodules, medium stiff, non- to slight plasticity, moist	1.1/2	5 SS 0908 1,1,1,3	7-8.1 same as SB02 (5.2-6.7) wet to saturated no black nodules (ML-SM)
			TD = 8.1 Ft		7-9	
	9					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH60SB08

Hole No. LH605B11

020730

DRILLING LOG	DIVISION: USACE-Tulsa District	INSTALLATION: Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT: Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT: 4 1/4" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY: Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number): LH605B11		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER: Jerry Bignall		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 10/15/95 COMPLETED 10/15/95	
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE: 8.9 Ft		18. TOTAL CORE RECOVERY FOR BORING: %	
		19. SIGNATURE OF INSPECTOR: Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		SM	silty fine SAND - Brown, loose poorly graded, moist	.5/.5	1 HA 0-.5	
		0.5	No material recovered 0.5-1			
	1	1				
		CL	silty CLAY - Gray to grayish brown, some iron staining, some fine sand zones, medium stiff, medium plasticity, dry to moist	1/2	2 SS 10:45 3,5,5,5	1-2 Gray to Grayish Brown silty clay with some fine sand zones, medium stiff, medium plasticity, dry to moist (CL-ML) some iron staining
	2	2				
			No Recovery 2-3 Ft		1-3	
	3	3				
			- some dusky red inclusions and plant root material	1.7/2	3 SS 10:49 1,3,4,5	3-4.7 Predominantly Gray silty clay, Medium stiff, medium plasticity, moist, (CL), Some dusky red inclusions and plant root material, some fine sand
	4					
		4.7	No Recovery 4.7-5 Ft		3-5	
	5	5				
			- increase in clay content, decrease in dusky red inclusions, inclusions change to yellowish brown, medium to high plasticity	1.8/2	4 SS 10:57 3,5,7,10	5-6.8 same as above with increasing clay content medium to high plasticity (CL-CH) Decrease in dusky red inclusions color changes to a yellowish brown inclusions
	6					
		6.8	No Recovery 6.8-7 Ft		5-7	
	7	7				
			- increase in fine sand and silt content, low to medium plasticity	1.9/2	5 SS 11:03 3,5,7,9	7-8.9 same as above increase in fine sand and silt content (CL-ML) low to medium plasticity
	8					
		8.9			7-9	
	9		TD = 8.9 Ft			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH605B11

Hole No. LH60SB12

020731

DRILLING LOG | DIVISION: USACE - Tulsa District | INSTALLATION: Longhorn Army Ammunition Plant | SHEET 1 OF , SHEETS

1. PROJECT: Phase 2, Group 5 Sites
2. LOCATION (Coordinates or Station)
3. DRILLING AGENCY: Philip Environmental
4. HOLE NO. (As shown on drawing title and file number): LH60SB12
5. NAME OF DRILLER: Jerry Bynall
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NA
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 8.8 Ft
10. SIZE AND TYPE OF BIT: 4 1/4" HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: NA
16. DATE HOLE: STARTED 10/15/95 | COMPLETED 10/15/95
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: Sverdrup Environmental

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM	silty, Fine SAND - Brown, loose, poorly graded, moist	0-0.5	1 HA 11:20 0-0.5	
	0.5		No material recovered 0.5 - 1 Ft			
	1	CL	silty CLAY - gray to grayish brown, some iron staining, some fine sand zones, medium stiff, medium plasticity, dry to moist	1.1/2	2 SS 11:32 3,5,3,4 1-3	1 - 1.6 Same as SB11 (1-2) 1.6 - 2.1 Grayish Brown silty fine sand, loose, poorly graded, moist (SM
	1.6	SM	silty Fine SAND - grayish brown, loose, poorly graded, moist			
	2		2.1 No Recovery 2.1 - 3 Ft			
	3	CL	silty CLAY - Gray, some dusky red inclusions and root material, some fine sand, medium stiff, medium plasticity, moist	1.7/2	3 SS 11:36 2,3,7,6 3-5	3 - 4.7 Same as SB11 (3-4.7)
	4					
	4.7		No Recovery 4.7 - 5 Ft			
	5		- increase in clay content, decrease in dusky red inclusions, inclusions change to yellowish brown, medium to high plasticity	1.3/2	4 SS 11:42 3,5,7,9 5-7	5 - 6.3 Same as SB11 (5-6.8)
	6					
	6.3		No Recovery 6.3 - 7 Ft			
	7		- increase in Fine sand and silt content, low to medium plasticity	1.8/2	5 SS 2,5,6,8 11:47 7-9	7 - 8.8 Same as SB11 (7.8 - 9) some black nodules.
	8					
	8.8		TD = 8.8 Ft			
	9					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2, Group 5 Sites LHAAP | HOLE NO. LH60SB12

Hole No. LH605B13

020732

DRILLING LOG	DIVISION: USACE - Tulsa District	INSTALLATION: Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT: Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT: 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY: Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number): LH605B13		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER: Jerry Bignall		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 10/15/95 / COMPLETED 10/15/95	
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE: 8.6 Ft		18. TOTAL CORE RECOVERY FOR BORING: %	
		19. SIGNATURE OF INSPECTOR: Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SM	Silty fine SAND - Brown, loose, poorly graded, moist	0.5 / 0.5	1 HA 13:05 0-.5	
	0.5		No material recovered 0.5-1 Ft			
	1	CL	silty CLAY - gray to grayish brown, some iron staining, some fine sand zones, medium stiff, medium plasticity, dry to moist	1.2 / 2	2 SS 1-3 3,4,4,5 13:12	1-2.2 Same as SB11 (1-2)
	2					
	2.2		No Recovery 2.2-3 Ft			
	3		- increasing silt content, yellowish brown inclusions, black root material, moist to wet	1.6 / 2	3 SS 3-5 1,2,2,2 13:16	3-4.6 Gray silty clay medium stiff, medium plasticity, moist to wet. Black plant root material, yellowish Brown inclusions. Silt content increase with depth (CL-ML)
	4					
	4.6		No Recovery 4.6-5 Ft			
	5				4 SS 5-7 13:23 1,3,5,5	5-5.3 Same as above
	5.3		- increase in clay content, medium to high plasticity, dry to moist	1.6 / 2		5.3-6.6 Same as SB11 (5-6.8)
	6					
	6.7		No Recovery 6.7-7 Ft			
	7				5 SS 7-9 13:28 2,4,5,8	@ 8.6 Same as above
	8			1.4 / 2		
	8.6		TD = 8.6 Ft			
	9					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH605B13

Hole No. LH63SB01

020733

DRILLING LOG	DIVISION: USACE - Tulsa District	INSTALLATION: Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT: Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT: 4¼" - HSA	
2. LOCATION (Coordinates or Station):		11. DATUM FOR ELEVATION SHOWN (MSL or MSL):	
3. DRILLING AGENCY: Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number):		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER: Jerry Bignall		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 10/12/95 / COMPLETED 10/12/95	
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE:	
9. TOTAL DEPTH OF HOLE: 16.5 Ft		18. TOTAL CORE RECOVERY FOR BORING: %	
		19. SIGNATURE OF INSPECTOR: Sverdrup Environmental	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM	silty fine SAND - brown, medium dense, poorly graded, with black gravel sized nodules, wet to saturated	2.5/5	1 HSA 11:15 0-5	0-1.3 Same as SB03 (0-.7) wet to saturated with Black nodules gravel sized (SM)
		1.3				1.3-1.6 Same as SB04
	2	CL	Silty CLAY - gray to reddish brown with dusky red inclusions, medium stiff to stiff, low to medium plasticity moist			1.75-2.2 (CL)
		2.5	N-Recovery 2.5-5 Ft			2.2-2.5 Same as SB04 (2.2-3.2) (CL)
	3					
	4					
	5					
		SM/CL 5.9	CLAY - reddish brown with gray silt and fine sand inclusions, very stiff, medium plasticity, dry		2 HSA 5-10	5-5.9 Reddish Brown clay with gray silt inclusions and fine sand. Low to medium plasticity, very stiff, dry (CL/ML)
	6	ML	Fine sandy SILT - Yellowish brown to light gray, laminations, very stiff, slight plasticity, dry some iron staining and black material	3/5		5.9-8 Yellowish brown to light Gray fine sandy silt. Laminated, very stiff, Dry slight Plasticity (ML) some iron staining and black root structure, root structures less prevalent than SB03 material
	7					
	8		No Recovery 8-10 Ft			
	9					
	10					
			-yellowish brown, increase in fine sand content, some iron staining and fine black root structures From 10.5-11 Ft		3 HSA 10-15 11:50	10-11 Same as SB03 (10-12.5) some fine black root structures 10.5-11.
	11		No Recovery 11-15 Ft	1/5		
	12					
	13					
	14					
	15					
		CL-ML	clayey SILT - light gray to reddish brown, stiff, slight to low plasticity, dry	1.5/2	4 SS 4,15,21 15-17 11:57	15-16.5 Same as SB03 (15-16.2)
	16					
			TD = 16.5 Ft			
	17					
	18					
	19					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP HOLE NO. LH63SB01

Hole No. LH635B02

020734

DRILLING LOG	DIVISION: USACE - Tulsa District	INSTALLATION: Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT: Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT: 4 1/4" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY: Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV	
4. HOLE NO. (As shown on drawing title and Site number): LH63SB02		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 / UNDISTURBED 3	
5. NAME OF DRILLER: Jerry Bignall		14. TOTAL NUMBER CORE BOXES: NA	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NA	
7. THICKNESS OF OVERBURDEN: NA		16. DATE HOLE: STARTED 10/11/95 / COMPLETED 10/12/95	
8. DEPTH DRILLED INTO ROCK: NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE: 16.5 Ft		18. TOTAL CORE RECOVERY FOR BORING	%
		19. SIGNATURE OF INSPECTOR: Sverdrup Environmental — Jerry Bignall	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM	silty Fine SAND - Brown, loose to medium dense, poorly graded, moist (wet at surface)	1/1 - 100%	HA 0-1 11:30	0-1.7 10YR 5/3 Brown silty Fine Sand, loose to medium dense, poorly grade, wet at surface moist at 1 Ft, (SM)
		1.7				1.7-2.5 5YR 5/6 Yellowish Red mottled Clay with some silt stiff, moist. High plasticity (H)
	2				2 HSA 0.5-5 11:50	
	3	CH	CLAY - Yellowish red, mottled, some silt, stiff, high plasticity, moist	4.5/4.5		2.5-3.8 same as above no mottling, no silt.
		3.8				3.8-5 Silty Fine sand, layered with dusky red clay inclusions medium dense slight plasticity (ML-SM) dry Silt and Sand Yellowish brown to light gray.
	4	SM-ML	Silty Fine SAND - Yellowish brown to light gray, layered, some dusky red clay inclusions, medium dense, slight plasticity, dry			
	5				3 HSA 5-10 12:18	5-6 Same as above with increasing silt content and decreasing clay inclusions.
	6			3.9/5		6-8.9 Gray Fine Sandy Clayey silt. with reddish brown to yellowish brown inclusions Black noduals, stiff, slight plasticity, dry, some layers increasing Fine sand and silt content in last .5 Ft. (ML)
	7	ML	Fine sandy clayey SILT - Gray with reddish brown to yellowish brown inclusions, few black nodules. stiff, low plasticity. dry			
	8					
	9					
		8.9	No Recovery			
	10					
		SM 10.5	silty Fine SAND - Yellowish brown, Medium dense, poorly graded dry	1.4/2	4 SS 10-12 12:43 6,7,14,17	10-10.5 Yellowish brown silty Fine sand, medium dense dry. Silt gray, (SM) Poorly Graded,
	11	CL	silty CLAY - Dusky Red, stiff, med. plasticity, dry, some 61.2t. nodules, stiff medium plasticity dry			10.5-10.9 Dusky Red silty clay with Black Nodvals, Stiff, dry medium Plasticity (CL)
		11.2				10.9-11.4 same as 10-10.5
	12	ML-SM	clayey SILT and Fine sand - Yellowish brown to gray, stiff slight to low plasticity, some black nodules dry			11.4-15 Yellowish brown dead gray Clayey silt and Fine sand stiff, slight to low plasticity, dry, with some black noduals, ML-SM
	13			3.8/3.6	5 HSA 12:50	
	14					
	15					
		15				15-16.7 Reddish brown and gray clayey silt with some Fine sand and black noduals stiff to very stiff, dry, low plasticity (ML-CL)
	16	ML	clayey SILT with some Fine sand, reddish brown to gray, some black nodules. stiff to very stiff, low plasticity, dry	1.5/2	6 SS 15-17 13:05	
		16.5				
	17		TD = 16.5 Ft		6,11,13,17	
	18					
	19					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites - LHAAP | HOLE NO. LH635B02

Hole No. LH63 SB03

020735

DRILLING LOG	DIVISION USACE - Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT 4 1/4" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (MSL or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and Site number) LH63SB03		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/12/95	COMPLETED 10/12/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 16.7 Ft		18. TOTAL CORE RECOVERY FOR BORING	%
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Steve Sun	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		SM 0.7	silty Fine SAND - brown, medium dense, poorly graded, wet			Brown silty Fine Sand Medium Dense, Poorly Graded Wet (SM)
	1		silty CLAY - gray to reddish brown with dusky red inclusions, medium stiff to stiff, low to medium plasticity, moist		1 HSA 08:38 0-5	.7-2.2 same as SB04 (1.75-2.2) (CL)
	2	CL		3.8/5		2.2-3.4 Same as SB04 (2.2-3.2) (CL)
	3					3.4-3.8 Same as SB04 (3.2-3.4) (ML)
		ML 3.8 No recovery 5	clayey Fine sandy SILT - yellowish brown medium stiff, slight to low plasticity, moist			5-5.7 Same as SB04 (5-6.2) (SM-ML)
	4		Note: No recovery between 3.8-5 Ft.			5.7-7 Same as SB04 (6.2-9) mottled (ML)
	5	SM-ML 5.7	clayey Fine Sandy SILT - gray to reddish brown, medium stiff to stiff, low plasticity dry		2 HSA 09:10 5-10	10-12.5 Light gray to Yellowish Brown Fine sandy silt, Stiff, slight plasticity Dry, Some iron staining and gray CH inclusions (ML)
	6	ML	SILT - Gray with some Fine sand and Fine black root structures, stiff, low plasticity, dry, mottled	2/5		
	7		7			15-16.2 Light gray to reddish brown clayey silt, stiff slight to low plasticity, dry (ML-CL)
			No recovery 7-10 Ft			16.2-16.7 Light Gray to Yellowish brown to Reddish brown silty fine sand, loose to medium dense, poorly graded Dry (SM)
	8					
	9					
	10		10			
			- yellowish brown, increase in Fine Sand content, some iron staining, and gray clay inclusions	2.5/5	3 HSA 09:25 10-15	
	11					
	12					
			12.5			
	13		NO Recovery 12.5 - 15			
	14					
	15		15			
		CL-ML	clayey SILT - light gray to reddish brown, stiff, slight to low plasticity dry		4 SS 5,6,12,14 09:35 15-17	
	16	16.2		1.7/2		
		SM	silty fine SAND - light gray to yellowish orange to reddish brown, loose to medium dense, poorly graded, dry			
	17		TD = 16.7 Ft			
	18					
	19					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Phase 2, Group 5 Sites LHAAP | HOLE NO. LH63 SB03

Hole No. LH635B04

020736

DRILLING LOG	DIVISION USACE - Tulsa District	INSTALLATION Longhorn Army Ammunition Plant	SHEET 1 OF 1 SHEETS
1. PROJECT Phase 2 Group 5 Sites		10. SIZE AND TYPE OF BIT 4¼" HSA	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY Philip Environmental		12. MANUFACTURER'S DESIGNATION OF DRILL CME 550 ATV	
4. HOLE NO. (As shown on drawing title and file number) LH635B04		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1	UNDISTURBED 3
5. NAME OF DRILLER Jerry Bignall		14. TOTAL NUMBER CORE BOXES NA	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER NA	
7. THICKNESS OF OVERBURDEN NA		16. DATE HOLE STARTED 10/11/95	COMPLETED 10/12/95
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 16.5		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Sverdrup Environmental Steve Brinton	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM	silty Fine SAND - grayish brown, loose, poorly graded, with few black nodules, wet to saturated.	1/1	1 HA ons M.	0-1.75 Grayish Brown silty Fine sand. Poorly Graded, Loose, wet to saturated (SM) w/ Black nodules
	2	CL	silty CLAY - gray to reddish brown with dusky red inclusions, medium stiff to stiff, low to medium plasticity. Moist	3.4/5	2 HSA 15:00 0-5	1.75 - 2.2 Gray Clayey silty with Dusky red clay inclusions moist, medium stiff, low to medium plasticity (CL)
	3					2.2 - 3.2 reddish Brown silty clay, medium stiff, medium plasticity, moist (CL)
	4	ML 3.4 no recovery	clayey Fine sandy SILT - Yellowish brown, medium stiff, slight to low plasticity, moist Note: No Recovery between 3.4 and 5 Ft.			3.2 - 3.4 Yellowish Brown clayey sandy silt moist medium stiff, slgh to low plasticity (ML)
	5				3 HSA 15:31 5-10	5 - 6.2 Gray and Reddish Brown Clayey fine sandy silt medium stiff to stiff low plasticity, dry. (SM-ML) with a zone of cemented (iron) sandstone (5.2 - 5.4)
	6	SM-ML	clayey Fine sandy SILT, Gray to reddish brown, medium stiff to stiff, low plasticity, dry, cemented zone (sandstone) 5.2 - 5.4 Ft.	4/5		6.2 - 9 Gray silt with fine sand and Black Fine root structures, stiff, dry, low plasticity (ml) with reddish brown Fine sand.
	7		SILT - Gray, with some Fine sand and Black STR Fine root structures, stiff, low plasticity, dry			
	8	ML				
	9		No recovery			10-13.8 Same as above with some gray clay inclusions (CH) From 10-11 Ft Clay content decrease after 11 Ft.
	10				4 HSA 15:58 10-15	
	11		- some gray clay inclusions			15-16.5 same as above
	12		- decreasing clay content	3.8/5		
	13					
	14		No recovery			
	15				5 SS 16:10	
	16			1.5/2	B, 13, M 21 15-17	
	17		TD = 16.5			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT Phase 2 Group 5 Sites LHAAP | HOLE NO. LH635B04

Hole No. LH635B05

020737

DRILLING LOG | DIVISION: COE - Tulsa | INSTALLATION: Longhorn Army Ammunition Plant | SHEET 1 OF 1 SHEETS

1. PROJECT: Phase 2 Group 5 Sites
2. LOCATION (Coordinates or Station):
3. DRILLING AGENCY: Philip Environmental
4. HOLE NO. (As shown on drawing title and file number): LHGD sb LH635B05
5. NAME OF DRILLER: Jerry Bignall
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: NA
8. DEPTH DRILLED INTO ROCK: NA
9. TOTAL DEPTH OF HOLE: 16.4 Ft
10. SIZE AND TYPE OF BIT: 4¼" HSA
11. DATUM FOR ELEVATION SHOWN (MSL or MSL):
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 550 ATV
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES: NA
15. ELEVATION GROUND WATER: NA
16. DATE HOLE: STARTED 10/11/95 | COMPLETED 10/12/95
17. ELEVATION TOP OF HOLE:
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: Sverdrup Environmental

ELEVATION a	DEPTH Ft b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SM 1.4	silty fine SAND - strong brown, loose, poorly graded, dry	1.5 / .5 sec	1 HSA 0-1.5	7.5YR 4/6 - Strong Brown Silty Fine Sand, loose, Poorly Grade, Dry (SM) (0-1.4)
	2	2.75	clayey fine sandy SILT strong brown to pale yellow, mottled, soft to stiff	3.7 / 5	2 HSA 09:55 0-5	7.5YR 5/6 - strong Brown Clayey Fine Sandy Silt - Soft slight Plasticity, moist (ML) 1.4-2.1 some iron stained clay 2.5Y 6/4 Light yellowish brown Fine sandy silt, medium dense some clay inclusions (mottled dry (2.1-2.3) ML
	3	CH 3.7	CLAY - Gray with dusky red inclusions Hard, High plasticity, dry			
	4		No Recovery			2.5Y 7/3 Pale yellow silt some sand and clay inclusions Dry, stiff (2.3-2.75) ML
	5	CH 5.8	CLAY - strong brown, mottled, very stiff, high plasticity, dry	3 / 1.8 / 5 10:12	3 HSA 10:12 Hand Cut 5-10	2.5Y 6/1 Gray Clay, Hard with dusky Red (2.5YR 4/4) inclusions, dry, High plasticity (CH) 2.75-3.7
	6	SM 6.6	silty fine SAND - light yellowish brown dense, poorly graded, dry			7.5YR 5/6 strong brown mottled Clay, very stiff (gray) dry, High plasticity, (CH) 5-5.8
	7	CL 6.8	silty CLAY - Yellowish brown mottled very stiff, medium to high plasticity, dry			2.5Y Light Yellowish Brown silty fine sand, poorly graded Dense, dry (SM) 5.8-6.6
	8	CL				10YR 5/6 Yellowish brown mottled silty clay medium to High Plasticity, dry, very stiff 6.6-6.8 CL
	9					
	10	CL 11		6, 11, 11, 17 / 1.3 / 2	4 SS 10-12 10:25	10YR 6/4 Light Yellowish Brown mottled, silty clay dry very stiff medium plasticity (10-11) CL
	11	ML	clayey SILT with fine sand, light gray, very stiff, some low plasticity, dry			
	12					10YR 7/2 Light gray clayey silt w/ some Fine sand, Low plasticity, dry, very stiff (11-11.3) (12/-13.8') increasing Fine sand content and fine sand lenses
	13	13.8		3 / 3	5 HSA 10:47 12-15	
	14	SP	fine SAND - Pale yellow grading to white to light gray, some iron staining medium dense, poorly graded, dry			2.5Y 7/3 Pale Yellow Fine Sand with some iron staining Medium dense poorly graded dry (SP) (13.9-15)
	15					2.5Y 8/1 to 7/1 White to light gray Fine sand, Medium dense poorly graded, dry (15-16.4) (SP)
	16			14, 15, 16, 19 / 1.4 / 2	6 SS 10:50 15-17	
			TD = 16.4 Ft			
	17					
	18					
	19					

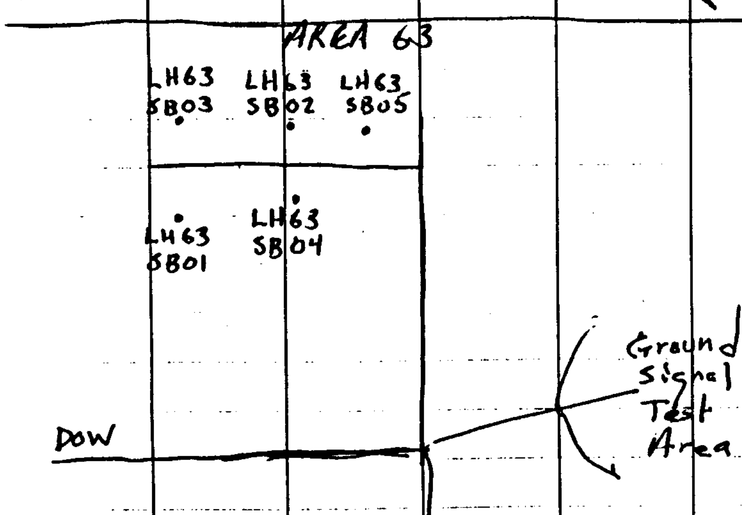
ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT: Phase 2 Group 5 Sites LHAAP | HOLE NO. LH635B05

(2)

Tuesday Oct. 10, 1995

53B



(3)

Wednesday Oct. 11, 1995

Weather: Clear and Warm. Forcast Clear, high low to Mid 80's

Personnel: S. Brunton, A. Steele, SVE

J. Bignol, Rob (Bod) DRESS-LER Phillip

Begin drilling LH63SB05 at ~ 09:30

COLLECTED LH63SS05 (000.0) at 09:45

HNU in open auger ϕ at 09:55

COLLECTED LH63SB05 (5-7) AT 10:10

COLLECTED LH63SB05 (10-12) AT 10:20

COLLECTED LH63SB05 (15-17) AT 10:55

HNU IN SAMPLE (15-17') ϕ AT 10:55

BEGIN DRILLING LH63SB02 AT ~ 11:30

COLLECTED LH63SS02 (000.0) AT 11:30. TRIPLE VOLUME WAS COLLECTED for PRIMARY, QC, & QA SAMPLES.

HNU IN OPEN AUGER ϕ AT 12:00.

COLLECTED LH63SB02 (5-7) AT 12:18. EXTRA VOLUME COLLECTED for MS/MSD SAMPLES.

COLLECTED LH63SB02 (10-12) AT 12:43

COLLECTED LH63SB02 (15-17) AT 13:05

COLLECTED LH63SS04 (000.0) AT 14:50

BEGAN DRILLING LH63SB04 AT 15:00

HNU IN BREATHING ZONE ϕ AT 14:47 & ϕ IN SAMPLE LH63SS04 AT 14:50

COLLECTED LH63SB04 (5-7) AT 15:30

COLLECTED LH63SB04 (10-12) AT 16:00

COLLECTED LH63SB04 (15-17) AT 16:13

020738

THURSDAY, OCTOBER 12, 1995

WEATHER: CLEAR & COOL. FORECAST ~~SUNNY~~ HIGH 80's, PARTLY CLOUDY

PERSONNEL: STEVE BRUNTON, ALICIA STEELE (SVE) & JERRY BIGNALL, ROB ~~BOESSLER~~ DOESSLER (PHILIP)

BEGAN DRILLING LH63SB03 AT 08:45

COLLECTED LH63SS03(000.0) AT 08:45

HNU IN AT SURFACE SOIL SAMPLE WAS ϕ

COLLECTED LH63SB03(5-7) AT 09:10; HNV = ϕ

HNU IN OPEN AUGER ϕ AT 09:25

COLLECTED LH63SB03(10-12) AT ~~09:30~~ 09:25

COLLECTED LH63SB03(15-17) AT 09:40

BEGAN DRILLING LH63SB01 AT 11:12

HNU IN SAMPLE (0-2') ϕ (5-7) AT 11:18

COLLECTED LH63SB01 AT 11:30; HNV = ϕ

COLLECTED LH63SB01(10-11) AT 11:50

COLLECTED LH63SB01(15-17) AT 11:57

COLLECTED LH63SS01(000.0), LH63SS01(000.0)QC, & LH63SS01(000.0)QA AT 12:20

FRIDAY, OCTOBER 13, 1995

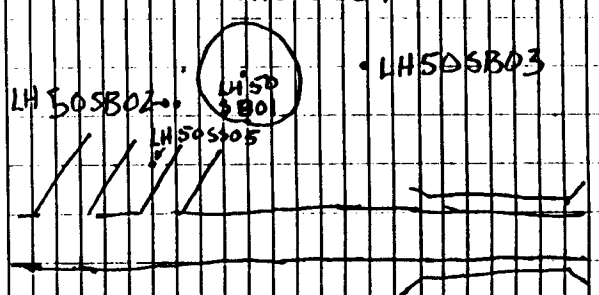
WEATHER: PARTLY CLOUDY, MILD

PERSONNEL: S. BRUNTON, A STEELE (SVE) R. DOESSLER, J. BIGNALL, ~~ROB~~ (PHILIP)

COLLECTED SOSS05(000.0), SOSS05(000.0)QC, SOSS05(000.0)QA AT 08:25; HNV = ϕ

COLLECTED SOSS04(000.0) AT 09:00; HNV = ϕ

BEGAN DRILLING LH50SB04(000.0) ~ 09:20



COLLECTED LH50SB04(5-7) AT 09:35

COLLECTED LH50SB04(10-12) AT 09:45

COLLECTED LH50SB04(15-17) AT 10:05

COLLECTED LH50SS01(000.0) & LH50SB01 LH50SS01(000.0)MS/MSD AT 11:00

COLLECTED LH50SB01(5-7) AT 11:15; HNV = 4

COLLECTED LH50SB01(10-12) AT 11:35

COLLECTED LH50SB01(15-17) AT 11:58

COLLECTED ~~LH50SB02~~ ~~LH63~~ LH50SS03(000.0), LH50SS03(000.0)QC, & LH50SS03(000.0)QA AT 13:45

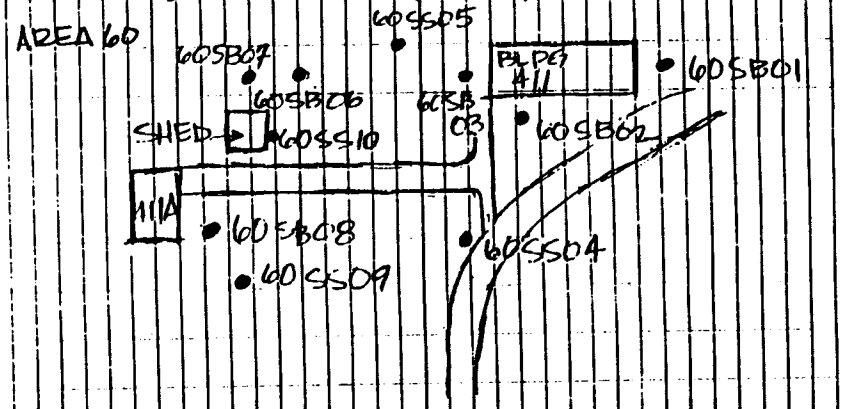
COLLECTED LH50SB03(5-7) AT 14:20

FRIDAY, OCTOBER 13, 1995 (CONT.)

COLLECTED LH50SB03 (10-12) AT 14:45
COLLECTED LH50SB03 (15-17) AT 14:55
COLLECTED LH50SS02 (000.0) AT 15:55
COLLECTED LH50SB02 (5-7) AT 16:10
COLLECTED LH50SB02 (10-12) 16:25.
COLLECTED LH50SB02 (15-17) AT 16:35

AS ~~[illegible]~~ SATURDAY, OCT. 14, 1995

WEATHER: CLEAR, COOL, BREEZY; HIGHS IN 70'S
PERSONNEL: A. STEELE & S. BRUNTON (SVE)
J. BIGNALL & D. DRESSLER (PHILIP)
COLLECTED LH50SB02 (15-17) EB @ 08:20
AREA 60



COLLECTED LH60SS01 (000.0) AT 10:10
COLLECTED LH60SB01 (1-3) AT 10:29
COLLECTED LH60SB01 (3-5) AT 10:37
COLLECTED LH60SB01 (7-9) AT ~~10:42~~ AS
COLLECTED ~~LH60SS02~~ LH60SS02 (000.0) AT 11:10
COLLECTED ~~LH60SB01~~ LH60SB02 (1-3) MS/MSD AT 11:30
COLLECTED LH60SB02 (3-5) AT 11:43
COLLECTED LH60SB02 (7-9) AT ~~11:58~~ 11:54
ALSO LH60SB02 (7-9) QC, & LH60SB02 (7-9) QA
COLLECTED LH60SS03 (000.0) AT 12:57
*COLLECTED LH60SB03 (1-3) AT 13:08 → SAMPLE THROWN OUT. DRILL RIG HAD TO BE MOVED B/C A PIPE WAS HIT ~ 3' BELOW GROUND SURFACE.

020710

SATURDAY, OCT. 14, 1995 (CON'T).

COLLECTED LH60SB08 (1-3) AT 13:42
COLLECTED LH60SB03 (3-5) AT 13:47
COLLECTED LH60SB03 (7-9) AT 14:02
COLLECTED LH60SS06 (000.0) AT 14:25
COLLECTED LH60SB06 (1-3) AT 14:32
COLLECTED LH60SB06 (3-5) & LH60SB06 (3-5) MS/MSD AT 14:40
COLLECTED LH60SB06 (7-9) AND LH60SB06 (7-9) FC, & LH60SB06 (7-9) QA AT 15:00
COLLECTED LH60SS07 (000.0) AT 15:18
COLLECTED LH60SB07 (1-3) AT 15:30
COLLECTED LH60SB07 (3-5) AT 15:38
COLLECTED LH60SB07 (7-9) AT 15:48
COLLECTED LH60SS04 (000.0) AT 16:05
COLLETED LH60SS05 (000.0) AT 16:12
" " LH60SS09 (000.0) AT 16:20
" " LH60SS10 (000.0), LH60SS10 (000.0) QC & LH60SS10 (000.0) QA AT 16:30
COLLECTED LH60SB03 (7-9) EB @ 14:15

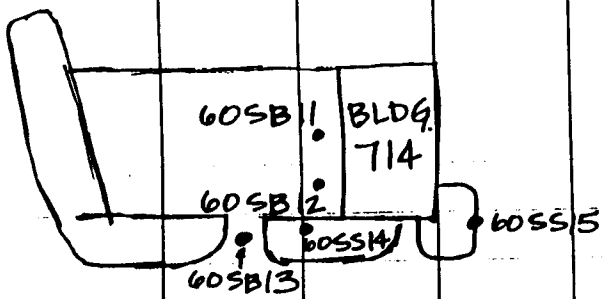
SUNDAY, OCTOBER 15, 1995

WEATHER: CLEAR & COOL; HIGHS IN 70s.
PERSONNEL: S. BRUNTON & A. STEELE (SVE)
J. BIGNALL & D. DRESSLER (PHILIP)
COLLECTED LH60SS08 (000.0) AT 08:45
BEGAN DRILLING LH60SB08 AT 08:50
COLLECTED LH60SB08 (1-3) AT 08:58
" " LH60SB08 (3-5) AT 09:02
" " LH60SB08 (7-9) AT 09:12
" " LH60SB08 (7-9) EB AT 09:30
" " LH60SS11 (000.0) AT 10:27
BEGAN DRILLING LH60SB11 AT 10:45
COLLECTED LH60SB11 (1-3) AT 10:51
" " LH60SB11 (3-5) & LH60SB11 (3-5) MS/MSD AT ~~10:59~~ 11:03
COLLECTED LH60SB11 (7-9), LH60SB11 (7-9) QC, LH60SB11 (7-7) QA AT 11:12
COLLECTED LH60SS12 (000.0) AT 11:27
BEGAN DRILLING LH60SB12 AT 11:30
COLLECTED LH60SB12 (1-3) AT 11:35
" " LH60SB12 (3-5) AT 11:41
" " LH60SB12 (7-9) AT 11:50
" " LH60SS13 (000.0) AT 13:08
BEGAN DRILLING LH60SB13 AT 13:09
COLLECTED LH60SB13 (1-3) AT 13:15
" " LH60SB13 (3-5) AT 13:24
" " LH60SB13 (7-9) AT 13:32

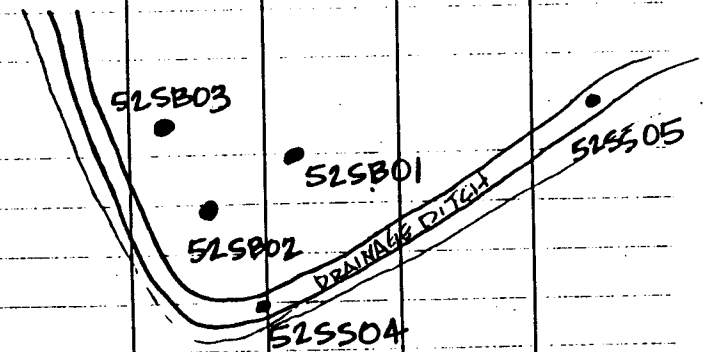
SUNDAY, OCT. 15, 1995 (CON'T)

COLLECTED LH60SB13(7-9)EB @ 13:45
COLLECTED LH60SS14(000.0) @ 13:48
" " LH60SS15(000.0), LH60SS15(000.2)QC,
AND LH60SS15(000.0)QA @ 13:55

AREA 60



AREA 52



MONDAY, OCTOBER 16, 1995

WEATHER: CLEAR & COOL; FORECAST: HIGHS 81-85°F
PERSONNEL: STEVE BRUNTON & ALICIA STEELE (SWB)
JERRY BIGNALL & ROBERT DRESSLER (PHILIP)
COLLECTED LH52SS02(0000) AT 09:30
BEGAN DRILLING LH52SB02 AT 09:34
COLLECTED LH52SB02(2-4) AT 09:49
" " LH52SB02(7-9), LH52SB02(7-9)QC,
AND LH52SB02(7-9)QA @ 10:07
COLLECTED LH52SB02(12-14)@10:28
" " LH52SS03(000.0) & LH52SS03(000.0) MS/MSD
@ 10:47
BEGAN DRILLING LH52SB03 @ 10:49
COLLECTED LH52SB03(2-4)@ 11:06
" " LH52SB03(7-9)@ 11:20
" " LH52SB03(12-14)@11:30
COLLECTED LH52SS01(000.0)@ 11:50
BEGAN DRILLING LH52SB01 @ 12:00
COLLECTED LH52SB01(2-4) @ 12:15
" " LH52SB01(7-9) @ 12:30
" " LH52SB01(12-14)@12:40
COLLECTED LH52SS04(000.0)@ 12:48
" " LH52SS05(000.0) @ 14:25
ALSO LH52SS05(000.0)QA & LH52SS05(000.0) QC

Group 5 Sites 51 - Site 50
Sediment samples from Goose/
Prairie Creek collected by S. Brunton
and P. Sazama.

Sample collected ~ 200 ft up and
down stream from bridge

LH50SD02 and LH50SD02MS/MSD
collected at 16:38
Silt fine Sand - Brown with organic
material (leaves, roots, twigs) strong
decay odor
LH50SD01, LH50SD01QA, LH50SD01QC
collected at 17:12
Silty Clay - Brush Gray, medium dense
organic material (leaves, roots, twigs) strong
decay odor
Equipment Rinsate LH50SD02EB
collected at 16:30, Trip Blank LH50TB
collected at 18:20. All samples submitted
for VOA, SVOC, Explosive, and TAL metals Analysis.

Weather: Warm, Partly cloudy, breezy
10 mph wind
Personnel: Steve Brunton, SvE
Resample Surface soils at
Group V site 63.
LH6355Ø3 Collected @ 10:03
LH6355Ø1 Collected @ 10:08
LH6355Ø4 Collected @ 10:13
LH6355Ø2 Collected @ 14:10
LH6355Ø2QA Collected @ 14:10
LH6355Ø2QC Collected @ 14:10
LH6355Ø5 Collected @ 14:20
All samples collected within 1 Ft of
original sample location
Group V Site 52
LH5255B03 Collected @ 15:30
LH5255B02 Collected @ 15:33
LH5255Ø4 Collected @ 15:36
LH5255Ø4MS/MSD Collected @ 15:36
LH5255Ø1 Collected @ 16:10
LH5255Ø1QA Collected @ 16:10
LH5255Ø1QC Collected @ 16:10
LH5255Ø5 Collected @ 16:20
LH52RSØ1 @ 16:06

(18) 2/20/96 Tuesday
Warm, 75° Breezy
Personnel: S. Brunton, M. Beymer
Site 50 Group V resample

LH50S5 ϕ1 @ 1505
LH50S5 ϕ2 @ 1515
LH50S5 ϕ3 @ 1455
LH50S5 ϕ4 @ 1500
LH50S5 ϕ5 @ 1520
LH50RS ϕ1 @ 1610

APPENDIX III
LHAAP GROUP 5 SITES
SITE INVESTIGATION
SURVEYING DATA

020745

SITE ID	NORTHING (feet)	EASTING (feet)
50SD01	6957493.88	3309331.37
50SD02	6957842.55	3309701.86
50SB01	6957411.86	3309529.56
50SB03	6957444.84	3309495.88
60SB04	6957388.27	3309511.81
50SS02	6957425.77	3309575.50
50SS05	6957445.22	3309604.15
62SB01	6951786.10	3306249.49
52SB02	6951768.69	3306221.55
52SB03	6951793.33	3306207.30
52SS04	6951761.76	3306220.48
52SS05	6951799.46	3306302.66
60SB01	6959210.27	3305877.17
60SB02	6959116.73	3305840.57
60SB03	6959101.03	3305795.87
60SB06	6959073.70	3305751.47
60SB07	6959045.58	3305731.38
60SB08	6959021.01	3305746.75
80SB11	6980080.82	3304682.47
80SB12	6960057.33	3304689.54
60SB13	6960006.78	3304676.47
60S504	6959059.76	3305830.89
60SS05	6959122.25	3305769.12
60SS09	6959010.16	3305768.61
60SS10	6959043.66	3305760.26
60SS14	8960029.74	3304708.02
60SS15	6960095.39	3304744.26
63SB01	6952809.20	3317882.99
63SB02	6952647.53	3318044.88
63SB03	6952768.23	3318033.25
63SB04	6952626.27	3317803.17
63SB05	6952355.30	3318008.75

North American Datum , 1983 U.S. Survey

APPENDIX IV - TABLE 1
LHAAP GROUP 5 SITES SI
SITE 50, SEDIMENT SAMPLES
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SD01	50SD01	50SD02
	SAMPLE ID	LH50SD01(0-1)	LH50SD01(0-1)QC	LH50SD02(0-1)
	DATE	11/29/95	11/29/95	11/29/95
	DEPTH (ft)	0.00	0.00	0.00
	RESULT TYPE	Primary	Duplicate	Primary
cis-1,2-Dichloroethene		<6	<6	115
Trichloroethene		<6	<6	33

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 2
LHAAP GROUP 5 SITES SI
SITE 50, SEDIMENT SAMPLES
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	50SD01	50SD01	50SD02
	SAMPLE ID	LH50SD01(0-1)	LH50SD01(0-1)QC	LH50SD02(0-1)
	DATE	11/29/95	11/29/95	11/29/95
	DEPTH (ft)	0.00	0.00	0.00
	RESULT TYPE	Primary	Duplicate	Primary
Aluminum		5040	4960	2600
Arsenic		1.2	1.3	2.9
Barium		88	86.5	19.8
Beryllium		1.9	1.9	<0.66
Calcium		1750	1730	480
Chromium		8.2	8.5	17.6
Cobalt		7.7	7.9	4.1
Copper		14	14	3.8
Iron		15500	15400	13000
Lead		8.02 J	9.28 J	7.74 J
Magnesium		1660	1640	450
Manganese		131 J	130 J	72.8 J
Nickel		24	25	6.4
Sodium		230	220	<131
Vanadium		22	21.6	21.4
Zinc		40	40	32

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

APPENDIX IV - TABLE 3
LHAAP GROUP 5 SITES SI
SITE 50, SURFACE SOIL
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SS01	50SS02	50SS03	50SS03	50SS04	50SS05
	SAMPLE ID	LH50SS01(000.0)	LH50SS02(000.0)	LH50SS03(000.0)	LH50SS03(000.0)	LH50SS04(000.0)	LH50SS05(000.0)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Duplicate	Primary	Primary
Trichloroethene		<5	(3) J	<5 UJ	5	(5)	<6

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
( ) = Less than Reporting Limit
UJ - Value is estimated-undetected. J - Value is estimated.

APPENDIX IV - TABLE 3
LHAAP GROUP 5 SITES SI
SITE 50, SURFACE SOIL
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SS05
	SAMPLE ID	LH50SS05(000.0)
	DATE	10/13/95
	DEPTH (ft)	0.00
	RESULT TYPE	Duplicate
Trichloroethene		<6

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

UJ - Value is estimated-undetected.

J - Value is estimated.

020719

APPENDIX IV - TABLE 4
LHAAP GROUP 5 SITES SI
SITE 50, SURFACE SOIL
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SS01	50SS02	50SS03	50SS03	50SS04	50SS05
	SAMPLE ID	LH50SS01(000.0)	LH50SS02(000.0)	LH50SS03(000.0)	LH50SS03(000.0)	LH50SS04(000.0)	LH50SS05(000.0)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Duplicate	Primary	Primary
Benzoic acid		<340	<390	<360	(224) J	<370	(388)
Bis(2-ethylhexyl)phthalate		<340	(214)	<360	(261) J	(240)	(206)
Butyl benzyl phthalate		<340	(386)	<360	<360 UJ	949	531
Di-n-butylphthalate		1545 U	3502 U	1488 U	2272 UJ	2188 U	3561 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
( ) = Less than Reporting Limit
J - Value is estimated. UJ - Value is estimated-undetected. U - Value is undetected.

APPENDIX IV - TABLE 4
LHAAP GROUP 5 SITES SI
SITE 50, SURFACE SOIL
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SS05
	SAMPLE ID	LH50SS05(000.0)
	DATE	10/13/95
	DEPTH (ft)	0.00
	RESULT TYPE	Duplicate
Benzoic acid		<390
Bis(2-ethylhexyl)phthalate		421
Butyl benzyl phthalate		1206
Di-n-butylphthalate		2057 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated. UJ - Value is estimated-undetected. U - Value is undetected.

APPENDIX IV - TABLE 5
LHAAP GROUP 5 SITES SI
SITE 50, SURFACE SOIL
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	50SS01	50SS02	50SS03	50SS03	50SS04	50SS05
	SAMPLE ID	LH50SS01(000.0)	LH50SS02(000.0)	LH50SS03(000.0)	LH50SS03(000.0)	LH50SS04(000.0)	LH50SS05(000.0)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Duplicate	Primary	Primary
Aluminum		290	6310	6880	4190	5310	11100
Arsenic		<0.5	5.3	3.6	3.0	4.8	4.5
Barium		4.1	73.9	69.6	56.3	82.5	109
Beryllium		<0.52	<0.57	<0.55	<0.55	0.57	<0.6
Calcium		<103	1820	1920	1800	1000	2160
Chromium		2.5	17	23.3	17.6	13.5	14
Cobalt		<1.0	3.1	5.3	3.9	8.5	6
Copper		<2.1	4.3	5.9	5.5	6.9	7.9
Iron		1050	18400	19000	17700	10100	12300
Lead		3.1 J	18.1 J	30 J	24 J	28.6 J	15 J
Magnesium		<103	310	470	280	320	990
Manganese		3.3	187	300	224	463	108
Nickel		1.1	4	6.5	3.3	5.1	9.9
Potassium		<516	<566	<546	<546	<561	670
Vanadium		3.3	32.3	31	26.7	22.2	25.6
Zinc		<5.2	22	30	24	26	30

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

APPENDIX IV - TABLE 5
LHAAP GROUP 5 SITES SI
SITE 50, SURFACE SOIL
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	50SS05
	SAMPLE ID	LH50SS05(000.0)
	DATE	10/13/95
	DEPTH (ft)	0.00
	RESULT TYPE	Duplicate
Aluminum		10700
Arsenic		5.3
Barium		90.3
Beryllium		0.62
Calcium		1770
Chromium		29.5
Cobalt		5.9
Copper		6.8
Iron		35600
Lead		24 J
Magnesium		790
Manganese		164
Nickel		7.9
Potassium		630
Vanadium		48.3
Zinc		28

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

APPENDIX IV - TABLE 6
LHAAP GROUP 5 SITES SI
SITE 50, SOIL BORINGS
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SB01	50SB01	50SB01	50SB02	50SB02	50SB02
	SAMPLE ID	LH50SB01(5-7)	LH50SB01(10-12)	LH50SB01(15-17)	LH50SB02(5-7)	LH50SB02(10-12)	LH50SB02(15-17)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
1,2,3-Trichlorobenzene		(4)	<6	<6	<6	<6	<6
cis-1,2-Dichloroethene		<6	<6	<6	<6	<6	156 J
n-Butylbenzene		(4)	<6	<6	<6	<6	<6
Naphthalene		9	<6	<6	<6	<6	<6
Trichloroethene		<6	<6	6	<6	<6	519

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
( ) = Less than Reporting Limit
J - Value is estimated.

APPENDIX IV - TABLE 6
LHAAP GROUP 5 SITES SI
SITE 50, SOIL BORINGS
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SB03	50SB03	50SB03	50SB04	50SB04	50SB04
	SAMPLE ID	LH50SB03(5-7)	LH50SB03(10-12)	LH50SB03(15-17)	LH50SB04(5-7)	LH50SB04(10-12)	LH50SB04(15-17)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
1,2,3-Trichlorobenzene		<5	<6	<6	<5	<6	<6
cis-1,2-Dichloroethene		<5	<6	<6	<5	<6	<6
n-Butylbenzene		<5	<6	<6	<5	<6	<6
Naphthalene		<5	<6	<6	<5	<6	<6
Trichloroethene		<5	<6	<6	<5	<6	<6

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

APPENDIX IV - TABLE 7
LHAAP GROUP 5 SITES SI
SITE 50, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SB01	50SB01	50SB01	50SB02	50SB02	50SB02
	SAMPLE ID	LH50SB01(5-7)	LH50SB01(10-12)	LH50SB01(15-17)	LH50SB02(5-7)	LH50SB02(10-12)	LH50SB02(15-17)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Bis(2-ethylhexyl)phthalate		398	<380	(307)	<390	<390	(241)
Butyl benzyl phthalate		817	<380	<390	<390	<390	589
Di-n-butylphthalate		1242 U	2098 U	1029 U	2448 U	2772 U	2566 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 7
LHAAP GROUP 5 SITES SI
SITE 50, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	50SB03	50SB03	50SB03	50SB04	50SB04	50SB04
	SAMPLE ID	LH50SB03(5-7)	LH50SB03(10-12)	LH50SB03(15-17)	LH50SB04(5-7)	LH50SB04(10-12)	LH50SB04(15-17)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Bis(2-ethylhexyl)phthalate		<360	(273)	<400	(195)	(200)	<390
Butyl benzyl phthalate		<360	<390	(200)	475	871	<390
Di-n-butylphthalate		2020 U	2098 U	3121 U	2730 U	2205 U	2558 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
( ) = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 8
LHAAP GROUP 5 SITES SI
SITE 50, SOIL BORINGS
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	50SB01	50SB01	50SB01	50SB02	50SB02	50SB02
	SAMPLE ID	LH50SB01(5-7)	LH50SB01(10-12)	LH50SB01(15-17)	LH50SB02(5-7)	LH50SB02(10-12)	LH50SB02(15-17)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Aluminum		8710	6120	6060	5520	6310	9990
Arsenic		1.9	2.5	<0.6	3	(0.59)	4.9
Barium		86.8	283	68.1	871	69	129
Beryllium		0.84	1.9	0.94	1.2	1.7	2.7
Calcium		1370	1780	1880	1240	1760	2370
Chromium		12	11	14.2	7.4	16.7	27.2
Cobalt		12.6	18.1	8.6	32.6	11	45.1
Copper		6.7	15	9	6.2	16	26.5
Iron		9940	14400	10700	8040	16500	47800
Lead		7.32	25.1	4.86	8.44 J	9.14 J	33 J
Magnesium		1560	1930	2070	1570	2210	2540
Manganese		71.7	354	54.6	196	68.2	420
Nickel		15.9	26.2	23.1	16.4	26.1	59.5
Potassium		630	630	650	<578	640	900
Sodium		300	560	650	270	590	780
Vanadium		16.9	28.8	10	15.9	27.2	49.9
Zinc		32	39	47	33	47	103

020758

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
J - Value is estimated.

APPENDIX IV - TABLE 8
LHAAP GROUP 5 SITES SI
SITE 50, SOIL BORINGS
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	50SB03	50SB03	50SB03	50SB04	50SB04	50SB04
	SAMPLE ID	LH50SB03(5-7)	LH50SB03(10-12)	LH50SB03(15-17)	LH50SB04(5-7)	LH50SB04(10-12)	LH50SB04(15-17)
	DATE	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95	10/13/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Aluminum		9310	8120	8100	11400	5330	4450
Arsenic		2.3	1.4	0.9	2.3	<0.6	<0.6
Barium		52.5	109	121	43.2	161	456
Beryllium		<0.55	1.8	0.83	<0.54	0.91	<0.59
Calcium		1100	1720	1850	960	1520	1710
Chromium		11	14.7	14.8	12.4	8.3	7
Cobalt		7.3	22.2	13	8.0	10	9
Copper		5.8	12	15	7.5	7.4	7.4
Iron		9640	14500	16200	11000	5140	4340
Lead		7.63 J	9.61 J	10.5 J	5.84 J	8.96 J	8.4 J
Magnesium		1310	2250	2590	1720	1340	1590
Manganese		30.4	126	125	30.2	165	257
Nickel		11	26.2	29.4	13.5	11.2	13.4
Potassium		<545	780	880	720	610	600
Sodium		170	500	630	130	520	560
Vanadium		16.8	21.8	22.3	21	14.3	9.2
Zinc		25	53	68.1	36	17	28

020759

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

APPENDIX IV - TABLE 9
LHAAP GROUP 5 SITES SI
SITE 52, SURFACE SOIL
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	52SS01	52SS02	52SS03	52SS04	52SS05	52SS05
	SAMPLE ID	LH52SS01(000.0)	LH52SS02(000.0)	LH52SS03(000.0)	LH52SS04(000.0)	LH52SS05(000.0)	LH52SS05(000.0)
	DATE	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
Acetone		<11	<13	<12	<12	15	<11

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 10
LHAAP GROUP 5 SITES SI
SITE 52, SURFACE SOIL
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT	(Units in ug/kg)	SITE	52SS01	52SS02	52SS03	52SS04	52SS05	52SS05
		SAMPLE ID	LH52SS01(000.0)	LH52SS02(000.0)	LH52SS03(000.0)	LH52SS04(000.0)	LH52SS05(000.0)	LH52SS05(000.0)
		DATE	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95
		DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
		RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
Di-n-butylphthalate			1400 U	955 U	1146 U	561 U	423 U	433 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

U - Value is undetected.

020761

APPENDIX IV - TABLE 11
LHAAP GROUP 5 SITES SI
SITE 52, SURFACE SOIL
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	52SS01	52SS02	52SS03	52SS04	52SS05	52SS05
	SAMPLE ID	LH52SS01(000.0)	LH52SS02(000.0)	LH52SS03(000.0)	LH52SS04(000.0)	LH52SS05(000.0)	LH52SS05(000.0)
	DATE	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
Aluminum		13300	8460	13000	12300	9830	10800
Arsenic		3	1.9	2.2	4.3	2.7	0.9
Barium		59.7	112	58.1	59.3	50.4	60.4
Calcium		180	260	<118	990	410	380
Chromium		20.4	22.7	13.3	12.5	12.4	11.8
Cobalt		2.3	3.4	2	3.1	3.1	3
Copper		4	3.8	3.3	4	2.8	3.1
Iron		15100	13100	8780	9780	9990	11600
Lead		7.54	9.94	6.63	7.83	9.37	6.94
Magnesium		600	340	570	590	470	540
Manganese		40.9	368	20.7	134	76.7	52
Nickel		3.7	3.6	4.1	5.5	3.1	3.1
Selenium		0.6	<0.6	0.6	0.7	<0.6	<0.6
Sodium		<112	<126	<118	<119	<113	120
Vanadium		40.2	33.3	24.3	23.8	24.4	24.8
Zinc		13	9.9	13	19	12	13

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 12
LHAAP GROUP 5 SITES SI
SITE 52, SOIL BORINGS
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	52SB01	52SB01	52SB01	52SB02	52SB02	52SB02
	SAMPLE ID	LH52SB01(2-4)	LH52SB01(7-9)	LH52SB01(12-14)	LH52SB02(2-4)	LH52SB02(7-9)	LH52SB02(7-9)QC
	DATE	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	2.00	7.00	12.00	2.00	7.00	7.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
p-Isopropyltoluene		<5	<6	<6	16	<6	<6
Acetone		<11	20	<13	<12	<12	<12

020763

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 12
LHAAP GROUP 5 SITES SI
SITE 52, SOIL BORINGS
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	52SB02	52SB03	52SB03	52SB03
	SAMPLE ID	LH52SB02(12-14)	LH52SB03(2-4)	LH52SB03(7-9)	LH52SB03(12-14)
	DATE	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	12.00	2.00	7.00	12.00
	RESULT TYPE	Primary	Primary	Primary	Primary
p-Isopropyltoluene		<6	<6	<6	<6
Acetone		<12	<12	<12	<12

020764

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 13
LHAAP GROUP 5 SITES SI
SITE 52, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	52SB01	52SB01	52SB01	52SB02	52SB02	52SB02
	SAMPLE ID	LH52SB01(2-4)	LH52SB01(7-9)	LH52SB01(12-14)	LH52SB02(2-4)	LH52SB02(7-9)	LH52SB02(7-9)QC
	DATE	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	2.00	7.00	12.00	2.00	7.00	7.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
Bis(2-ethylhexyl)phthalate		<370	(249)	(218)	(197)	<390	(156)
Butyl benzyl phthalate		<370	<380	<420	<410	<390	<390
Di-n-butylphthalate		1797 U	380 U	<420	1127 U	1036 U	1379 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 13
LHAAP GROUP 5 SITES SI
SITE 52, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	52SB02	52SB03	52SB03	52SB03
	SAMPLE ID	LH52SB02(12-14)	LH52SB03(2-4)	LH52SB03(7-9)	LH52SB03(12-14)
	DATE	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	12.00	2.00	7.00	12.00
	RESULT TYPE	Primary	Primary	Primary	Primary
Bis(2-ethylhexyl)phthalate		877	<400	<380	<410
Butyl benzyl phthalate		(392)	<400	<380	<410
Di-n-butylphthalate		1582 U	2448 U	1535 U	<410

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
( ) = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 14
LHAAP GROUP 5 SITES SI
SITE 52, SOIL BORINGS
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	52SB01	52SB01	52SB01	52SB02	52SB02	52SB02
	SAMPLE ID	LH52SB01(2-4)	LH52SB01(7-9)	LH52SB01(12-14)	LH52SB02(2-4)	LH52SB02(7-9)	LH52SB02(7-9)QC
	DATE	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	2.00	7.00	12.00	2.00	7.00	7.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
Aluminum		6920	16800	9200	1350	11100	9140
Arsenic		2.7	2.3	3.1	1.6	1.5	4.8
Barium		75.4	122	58.8	102	116	99.6
Beryllium		0.88	0.66	0.71	<0.62	0.92	0.72
Calcium		490	430	1320	480	960	830
Chromium		11	15.8	14.3	13	14.7	13.6
Cobalt		5.4	7.1	12	4.6	9.0	8.1
Copper		7.1	6.4	8.8	6.1	9.7	8.3
Iron		13300	16400	21000	12900	13800	12700
Lead		4.6	6.93	9.06	7.45	6.81	29.4
Magnesium		1000	1620	2060	1300	2100	1770
Manganese		76.9	29.4	288	18.8	60.4	49.1
Nickel		12.5	14.3	16.9	8.7	16.4	14.8
Potassium		<548	640	740	<621	760	710
Sodium		480	390	780	370	710	590
Vanadium		20.9	30.8	25.1	20.5	23	20.3
Zinc		26	30	42	23	42	37

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 14
LHAAP GROUP 5 SITES SI
SITE 52, SOIL BORINGS
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	52SB02	52SB03	52SB03	52SB03
	SAMPLE ID	LH52SB02(12-14)	LH52SB03(2-4)	LH52SB03(7-9)	LH52SB03(12-14)
	DATE	10/16/95	10/16/95	10/16/95	10/16/95
	DEPTH (ft)	12.00	2.00	7.00	12.00
	RESULT TYPE	Primary	Primary	Primary	Primary
Aluminum		8780	12600	5860	6700
Arsenic		1.5	1.8	2.1	2.9
Barium		111	117	268	114
Beryllium		0.68	<0.6	0.82	0.88
Calcium		970	490	800	1000
Chromium		11	9.3	10	12.3
Cobalt		5.1	4.7	15.4	15
Copper		8.2	4.6	7.9	8.6
Iron		14100	9030	13400	18500
Lead		9.32	8.1	9.58	4.86
Magnesium		1640	1100	1350	1460
Manganese		79.4	26	867	304
Nickel		12.5	6.1	15.1	17.8
Potassium		750	<596	<577	680
Sodium		740	320	490	780
Vanadium		19.6	15.7	19.2	23.4
Zinc		36	16	29	35

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 15
LHAAP GROUP 5 SITES SI
SITE 60, SURFACE SOIL
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SS01	60SS02	60SS03	60SS04	60SS05	60SS06
	SAMPLE ID	LH60SS01(000.0)	LH60SS02(000.0)	LH60SS03(000.0)	LH60SS04(000.0)	LH60SS05(000.0)	LH60SS06(000.0)
	DATE	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
4,4'-DDE		40	<3.8	<176	<3.7	<3.8	<4.1
4,4'-DDT		458 J	<3.8	<176	<3.7	<3.8	<4.1
Dieldrin		<3.7	<3.8	25404	<3.7	<3.8	<4.1

020769

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 15
LHAAP GROUP 5 SITES SI
SITE 60, SURFACE SOIL
DETECTED
PESTICIDES

CONSTITUENT	(Units in ug/kg)	SITE	60SS07	60SS08	60SS09	60SS10	60SS10	60SS11
		SAMPLE ID	LH60SS07(000.0)	LH60SS08(000.0)	LH60SS09(000.0)	LH60SS10(000.0)	LH60SS10(000.0)	LH60SS11(000.0)
		DATE	10/14/95	10/15/95	10/14/95	10/14/95	10/14/95	10/15/95
		DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
		RESULT TYPE	Primary	Primary	Primary	Primary	Duplicate	Primary
4,4'-DDE			<3.9	<3.7 UJ	<3.7	<3.5 UJ	<3.5	126.09 J
4,4'-DDT			<3.9	<3.7 UJ	<3.7	<3.5 UJ	<3.5	<4.1
Dieldrin			<3.9	<3.7 UJ	<3.7	<3.5 UJ	<3.5	<4.1

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated. UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 15
LHAAP GROUP 5 SITES SI
SITE 60, SURFACE SOIL
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SS12	60SS13	60SS14	60SS15	60SS15
	SAMPLE ID	LH60SS12(000.0)	LH60SS13(000.0)	LH60SS14(000.0)	LH60SS15(000.0)	LH60SS15(000.0)
	DATE	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Duplicate
4,4'-DDE		203	<3.5	31.63	18.73 J	20.72 J
4,4'-DDT		185 J	<3.5	<4.0	16.07 J	18.35 J
Dieldrin		<4.0	<3.5	<4.0	<3.8	<3.7

020771

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 16
LHAAP GROUP 5 SITES SI
SITE 60, SURFACE SOIL
DETECTED
HERBICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SS01	60SS02	60SS03	60SS04	60SS05	60SS06
	SAMPLE ID	LH60SS01(000.0)	LH60SS02(000.0)	LH60SS03(000.0)	LH60SS04(000.0)	LH60SS05(000.0)	LH60SS06(000.0)
	DATE	10/14/95	10/14/95	10/14/95	10/15/95	10/15/95	10/14/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
2,4,5-TP (Silvex)		<0.91	4.18	<0.88	<0.92	<0.94	<1.01 UJ

020772

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 16
LHAAP GROUP 5 SITES SI
SITE 60, SURFACE SOIL
DETECTED
HERBICIDES

CONSTITUENT	(Units in ug/kg)	SITE	60SS07	60SS08	60SS09	60SS10	60SS10	60SS11
		SAMPLE ID	LH60SS07(000.0)	LH60SS08(000.0)	LH60SS09(000.0)	LH60SS10(000.0)	LH60SS10(000.0)	LH60SS11(000.0)
		DATE	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95
		DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
		RESULT TYPE	Primary	Primary	Primary	Primary	Duplicate	Primary
2,4,5-TP (Silvex)			6.02	<0.92	<0.92	<0.87 UJ	33.96	<1.01

020773

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 16
LHAAP GROUP 5 SITES SI
SITE 60, SURFACE SOIL
DETECTED
HERBICIDES

CONSTITUENT	(Units in ug/kg)	SITE	60SS12	60SS13	60SS14	60SS15	60SS15
		SAMPLE ID	LH60SS12(000.0)	LH60SS13(000.0)	LH60SS14(000.0)	LH60SS15(000.0)	LH60SS15(000.0)
		DATE	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95
		DEPTH (ft)	0.00	0.00	0.00	0.00	0.00
		RESULT TYPE	Primary	Primary	Primary	Primary	Duplicate
2,4,5-TP (Silvex)			<1	<0.88	<0.99	<0.94	<0.93

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

UJ - Value is estimated-undetected.

020774

APPENDIX IV - TABLE 17
LHAAP GROUP 5 SITES SI
SITE 60, SOIL BORINGS
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SB01	60SB01	60SB01	60SB02	60SB02	60SB02
	SAMPLE ID	LH60SB01(1-3)	LH60SB01(3-5)	LH60SB01(7-9)	LH60SB02(1-3)	LH60SB02(3-5)	LH60SB02(7-9)
	DATE	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95
	DEPTH (ft)	1.00	3.00	7.00	1.00	3.00	7.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Aldrin		<2.0	<2.0 UJ	<2.1	<1.9	<2.0	<1.9
Dieldrin		<4.0	<4.1 UJ	<4.2	<3.7	<3.9	<3.9
Endosulfan sulfate		<4.0	<4.1 UJ	<4.2	<3.7	<3.9	<3.9

020775

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 17
LHAAP GROUP 5 SITES SI
SITE 60, SOIL BORINGS
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SB02	60SB03	60SB03	60SB03	60SB06	60SB06
	SAMPLE ID	LH60SB02(7-9)QC	LH60SB03(1-3)	LH60SB03(3-5)	LH60SB03(7-9)	LH60SB06(1-3)	LH60SB06(3-5)
	DATE	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95
	DEPTH (ft)	7.00	1.00	3.00	7.00	1.00	3.00
	RESULT TYPE	Duplicate	Primary	Primary	Primary	Primary	Primary
Aldrin		<2.0	<1.9	<2.0	<1.9	<2.0	<1.9
Dieldrin		<4.0	11.55	6.3	<3.9	<3.9	<3.9
Endosulfan sulfate		<4.0	<3.7	<4.1	<3.9	<3.9	<3.9

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

UJ - Value is estimated-undetected.

020776

APPENDIX IV - TABLE 17
LHAAP GROUP 5 SITES SI
SITE 60, SOIL BORINGS
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SB06	60SB06	60SB07	60SB07	60SB07	60SB08
	SAMPLE ID	LH60SB06(7-9)	LH60SB06(7-9)QC	LH60SB07(1-3)	LH60SB07(3-5)	LH60SB07(7-9)	LH60SB08(1-3)
	DATE	10/14/95	10/14/95	10/14/95	10/14/95	10/14/95	10/15/95
	DEPTH (ft)	7.00	7.00	1.00	3.00	7.00	1.00
	RESULT TYPE	Primary	Duplicate	Primary	Primary	Primary	Primary
Aldrin		<2.1	<2.0	<2.0	<2.2	<2.2	<2.0
Dieldrin		<4.2	<4.0	<4.0	<4.3	<4.5	<4.0
Endosulfan sulfate		<4.2	<4.0	<4.0	<4.3	<4.5	<4.0

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 17
LHAAP GROUP 5 SITES SI
SITE 60, SOIL BORINGS
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SB08	60SB08	60SB11	60SB11	60SB11	60SB11
	SAMPLE ID	LH60SB08(3-5)	LH60SB08(7-9)	LH60SB11(1-3)	LH60SB11(3-5)	LH60SB11(7-9)	LH60SB11(7-9)
	DATE	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95
	DEPTH (ft)	3.00	7.00	1.00	3.00	7.00	7.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Duplicate
Aldrin		<2.0	<2.1	<2.0 UJ	<2.1	<2.1	<2.1
Dieldrin		<3.9	<4.2	<4.0 UJ	<4.1	<4.2	<4.2
Endosulfan sulfate		<3.9	<4.2	<4.0 UJ	<4.1	<4.2	<4.2

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Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

J - Value is estimated.

UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 17
LHAAP GROUP 5 SITES SI
SITE 60, SOIL BORINGS
DETECTED
PESTICIDES

CONSTITUENT (Units in ug/kg)	SITE	60SB12	60SB12	60SB12	60SB13	60SB13	60SB13
	SAMPLE ID	LH60SB12(1-3)	LH60SB12(3-5)	LH60SB12(7-9)	LH60SB13(1-3)	LH60SB13(3-5)	LH60SB13(7-9)
	DATE	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95	10/15/95
	DEPTH (ft)	1.00	3.00	7.00	1.00	3.00	7.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Aldrin		<2.0	<2.0	<2.1	2.4 J	<2.0	<2.0
Dieldrin		<4.0	<4.0	<4.1	<3.8 UJ	<3.9	<3.9
Endosulfan sulfate		<4.0	<4.0	<4.1	(0.7) J	<3.9	<3.9

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
J - Value is estimated. UJ - Value is estimated-undetected.

APPENDIX IV - TABLE 18
LHAAP GROUP 5 SITES SI
SITE 63, SURFACE SOIL
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SS01	63SS01	63SS02	63SS02	63SS03	63SS04
	SAMPLE ID	LH63SS01(000.0)	LH63SS01(000.0)	LH63SS02(000.0)	LH63SS02(000.0)	LH63SS03(000.0)	LH63SS04(000.0)
	DATE	10/12/95	10/12/95	10/11/95	10/11/95	10/12/95	10/11/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Duplicate	Primary	Duplicate	Primary	Primary
Naphthalene		6	<6	<6	<6	<6	<6
Acetone		<13	<13	<13	<13	<12	31

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

020730

APPENDIX IV - TABLE 18
LHAAP GROUP 5 SITES SI
SITE 63, SURFACE SOIL
DETECTED
VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SS05
	SAMPLE ID	LH63SS05(000.0)
	DATE	10/11/95
	DEPTH (ft)	0.00
	RESULT TYPE	Primary
Naphthalene		<6
Acetone		<11

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 19
LHAAP GROUP 5 SITES SI
SITE 63, SURFACE SOIL
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SS01	63SS01	63SS02	63SS02	63SS03	63SS04
	SAMPLE ID	LH63SS01(000.0)	LH63SS01(000.0)	LH63SS02(000.0)	LH63SS02(000.0)	LH63SS03(000.0)	LH63SS04(000.0)
	DATE	10/12/95	10/12/95	10/11/95	10/11/95	10/12/95	10/11/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Duplicate	Primary	Duplicate	Primary	Primary
Bis(2-ethylhexyl)phthalate		<430	(216)	<420	<420	<400	<400
Di-n-butylphthalate		1694 U	1540 U	435 U	<420	<400	794 U

020782

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 19
LHAAP GROUP 5 SITES SI
SITE 63, SURFACE SOIL
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SS05
	SAMPLE ID	LH63SS05(000.0)
	DATE	10/11/95
	DEPTH (ft)	0.00
	RESULT TYPE	Primary
Bis(2-ethylhexyl)phthalate		<380
Di-n-butylphthalate		<380

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

U - Value is undetected.

APPENDIX IV - TABLE 20
LHAAP GROUP 5 SITES SI
SITE 63, SURFACE SOIL
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	63SS01	63SS01	63SS02	63SS02	63SS03	63SS04
	SAMPLE ID	LH63SS01(000.0)	LH63SS01(000.0)	LH63SS02(000.0)	LH63SS02(000.0)	LH63SS03(000.0)	LH63SS04(000.0)
	DATE	10/12/95	10/12/95	10/11/95	10/11/95	10/12/95	10/11/95
	DEPTH (ft)	0.00	0.00	0.00	0.00	0.00	0.00
	RESULT TYPE	Primary	Duplicate	Primary	Duplicate	Primary	Primary
Aluminum		11800	9890	7350	6220	8370	12100
Arsenic		3.6	2.9	2.8	2.9	3.6	1.9
Barium		124	99.2	108	182	80.5	127
Beryllium		<0.64	<0.63	<0.63	<0.63	<0.6	0.74
Cadmium		<0.64	<0.63	<0.63	<0.63	1	<0.61
Calcium		600	630	290	380	310	290
Chromium		12	11	14.5	14.3	11	14
Cobalt		7.7	6.2	6.4	6.3	6.9	6.8
Copper		3.4	3.7	<2.5	3.3	3	4.1
Iron		9730	9450	8420	11300	7650	12000
Lead		9.64	9.5	9.97	15.2	18	9.44
Magnesium		710	610	460	430	580	680
Manganese		598	506	609	837	334	556
Nickel		5.9	4.6	5.3	5.1	6.2	7.1
Vanadium		22	20.8	22.3	26.8	19.5	28.1
Zinc		19	18	14	12	19	18

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 20
LHAAP GROUP 5 SITES SI
SITE 63, SURFACE SOIL
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	63SS05
	SAMPLE ID	LH63SS05(000.0)
	DATE	10/11/95
	DEPTH (ft)	0.00
	RESULT TYPE	Primary
Aluminum		3740
Arsenic		3.3
Barium		59.7
Beryllium		<0.57
Cadmium		<0.57
Calcium		300
Chromium		13.2
Cobalt		5.9
Copper		<2.28
Iron		6840
Lead		9.0
Magnesium		220
Manganese		271
Nickel		3.9
Vanadium		16.9
Zinc		8.4

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 21
LHAAP GROUP 5 SITES SI
SITE 63, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SB01	63SB01	63SB01	63SB02	63SB02	63SB02
	SAMPLE ID	LH63SB01(5-7)	LH63SB01(10-12)	LH63SB01(15-17)	LH63SB02(5-7)	LH63SB02(10-12)	LH63SB02(15-17)
	DATE	10/12/95	10/12/95	10/12/95	10/11/95	10/11/95	10/11/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Bis(2-ethylhexyl)phthalate		(249)	<380	<390	(334)	<370	566
Di-n-butylphthalate		1449 U	1733 U	1627 U	<380	<370	<380

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 21
LHAAP GROUP 5 SITES SI
SITE 63, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SB03	63SB03	63SB03	63SB04	63SB04	63SB04
	SAMPLE ID	LH63SB03(5-7)	LH63SB03(10-12)	LH63SB03(15-17)	LH63SB04(5-7)	LH63SB04(10-12)	LH63SB04(15-17)
	DATE	10/12/95	10/12/95	10/12/95	10/11/95	10/11/95	10/11/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Bis(2-ethylhexyl)phthalate		<380	<380	(206)	(256)	<370	(256)
Di-n-butylphthalate		<380	1397 U	1059 U	1264 U	624 U	<380

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
( ) = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 21
LHAAP GROUP 5 SITES SI
SITE 63, SOIL BORINGS
DETECTED
SEMI-VOLATILE ORGANIC COMPOUNDS

CONSTITUENT (Units in ug/kg)	SITE	63SB05	63SB05	63SB05
	SAMPLE ID	LH63SB05(5-7)	LH63SB05(10-12)	LH63SB05(15-17)
	DATE	10/11/95	10/11/95	10/11/95
	DEPTH (ft)	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary
Bis(2-ethylhexyl)phthalate		(279)	(233)	890
Di-n-butylphthalate		<370	<370	496 U

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
() = Less than Reporting Limit
U - Value is undetected.

APPENDIX IV - TABLE 22
LHAAP GROUP 5 SITES SI
SITE 63, SOIL BORINGS
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	63SB01	63SB01	63SB01	63SB02	63SB02	63SB02
	SAMPLE ID	LH63SB01(5-7)	LH63SB01(10-12)	LH63SB01(15-17)	LH63SB02(5-7)	LH63SB02(10-12)	LH63SB02(15-17)
	DATE	10/12/95	10/12/95	10/12/95	10/11/95	10/11/95	10/11/95
	DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Aluminum		16600	9090	12700	10300	11300	11500
Arsenic		2.7	2.2	4	2.1	1.9	1.8
Barium		163	228	199	344	151	108
Beryllium		0.9	0.99	1.5	1.5	0.89	1.2
Calcium		850	1100	1520	1310	1370	1660
Chromium		18	13.1	17.2	16.2	14.8	14
Cobalt		10	39.8	9.5	22.2	9.8	7.9
Copper		10	8.8	11	10	6.5	6.4
Iron		17100	15300	22300	14000	11500	16200
Lead		9.1	9.3	11.9	13.2	6.7	5.25
Magnesium		2710	1870	2390	2790	1770	1940
Manganese		78.8	639	234	204	77.6	113
Nickel		20.3	17	20.1	23.5	12.2	16.7
Potassium		1100	680	890	870	890	750
Sodium		340	370	580	600	620	630
Vanadium		29.6	23.3	36	25	21.9	25.1
Zinc		55	44	53	62.9	38	45

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 22
LHAAP GROUP 5 SITES SI
SITE 63, SOIL BORINGS
DETECTED
METALS

CONSTITUENT	(Units in mg/kg)	SITE	63SB03	63SB03	63SB03	63SB04	63SB04	63SB04
		SAMPLE ID	LH63SB03(5-7)	LH63SB03(10-12)	LH63SB03(15-17)	LH63SB04(5-7)	LH63SB04(10-12)	LH63SB04(15-17)
		DATE	10/12/95	10/12/95	10/12/95	10/11/95	10/11/95	10/11/95
		DEPTH (ft)	5.00	10.00	15.00	5.00	10.00	15.00
		RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
Aluminum			15400	13100	10200	12200	8770	10800
Arsenic			1.2	3.7	2.1	2.9	1.5	1.7
Barium			298	198	90.5	153	179	198
Beryllium			1.4	0.8	<0.59	0.85	1.2	1.3
Calcium			1450	1530	1100	790	1100	1670
Chromium			20.7	17.6	12	14.3	12	18.3
Cobalt			28.3	13.7	3.6	9.5	13.5	11.8
Copper			11	9.8	5.5	8.4	9.2	9.7
Iron			15800	14500	15900	14300	17800	21200
Lead			10.2	16	5.3	10.4	4.84	5.74
Magnesium			3250	2450	1490	2290	1820	2420
Manganese			179	225	49.4	70.7	325	216
Nickel			24.6	16.2	14.5	18.1	15.9	24.5
Potassium			1000	1000	690	990	670	830
Sodium			560	650	530	370	500	730
Vanadium			30.4	24.8	27	23.3	26	23.8
Zinc			71.4	50	36	60.1	45	64.2

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

APPENDIX IV - TABLE 22
LHAAP GROUP 5 SITES SI
SITE 63, SOIL BORINGS
DETECTED
METALS

CONSTITUENT (Units in mg/kg)	SITE	63SB05	63SB05	63SB05
	SAMPLE ID	LH63SB05(5-7)	LH63SB05(10-12)	LH63SB05(15-17)
	DATE	10/11/95	10/11/95	10/11/95
	DEPTH (ft)	5.00	10.00	15.00
	RESULT TYPE	Primary	Primary	Primary
Aluminum		14200	10400	5350
Arsenic		3.7	2.3	<0.5
Barium		147	124	65.6
Beryllium		0.84	0.87	<0.53
Calcium		760	900	550
Chromium		16.3	12	9.7
Cobalt		11.2	9.3	3
Copper		9.1	7	3.3
Iron		14900	11400	5390
Lead		10	11	5.12
Magnesium		2410	1640	780
Manganese		46.6	39.2	23.2
Nickel		16.3	14.2	5.9
Potassium		1100	740	<533
Sodium		360	450	300
Vanadium		27.4	20.6	11.5
Zinc		53	37	15

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

020732

June 23, 1997

VIA REGULAR MAIL AND FACSIMILE

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Final Remedial Investigation Report
Group 1 Sites (Sites 1, 11, 27, XX)

Dear Mr. McPherson:

In accordance with the Federal Facility Agreement (FFA) for the Longhorn Army Ammunition Plant, the Environmental Protection Agency (EPA) has reviewed the *Final Remedial Investigation Group 1 Sites Volume II Baseline Risk Assessments (Site 1, 11, 27, and XX)* (U.S. COE, May 1997). Enclosed please find EPA's comments on this report. If you have any questions, please contact me at (214) 665-6758.

Sincerely,

Chris G. Villarreal

Chris G. Villarreal
Project Manager

Enclosure

cc: Warren Sayes, COE Eastern Area Office (CESWF-AD-E)
Yolane Hartsfield, COE Tulsa District (CESWT-PP-ME)
Diane Poteet, TNRCC (MC-143)

020793

EPA's Comments on the Final Remedial Investigation Report Group 1 Sites Volume II Baseline Risk Assessments (Site 1, 11, 27, and XX)

HUMAN HEALTH RISK ASSESSMENT COMMENTS:

1. For the four sites, please provide additional language to evaluate exposure to lead in soil by a hypothetical future industrial worker. A screening level of 2000 ppm lead concentration was found to be an acceptable level for women in child bearing age exposed to site soil. This 2000 ppm soil lead concentration was evaluated using Bower's model (slope model) that correlates intake of lead with blood lead levels in adults. EPA modified Bower's model to reflect protection of the fetus for a worker such that exposure to lead by the mother would result in 95% probability that the fetus blood lead level would not exceed 10 ug/dl. For your information, the following is enclosed:

   - *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (EPA, December 1996)
   - Draft Region 6 Superfund Guidance Adult Lead Cleanup Level
   - *Assessing the Relationship Between Environmental Lead Concentrations and Adult Blood Lead Levels* (Risk Analysis, Vol 14, No. 2, 1994)

2. Section 1.3.4 Human Health Exposure Scenarios, page 1-10:

Text states "One exposure scenario that is not conceivable for LHAAP sites at this time is future residential land use. The facility is owned by the U.S. Government, represents a large capital investment, and is currently assigned a continuing mission. Changes in ownership, residential development, or other land use changes affecting potential exposure scenarios involving future residential land use were not evaluated for LHAAP Group 1 sites."

Comment A March 27, 1997 Department of the Army letter from James A. McPherson (Commander's Representative) to Chris Villarreal (EPA Remedial Project Manager), stated that ". . . the Army now plans to excess the remainder of the LHAAP . . . in parcels based on availability and/or environmental remediation to industrial use standards."

Text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

3. Section 2.3.2 Identification of Exposure Pathways, Table 2-5, page 2-14:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

4. Section 3.3.2 Identification of Exposure Pathways, Table 3-4, page 3-10:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

5. Section 4.3.2 Identification of Exposure Pathways, Table 4-5, page 4-13:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

6. Section 5.3.2 Identification of Exposure Pathways, Table 5-5, page 5-12:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

ECOLOGICAL RISK ASSESSMENT COMMENTS

1. Page 1-20:

   Regarding the selection of receptors, there needs to be description of the ecologically-relevant trophic guilds expected to be exposed and expected to be sensitive to toxicity of the contaminants detected. The receptors evaluated in the assessment should be described as species representing guilds. Also, assessment and measurement endpoints as well as testable hypotheses need to be included. See also the last sentence in the second paragraph on page 2-110, the last sentence on page 3-48, the last sentence of the first paragraph on page 4-71, and the last sentence of the second paragraph on page 5-68.

2. Throughout the text, the words extreme and overly in reference to conservative estimates can be eliminated.

3. Page 1-21:

   Regarding exposure algorithms, estimation of ingestion of contaminants in vegetation and surface water should be considered for inclusion for all of Sites (1, 11, 27, and XX).

4. Page 2-109:

   It is stated that surface water is limited to that conveyed for short periods following rainfall events in drainage ditches bordering the site, and that local creeks and bayous are a considerable distance from the site. Please provide documentation for the contention that site-related contaminants do not migrate from runoff or ditches or groundwater to local creeks and bayous during storm events. This comment applies to sections in the text for the other Sites (11, 27, and XX).

5. Page 2-109:

   Regarding detected chemicals, explanation is needed about the adequacy of the detection limits with respect to conservative ecotoxicity screening values. This comment applies to the other site sections of the document.

6. Pages 2-111-2-112:

   The term safety factors should be replaced with the term extrapolation factors.

7. Page 2-111:

A conversion factor of 10 (not 5) should be used to convert either a LOAEL to a NOAEL or an LC50 to a LOAEL.

8. Pages 4-69, 4-70, and 5-67:

The third paragraph on page 4-69 and the first complete paragraph on page 5-67 need to be eliminated, and the words "as noted" need to be eliminated in the second sentence of the third paragraph on page 4-70.

9. Pages 4-69 and 5-67:

It is stated that surface water and sediment samples were collected for Site 27 due to its proximity to Harrison Bayou and for Site XX due to proximity to Harrison Bayou and Saunder's Branch. Unlike the rest of the document where soil data was collected and ecorisk screening hazard quotients were calculated before comparisons to background were made, for this aquatic data, no ecorisk screening was conducted prior to comparison to background. For this aquatic data for both Sites 27 and XX, an aquatic screening ecorisk assessment needs to be conducted.

10. Appendix B:

Regarding the earthworm BAFs, please confirm whether those selected (if there were multiple BAFs for a chemical) were the more conservative values of the options.

11. Appendix C:

The table of ecotoxicity values shows one value per contaminant. Please provide a table of all ecotoxicity values found per chemical to document that the conservative values were selected.

020797

FACSIMILE TRANSMITTAL

U.S. EPA REGION 6
HAZARDOUS WASTE MANAGEMENT DIVISION
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

TO: David Tolbert - Longhorn Army Ammunition Plant	
MACHINE NUMBER: (903)679-2484	VERIFICATION NUMBER: ( )
FROM: Chris G. Villarreal Project Manager	
PHONE: (214) 665-6758	MAIL CODE: 6SF-AP
OFFICE: Superfund, Texas Section	
DATE: June 23, 1997	PAGES, INCLUDING COVER SHEET: 6
PLEASE NUMBER ALL PAGES	
INFORMATION FOR SENDING FACSIMILE MESSAGES	
OUR EQUIPMENT	FACSIMILE NUMBER
PANAFAX UF-766	(214) 665-6660

COMMENTS:

EPA's Comments on the Group 1 Baseline Risk Assessment. Documents identified in the Human Health Risk Assessment comment will be provided via regular mail.

Copies to: Yolane Hartsfield

020798

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

June 23, 1997

VIA REGULAR MAIL AND FACSIMILE

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Final Remedial Investigation Report
Group 1 Sites (Sites 1, 11, 27, XX)

Dear Mr. McPherson:

In accordance with the Federal Facility Agreement (FFA) for the Longhorn Army Ammunition Plant, the Environmental Protection Agency (EPA) has reviewed the *Final Remedial Investigation Group 1 Sites Volume II Baseline Risk Assessments (Site 1, 11, 27, and XX)* (U.S. COE, May 1997). Enclosed please find EPA's comments on this report. If you have any questions, please contact me at (214) 665-6758.

Sincerely,

Chris G. Villarreal

Chris G. Villarreal
Project Manager

Enclosure

cc: Warren Sayes, COE Eastern Area Office (CESWF-AD-E)
Yolane Hartsfield, COE Tulsa District (CESWT-PP-ME)
Diane Poteet, TNRCC (MC-143)

020799

EPA's Comments on the Final Remedial Investigation Report Group 1 Sites Volume II Baseline Risk Assessments (Site 1, 11, 27, and XX)

HUMAN HEALTH RISK ASSESSMENT COMMENTS:

1. For the four sites, please provide additional language to evaluate exposure to lead in soil by a hypothetical future industrial worker. A screening level of 2000 ppm lead concentration was found to be an acceptable level for women in child bearing age exposed to site soil. This 2000 ppm soil lead concentration was evaluated using Bower's model (slope model) that correlates intake of lead with blood lead levels in adults. EPA modified Bower's model to reflect protection of the fetus for a worker such that exposure to lead by the mother would result in 95% probability that the fetus blood lead level would not exceed 10 ug/dl. For your information, the following is enclosed:

   - *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (EPA, December 1996)
   - Draft Region 6 Superfund Guidance Adult Lead Cleanup Level
   - *Assessing the Relationship Between Environmental Lead Concentrations and Adult Blood Lead Levels* (Risk Analysis, Vol 14, No. 2, 1994)

2. Section 1.3.4 Human Health Exposure Scenarios, page 1-10:

Text states "One exposure scenario that is not conceivable for LHAAP sites at this time is future residential land use. The facility is owned by the U.S. Government, represents a large capital investment, and is currently assigned a continuing mission. Changes in ownership, residential development, or other land use changes affecting potential exposure scenarios involving future residential land use were not evaluated for LHAAP Group 1 sites."

Comment A March 27, 1997 Department of the Army letter from James A. McPherson (Commander's Representative) to Chris Villarreal (EPA Remedial Project Manager), stated that ". . . the Army now plans to excess the remainder of the LHAAP . . . in parcels based on availability and/or environmental remediation to industrial use standards."

Text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

020800

3. Section 2.3.2 Identification of Exposure Pathways, Table 2-5, page 2-14:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

4. Section 3.3.2 Identification of Exposure Pathways, Table 3-4, page 3-10:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

5. Section 4.3.2 Identification of Exposure Pathways, Table 4-5, page 4-13:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

6. Section 5.3.2 Identification of Exposure Pathways, Table 5-5, page 5-12:

Bottom of table, last column
Text states ". . . Property is owned by the U.S. Government with no changes in ownership ever anticipated."

Comment The above text needs to be revised to indicate that the Army now plans to excess LHAAP based on availability and/or environmental remediation to industrial use standards.

020801

ECOLOGICAL RISK ASSESSMENT COMMENTS

1. Page 1-20:

   Regarding the selection of receptors, there needs to be description of the ecologically-relevant trophic guilds expected to be exposed and expected to be sensitive to toxicity of the contaminants detected. The receptors evaluated in the assessment should be described as species representing guilds. Also, assessment and measurement endpoints as well as testable hypotheses need to be included. See also the last sentence in the second paragraph on page 2-110, the last sentence on page 3-48, the last sentence of the first paragraph on page 4-71, and the last sentence of the second paragraph on page 5-68.

2. Throughout the text, the words extreme and overly in reference to conservative estimates can be eliminated.

3. Page 1-21:

   Regarding exposure algorithms, estimation of ingestion of contaminants in vegetation and surface water should be considered for inclusion for all of Sites (1, 11, 27, and XX).

4. Page 2-109:

   It is stated that surface water is limited to that conveyed for short periods following rainfall events in drainage ditches bordering the site, and that local creeks and bayous are a considerable distance from the site. Please provide documentation for the contention that site-related contaminants do not migrate from runoff or ditches or groundwater to local creeks and bayous during storm events. This comment applies to sections in the text for the other Sites (11, 27, and XX).

5. Page 2-109:

   Regarding detected chemicals, explanation is needed about the adequacy of the detection limits with respect to conservative ecotoxicity screening values. This comment applies to the other site sections of the document.

6. Pages 2-111-2-112:

   The term safety factors should be replaced with the term extrapolation factors.

020802

7. Page 2-111:

A conversion factor of 10 (not 5) should be used to convert either a LOAEL to a NOAEL or an LC50 to a LOAEL.

8. Pages 4-69, 4-70, and 5-67:

The third paragraph on page 4-69 and the first complete paragraph on page 5-67 need to be eliminated, and the words "as noted" need to be eliminated in the second sentence of the third paragraph on page 4-70.

9. Pages 4-69 and 5-67:

It is stated that surface water and sediment samples were collected for Site 27 due to its proximity to Harrison Bayou and for Site XX due to proximity to Harrison Bayou and Saunder's Branch. Unlike the rest of the document where soil data was collected and ecorisk screening hazard quotients were calculated before comparisons to background were made, for this aquatic data, no ecorisk screening was conducted prior to comparison to background. For this aquatic data for both Sites 27 and XX, an aquatic screening ecorisk assessment needs to be conducted.

10. Appendix B:

Regarding the earthworm BAFs, please confirm whether those selected (if there were multiple BAFs for a chemical) were the more conservative values of the options.

11. Appendix C:

The table of ecotoxicity values shows one value per contaminant. Please provide a table of all ecotoxicity values found per chemical to document that the conservative values were selected.

020803

FACSIMILE TRANSMITTAL

U.S. EPA REGION 6
HAZARDOUS WASTE MANAGEMENT DIVISION
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

TO: David Tolbert Longhorn Army Ammunition Plant	
MACHINE NUMBER: (903)679-2484	VERIFICATION NUMBER: ( )
FROM: Chris G. Villarreal Project Manager	
PHONE: (214) 665-6758	MAIL CODE: 6SF-AP
OFFICE: Superfund, Texas Section	
DATE: June 24, 1997	PAGES, INCLUDING COVER SHEET: 5
PLEASE NUMBER ALL PAGES	
INFORMATION FOR SENDING FACSIMILE MESSAGES	
OUR EQUIPMENT	FACSIMILE NUMBER
PANAFAX UF-766	(214) 665-6660

COMMENTS:

EPA's comments on the draft Group 1 Proposed Plan.

If you have any questions or need additional information, please call.

Copies to:

020804

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

June 24, 1997

VIA REGULAR MAIL AND FACSIMILE

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Draft Proposed Plan of Action for the
Group 1 Sites (Sites 1, 11, 27, XX)

Dear Mr. McPherson:

In accordance with the Federal Facility Agreement (FFA) for the Longhorn Army Ammunition Plant, the Environmental Protection Agency (EPA) has reviewed the draft *Proposed Plan of Action for Group 1 Sites* (U.S. COE, May 1997). Enclosed please find EPA's comments on this plan. If you have any questions, please contact me at (214) 665-6758.

Sincerely,

Chris G Villarreal

Chris G. Villarreal
Project Manager

Enclosure

cc: Warren Sayes, COE Eastern Area Office (CESWF-AD-E)
Yolane Hartsfield, COE Tulsa District (CESWT-PP-ME)
Diane Poteet, TNRCC (MC-143)

020805

EPA's Comments on the Longhorn Army Ammunition Plant Draft Proposed Plan Of Action for the Group 1 Sites (Sites 1, 11, 27, XX)

1. **Page 1**

General Comment

Need to include footnote that indicates that "**bolded text**" is defined in the glossary at the end of the proposed plan.

2. **Page 2, third full paragraph:**

Text states

"(i.e. Remedial Investigation/Feasibility Study Report for Group 1 Sites and the Baseline Human Health Risk Analysis)."

Comment

Modify text as follows:

"(i.e. Remedial Investigation/Feasibility Study Report for Group 1 Sites and the Baseline Human Health and Ecological Risk Analysis)."

3. **Page 2, EPA's Administrative Record Repository Location:**

The location of EPA's Administrative Record repository has changed from the 12th floor library to the following location:

U.S. EPA Region 6
7th Floor Reception Area
1445 Ross Avenue
Dallas, Texas 75202-2733
toll free 1-800-533-3508
Mon. - Fri. 8 a.m. to 4 p.m.

4. **Page 3, first paragraph:**

Text states

"The ROD discusses the following: site history, site characteristics, site investigations, human health and environmental risks, and alternatives for any remediation necessary."

Comment

Will the ROD discuss **alternatives for any remediation necessary** or just the No Further Action

alternative? If the ROD will only discuss the No Further Action Alternative, you may want to modify the above text as follows:

"The ROD discusses the following: site history, site characteristics, site investigations, human health and environmental risks, and the nine criteria evaluation of remedial alternatives."

5. **Page 3, first paragraph:**

Text states
"The ROD will present the U.S. Army's decision regarding future remedial action at the Group 1 Sites and will explain the rationale for the selected site decision **(based on public comment)**."

Comment
Remove "**(based on public comment)**" from the above text. You may want to reference that the selected decision is based upon the nine criteria evaluation (See Evaluation of No Action Proposal) and that this evaluation includes community acceptance.

6. **Page 3, Site Location:**

Text states
"Access is limited to personnel at LHAAP."

Comment
What about the Caddo Lake Institute, recreational hunters, etc.?

7. **Page 3, Site 11, Suspected TNT Burial Site**

Text states
"Based on information gathered by **USATHAMA**, during the 1940s, bulk TNT may have been disposed of near the intersection of avenues P and Q."

Comment
USATHAMA is not defined in the glossary.

Revised text as follows:
"Based on information gathered by **USATHAMA**, bulk TNT may have been disposed of near the intersection of avenues P and Q during the 1940s."

8. **Page 4, Site XX, Ground Signal Test Area**

Text states
"Prior to the recent rocket motor burn-outs at the site for the INF Treaty, . . . "

020807

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

July 2, 1997

Mr. David Tolbert, Project Manager
Longhorn Army Ammunition Plant
Attn: SMCLO-EN
Marshall, Texas 75671-1059

Re: Memorandum of Agreement for Natural Resource Issues at Longhorn Army Ammunition Plant

Dear Mr. Tolbert:

On behalf of the State and Federal Trustees, I am writing in the role of Lead Administrative Trustee representative for Natural Resource Trustee involvement at the Longhorn Army Ammunition Plant (LHAAP) site. Included with this letter is a proposed Memorandum of Agreement (MOA) for natural resource issues at the LHAAP site. The Trustees collectively agree that this MOA provides the most appropriate framework for a cooperative assessment/restoration process between the Trustees and the Department of Defense.

The Trustees would like an opportunity to discuss this MOA with the Department of Defense at your earliest convenience, preferably in early August. Please contact me at (512) 239-2152 (mail code MC142) to arrange a meeting to begin discussion on this document.

On behalf of the Trustees,

for GKL

Ginny King, Project Manager
Natural Resource Trustee Program
Emergency Response and Assessment Section
Texas Natural Resource Conservation Commission

GK/ok

Enclosure

cc: Scott M. Farley, Office of Counsel, U.S. Department of Army
Colleen A. Rathburn, Office of Counsel, U.S. Army Environmental Center
Don Pitts, TPWD
Diane Hyatt, TGLO
Steve Spencer, DOI

DRAFT
6/13/ 97 version

MEMORANDUM OF AGREEMENT FOR THE NATURAL RESOURCE ISSUES AT THE LONGHORN ARMY AMMUNITION PLANT

I. INTRODUCTION

The parties to this Memorandum of Agreement (MOA) are the Texas Parks and Wildlife Department (TPWD), Texas General Land Office (GLO), Texas Natural Resource Conservation Commission (TNRCC), the Department of Interior (DOI), and the Department of Defense (DOD). The DOI will not participate in the execution of any legal instrument associated with settlement of a natural resource damage claim.

II. DEFINITIONS

For purposes of the MOA:

1) the term "Trustees" means collectively TPWD, GLO, TNRCC and DOI.

2) the term " Potentially Responsible Party" or "PRP" means DOD and the Thiokol Corporation.

III. INTRODUCTION

The Longhorn Army Ammunition Plant (LHAAP) is a government-owned, contractor-operated (GOCO) industrial facility under the jurisdiction of the U.S. Army Armament, Munitions and Chemical Command (AMCOMM). The facility was established in 1942 to produce 2,4,6 trinitrotoluene (TNT). Production of TNT stopped in August 1945 with the ending of World War II. In more recent past, its primary mission was to load, assemble and packout pyrotechnic, illuminating and signal ammunition, and solid propellant rocket motors. The Longhorn Division of Thiokol Corporation is the operating contractor. The installation has also been responsible for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate Nuclear Force (INF) Treaty in effect between the United States and the former U.S.S.R.

LHAAP was place on the National Priorities List (NPL) on August 9, 1990. After being listed on the NPL, LHAAP, the U.S. Environmental Protection Agency (EPA) and the Texas Water Commission (TWC- now TNRCC) entered into a CERCLA Section 120 Agreement for remedial activities at LHAAP. The 120 Agreement, referred to as the Federal Facilities Agreement (FFA), became effective on December 30, 1991. The FFA specified that remedial activities would be conducted at 13 areas on LHAAP following CERCLA guidelines. The CERCLA remedial activities for LHAAP have been divided into 18 "tasks".

IV. PURPOSE AND GENERAL APPROACH

The National Contingency Plan (NCP), 40 CFR, section 300.615 (d) (2) provides Trustees and potentially responsible parties (PRP) the opportunity to reach negotiated settlement agreements in order to obtain PRP-financed or PRP-conducted assessments. This MOA is the negotiated agreement to conduct such an assessment. The assessment is intended to be a cooperative natural resource injury assessment, designed to restore natural resources injured by hazardous releases in an expedited and cost efficient fashion. This MOA provides the structure under which the Parties will cooperatively conduct a natural resource injury assessment, determine appropriate remedial actions to address site releases and, if necessary, undertake steps to restore, rehabilitate, replace and/or acquire the equivalent of natural resources injured or natural resource services lost as a result of those releases concurrently with the implementation of remedial actions. In the event that the restoration cannot be accomplished during remediation under CERCLA/RCRA activities, the Parties will cooperatively design restoration that will serve to compensate the public for injury of natural resources and lost use of natural resource services. More specifically, this MOA provides the framework by which the Parties will cooperatively perform the following:

* Identify potential natural resource injuries;
* Evaluate existing data to determine suitability for use in injury determination and injury quantification for the natural resource injuries;
* Identify additional data needs;
* Develop plans for obtaining necessary additional information;
* Plan for and implement an ecological risk assessment to determine target cleanup levels protective of natural resources for hazardous substance releases at or from the Site;
* Develop appropriate remedial actions for hazardous substances that are at concentrations that are determined to pose risk to, or have caused injuries to natural resources or that have resulted in lost services from injured natural resources;
* Develop appropriate restoration alternatives that will return natural resources and their services to baseline levels that existed prior to site releases, and incorporate restoration into Remedial actions whenever feasible; and
* Develop a settlement agreement which shall include the restoration plan.

The Parties agree that the principles of this cooperative natural resource injury assessment process are as outlined below:

* The cooperative natural resource injury assessment process is a phased approach, with each phase being sequential or running concurrently as agreed to by the parties. The phases are: 1) Injury Assessment (including the identification of additional data needs and proposals for additional required data); 2) Restoration Planning (including the location and scope of any natural resource restoration, replacement, and/or acquisition of equivalent natural resources undertaken, and settlement agreements) and 3) Restoration.

* During the cooperative natural resource injury assessment process, the Parties will concentrate on the restoration of lost services (service losses include the loss of ecological services as well as human services). However, any direct loss of natural resources due to

injury as a result of the release, or remediation at the site, will also be incorporated in the injury assessment phase.

* The Parties will attempt to determine the appropriate type and extent of restoration during the injury assessment phase. The goal of the cooperative restoration-based injury assessment process is to incorporate the injury assessment with the remedial phase. To the extent practicable, this injury assessment phase will be integrated with the risk assessment and RCRA Corrective Action process, and the restoration planning phase will parallel any remedial actions required under either RCRA and/or CERCLA, including the concurrent collection of data and analysis with RCRA corrective action. The ecological endpoints will be considered in the analysis of the ecological services that have been adversely affected by the releases. The eco-risk characterization will be used in considering the quantification of service losses.

* When injuries to natural resources or their services are quantified, the Parties will develop a written restoration plan.
* The Parties intend to reach settlement once the restoration plan is finalized, including any additional monitoring required to determine the success of the restoration.

The detailed plans for this joint assessment will be described in an Attachment to be developed and incorporated into this MOA.

V. TRUSTEE AUTHORITY

The Trustees enter into this MOA in accordance with the legal authorities provided to each Trustee by CERCLA; the National Contingency Plan (NCP) 40 CFR Part 300; the Natural Resource Damage Assessment Regulations, 43 CFR Part 11; and any other applicable laws or authorities.

VI. INJURY ASSESSMENT AND RESTORATION PROCESS

The Parties have determined that it is appropriate to develop a process for assessing potential natural resource injuries resulting from DOD operations at the LHAAP and for planning restoration of any injured resources/service losses. The process should follow other cooperative restoration-based approaches in that the process will consist of phased approaches: 1) Preliminary Natural Resource Survey (which has already been performed but not finalized), 2) Injury Assessment, 3) Restoration Planning, 4) Restoration. The work that will comprise each phase will be subject to the terms and conditions of this MOA. This work will be described in separate attachments to this MOA, each representing a separate phase. Each attachment will also identify work plans for that phase, which will be negotiated and agreed upon separately. Procedurally, each attachment and corresponding assessment/restoration plan(s), once agreed to in writing by the Trustees and the DOD will be deemed an amendment to this MOA. The Parties agree that the process for the natural resource injury assessment and restoration described in this agreement, including any incorporated attachments shall be comprised of and shall represent appropriate and reliable scientific methodologies for determining appropriate restoration measures. Each

attachment will be subject to the terms and conditions of this MOA. Disputes regarding the conduct and implementation of the process shall be governed by Paragraph XII.

VII. PUBLIC PARTICIPATION

In accordance with applicable law, the Trustees will provide public notice and solicit public review and comment during certain phases of the Assessment process.

VIII. IMPLEMENTATION OF THE PROCESS

The Parties agree that the technical representatives of any Party may be present at any and all locations where work is being performed and is part of the resource assessment and restoration process as described in Paragraph IV and in any Attachments incorporated herein. The Parties will fully and freely share all data developed for the purposes of the studies as well as study design and procedures, including quality assurance/quality control procedures. The parties' representatives shall have access to and use of all such data collected during the period of this MOA.

IX. DISBURSEMENT OF FUNDS

DOD agrees to fund the reasonable costs associated with the Trustees' participation in the activities outlined in Section II. Funding to enable the Trustees to participate in the natural resource assessment and restoration process shall be provided in accordance with the law providing for funding of assessments costs of Trustees through the most appropriate mechanism DOD selects to coincide with their budget system. However, with the addition of each attachment describing the phase of the Assessment and containing a budget for implementation, the DOD covenants to pay the Trustees in immediately available funds within thirty (30) working days of the submission of the budget described in such attachment. The budget will include reasonable administrative costs for the coordination, technical design and technical review of work plans, as well as the execution of such work plans. The funds shall be deposited into an appropriate, interest-bearing account which the Trustees shall designate for the Trustees' use solely to fund the study plans described in attachments hereto. Funds may not be transferred between studies without the written consent of all Parties. Budgets are subject to amendment by the parties if they are found inadequate to accomplish the tasks described in the attachments. The Trustees will provide a full accounting of the expenditure of funds for each study. Funds and any accrued interest remaining at the conclusion of any study will be returned to the PRP. Nothing in the MOA shall be construed as permitting double recovery of funds provided by the PRP under this MOA in any future litigation arising from the hazardous releases from the Site.

X. THE PARTIES' INDEPENDENT FINDINGS AND RIGHTS

The Parties will employ good faith efforts to reach agreement on the interpretation of the data resulting from the implementation of any process described in Paragraph IV and any Attachments

hereto. Unless otherwise agreed to in this MOA or in an Attachment stipulation incorporated into this MOA, the Parties expressly reserve and maintain the right to join or not join, in a timely manner, in the interpretation of the data resulting from any study or, alternatively, to produce separate and independent findings and conclusions.

Unless otherwise agreed to in this MOA or an Attachment or stipulation incorporated into this MOA, the Parties expressly reserve the right to perform independent studies for potential use in the Assessment. The decision of any Party(ies) to undertake such independent studies shall be subject to the dispute resolution requirements of Paragraph XII. Whichever Party(ies) decides to undertake such independent studies must send the written Notice of Dispute required by Paragraphs XII. If the work involves time critical elements, the work may proceed pending dispute resolution. If any independent studies proceed pursuant to this paragraph absent agreement of all the Parties, either because time critical elements are involved or because of the failure of dispute resolution, the notice requirements of Paragraph XII apply.

Notwithstanding any other provision of this MOA, the Parties agree that studies performed under this paragraph will not be used in the Assessment process or any judicial or administrative proceeding related to the Assessment without prior agreement of all Parties. This provision shall survive termination of this MOA. Except as noted herein or unless otherwise agreed upon by all Parties, these studies will not be used to challenge any studies performed or plans implemented as part of the cooperative assessment process governed by this MOA and any attachments or amendments to this MOA.

XI. RESERVATION OF RIGHTS AND CLAIMS

Except as specifically provided in this MOA or in any Attachments or stipulations incorporated into this MOA, the Parties agree that none of them is making any admission of fact or law by entering into this MOA. This MOA shall not be admissible as evidence or proof of liability or nonliability. Except as provided in this MOA or any Attachments or stipulations incorporated into this MOA, this MOA shall not be admissible as to the validity or nonvalidity of any claim or defense in any proceeding relating to this matter. Except as provided in this MOA or any Attachments or stipulations entered into pursuant to this MOA, nothing in this MOA is intended or shall be construed as a waiver by any of the Parties of any defenses or affirmative claims in any proceeding relating to DOD's operations at the LHAAP or of any rights or remedies.

Nothing in this agreement is intended, nor shall it be construed as a waiver of any attorney-client privilege, work product privilege, or any other privilege that may be asserted in this or any other matter unless explicitly stated herein. Factual data collected pursuant to this MOA shall not be considered work product or attorney-client privilege.

Except as otherwise provided in this MOA in any attachments or stipulations incorporated into this MOA, DOD is not released from any liability, including but not limited to claims for damage, injury, loss or destruction of natural resources of their services, claims for restoration, rehabilitation, replacement or acquisition of the equivalent of natural resources or lost services of

those resources, or any other causes of action or request for relief, either administratively or judicially, under either state or federal law, as well as any claims, causes of action, or requests for relief in admiralty, arising from the releases described above.

XII. SETTLEMENT NEGOTIATIONS

Upon completion of the cooperative natural resource injury assessment process, the Parties will employ good faith efforts to resolve any outstanding issues necessary for a final resolution of all natural resource issues associated with DOD's operations at the Site.

These issues may include but are not limited to: (1) the location and scope of any natural resource restoration, replacement, and/or acquisition of equivalent natural resources to be undertaken and assessment costs to be paid by DOD; (2) the amount of any natural resource damages and assessment costs to be paid to the Trustees by DOD; and (3) the contents and details of the final settlement agreement. The Parties agree that the final settlement will include a release of natural resource damage liability or covenant not to sue pursuant to all applicable federal and Texas laws, as well as provisions that ensure the successful implementation of the selected restoration project.

XIII. GENERAL

This MOA is no way affects or relieves the Parties of their responsibility to comply with any applicable federal, state or local law, regulation, or permit.

XIV. DISPUTE-RESOLUTION MECHANISM

The Parties agree to attempt to resolve any disputes concerning the implementation of this agreement through good faith informal negotiations between the DOD and other State and Federal Trustee representatives. Any disputes arising from the conduct or implementation of study plans shall be addressed first by the technical committee responsible for their formulation. The period for informal negotiations shall not exceed 30 days from the time the dispute arises unless otherwise agreed in writing among all Parties involved. A dispute shall be considered to have arisen when one Party sends the other Parties a written Notice of Dispute. The notice shall describe the dispute with enough specificity to allow the other Parties to identify the issues involved and to respond effectively. If the dispute cannot be resolved, the Parties agree to seek mediation following 31 TAC 20.43 as guidance.

XV. MODIFICATION AND TERMINATION

Any modification of this MOA or its attachment(s) must be in writing and executed by all of the Parties. Any Party may terminate its participation in this MOA at any time by giving 30 days written notice to all Parties. Notice of intent to terminate participation in the MOA must clearly state the reasons for such termination and must be signed by the authorized official of the terminating Party(ies). Termination by a single Trustee shall not void the agreement as to the

remaining Parties. The decision of any Party(ies) to conduct independent studies pursuant to Paragraphs IV and VII shall not, in and of itself be deemed to constitute termination of participation in the MOA. Not withstanding any provisions in this MOA to the contrary, all stipulations shall survive the termination of this MOA for any reason.

XVI. EFFECTIVE DATE

This MOA may be executed in one or more counterparts, all of which shall be considered an original. The Effective Date of any Attachment hereafter developed and incorporated into this MOA shall be the date set forth in such Attachment. This MOA shall become effective as of the last date of its execution by the authorized representatives of the Parties.

XVII. NATURAL RESOURCE TRUSTEE CONTACT PERSONNEL

This MOA establishes that TNRCC will serve as the Lead Administrative Trustee (LAT) for this matter. Duties of the LAT include, but are not limited to the following: scheduling of meetings between the Parties; acting as the central point of contact for the Parties; maintaining records and documents relating to the injury assessment; and preparing, issuing or arranging for public notices or reports as determined necessary by the Trustee or by the Parties.

Each Trustee agency hereby respectively designates the following person(s) as its representative contact regarding this incident:

1. For TPWD: Mr. Don Pitts
   Texas Parks and Wildlife Department
   4200 Smith School Road
   Austin, Texas 78744
   Phone:(512)389-4640
   Fax (512)389-4394

2. For TGLO: Ms. Diane B. Hyatt
   Texas General Land Office
   Natural Resource Damage Assessment
   1700 N. Congress Ave. Rm. 629
   Austin, TX 78701-1495
   Phone: (512)475-1395
   Fax: (512)463-5367

3. For TNRCC: Ms. Ginny L. King
   Texas Natural Resource Conservation Commission

020315

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

July 7, 1997

CERTIFIED MAIL
P 746 032 989
RETURN RECEIPT REQUESTED

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Group 1 - Proposed Plan of Action

Dear Mr. McPherson:

The Texas Natural Resource Conservation Commission (TNRCC) staff has completed its review of the above reference document, which was received on June 2, 1997. Our comments are enclosed. If you have any further questions regarding this matter, please call me at (512) 239-2502.

Sincerely,

Diane R. Poteet

Diane R. Poteet
Project Manager (MC-143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

Enclosure

cc: Chris Villarreal, EPA Region 6 (6SF-AP)
Yolane Hartsfeld, COE Tulsa District (CESWT-PP-EA)
Warren Sayes, COE Eastern Area Office (CESWF-AD-E)

Longhorn Army Ammunition Plant, Group 1 Sites (1, 11, 27 and XX), Proposed Plan of Action
TNRCC COMMENTS

No.	Subject	Comment
1	General - page numbers	Please number pages (at least for commenting purposes).
2	Figure 1: LHAAP, Group 1 Sites (page 1)	This figure is illegible. Needs to be bigger. It is recommended that it be put on its own separate page.
3	PROPOSED PLAN ANNOUNCED (page 1)	First sentence: Insert "United States" before "Department of the Army".
4	General - Subsection titles for sites	First, there exists a lot of inconsistency in the naming of the sites. Under SITE HISTORY, each site is listed by its number/letter and its name. Under SITE CHARACTERISTICS, each site is listed only by number/letter. Under INVESTIGATION RESULTS, each site is being described by both its number/letter and name again. In the CURRENT AND FUTURE HEALTH RISKS section, the titles switch back to number/letter only again. Second, there is a lot of inconsistency on what part (all or only the site number/letter) of the title gets underlined. Finally, the word "site" is sometimes "SITE" and sometimes it is "Site". Please be consistent.
5	General - Bolded Glossary Terms	There is no explanation that the bolded terms are defined in a glossary at the end of the plan.
6	Use of "Remedial Investigation/Feasibility Study" and "Baseline Human Health Risk Analysis" (page 2)	Fourth and fifth paragraphs: First, "Feasibility Study" should be dropped when referring to the Group 1 Remedial Investigation Report because no Feasibility Study was performed. Second, to make it easier for the public to find the documents in the Administrative Record, it is recommended that when referring to the report or sections in it, the actual title on the report be used: "Group 1 Remedial Investigation Report, Volume 1", and "Baseline Risk Assessments, Volume II".

TNRCC Comments (continued):

No.	Subject	Comment
7	SITE HISTORY AND BACKGROUND (page 3)	It is recommended that the title of this section be changed to "SITE LOCATION AND BACKGROUND", since that is how the subsections are labeled.
8	SITE LOCATION (page 3)	Following the underlining scheme, the title of this subsection should probably be underlined. It is recommended that all titles be written down in an outline form so as to make sure there is consistency (see comment #4 above).
9	SITE HISTORY (page 3)	Second paragraph: We recommend placing an introductory statement regarding the four sites at the end of this paragraph. Something like: "An overview of the past uses of each site will now be presented."
10	Site 11, Suspected TNT Burial Site (page 3)	First paragraph: Since "TNT" is not being used in the name of a site here, it probably should be spelled out; or it should be spelled out the first time it is used (see first page).
11	Site XX, Ground Signal Test Area (page 4)	First paragraph, second sentence: Please spell out "INF" the first time the term is used.
12	Site 27, South Test Area (page 4)	Second paragraph: The word "demilitarized" does not explain much. For a better explanation to the public, it is recommended that a different word (or words) be used.
13	Site 27, South Test Area (page 4)	Second paragraph, last sentence: Vegetation has encroached on many areas at the other sites, too. The relevance of this statement is not seen, and to be consistent, it is recommended that the sentence be removed or something be added about the vegetation at other sites.
14	REMEDIAL INVESTIGATION (page 5)	Second paragraph, first sentence: Remedial Investigation was defined as "RI" in the previous paragraph, and it is recommended that "RI" be used. There are a few other places in the plan where the text switches back and forth between "remedial investigation" and "RI". The only time "RI" should be spelled out after it has been defined, is when it is at the beginning of a sentence. Please be consistent.

TNRCC Comments (continued) :

No.	Subject	Comment
15	SITE CHARACTERISTICS - Site 1 and Site 27 (pages 5-6)	The drainage of Sites 11 and XX are described. To be consistent, please describe the drainage of Sites 1 and 27, too.
16	SITE CHARACTERISTICS - Site 11 (page 5)	First paragraph: When Central Creek is mentioned, there is no connection made with it and Caddo Lake as was made with Saunders Branch and Harrison Bayou. Please be consistent.
17	INVESTIGATION RESULTS (page 6)	In regards to the title of this section, it is recommended that the word "REMEDIAL" be placed in front of "INVESTIGATION".
18	INVESTIGATION RESULTS - all sites (pages 6-8)	It is recommended that "groundwater grab samples" not be mentioned because the data results of these samples were not used to determine risk. If the Army chooses to leave it in, it needs to be further explained because it is not clear what the Army means by using groundwater grab samples as "screening tools".
19	INVESTIGATION RESULTS - all sites (pages 6-8)	There is a lot of inconsistency in the use of "Phase 1 (or 2)" versus "Phase one (or two)" versus "Phase 1 (or 2) RI" and "RI". Also, sometimes numbers for samples and borings revert back and forth from just the number to the spelling of the number. A good example is on page 8, first paragraph under "Surface Water and Sediment Investigation": "**Seven** sediment samples and 7 surface water samples were collected during .....". As a rule, numbers below 10 are written out and those above 10 are not, unless the number is at the beginning of the sentence. We recommend checking a good reference and being consistent with what you choose to use.

TNRCC Comments (continued):

No.	Subject	Comment
20	INVESTIGATION RESULTS - Results for Metals (pages 6-8)	First, there is a lot of inconsistency on how the results are reported. Sometimes the metals are listed and sometimes it is stated that "Several metals were also detected...". Sometimes it is stated that "No high metals concentrations were detected..." or "...metals and anions were low". Second, the phrase "All metals and anions are naturally occurring" is used as an interpretation, whereas, the organics are not interpreted at all. Our recommendation is to specifically list the concentration results and leave out the interpretation. In addition, because specific metals are listed in the risk assessment section, these same metals need to be introduced in the investigation section. Again, we recommend leaving out all interpretation, except for lab and field contamination. The lab and field contamination needs to be addressed because the contaminant would not have been carried through the risk assessment (which is also a good place to explain the lab and field contamination problems).
21	SUMMARY OF SITE RISK (pages 8)	Please add "Human" before the word "Health" and an "S" on the end of "RISK" in the title of the subsection "CURRENT AND FUTURE HEALTH RISK".
22	Chemicals of Potential Concern (COPC) (pages 9-10)	Please be consistent (in text and titles) with the use of "Chemicals of Potential Concern (COPC)" versus "Chemicals of Concern (COC)". If there was no risk found with any of the chemicals, should there be any COC's? Also, if it is to be abbreviated after it is defined, then please be consistent in its use.
23	Ecological Risk Assessment (pages 9-10)	It is recommended that the Ecological Risk Assessment be treated as a separate subsection under "SUMMARY OF SITE RISK", instead of being a subpart of the Current and Future Human Health Risks.
24	FEASIBILITY STUDY (FS) (Page 10)	"FS" is used in the first sentence and "Feasibility Study" is used in the last. Please be consistent. It is also more proper (usage favors the pronunciation of the abbreviation itself rather than its spelled out form) to say "An FS..." then "A FS..".

TNRCC Comments (continued):

No.	Subject	Comment
25	EVALUATION OF NO ACTION PROPOSAL *and* CONCLUSIONS AND RECOMMENDATIONS (page 11)	First, the title of these sections are partially underlined. Second, the spacing of "CONCLUSIONS AND RECOMMENDATIONS" is not right. The spacing of some of the text on this page is also not correct. The "full" justification may be need be turned off for this page if *WordPerfect* is being used.
26	Extra period. (page 12)	Paragraph at top of page: Last sentence has an extra period.

020822

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

July 14, 1997

CERTIFIED MAIL
P 746 032 988
RETURN RECEIPT REQUESTED

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

Re: Longhorn Army Ammunition Plant
Group 5 - Final Site Characterization Report

Dear Mr. McPherson:

The Texas Natural Resource Conservation Commission (TNRCC) staff has completed its review of the above reference document, which was received on June 2, 1997. Our comments are enclosed. If you have any further questions regarding this matter, please call me at (512) 239-2502.

Sincerely,

Diane R. Poteet

Diane R. Poteet
Project Manager (MC-143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

Enclosure

cc: Chris Villarreal, EPA Region 6 (6SF-AP)
Yolane Hartsfeld, COE Tulsa District (CESWT-PP-EA)
Warren Sayes, COE Eastern Area Office (CESWF-AD-E)

Longhorn Army Ammunition Plant, Group 1 Sites (1, 11, 27 and XX), Proposed Plan of Action
TNRCC COMMENTS

No.	Subject	Comment
1	General	If the Army wants to use soil background data for comparisons to site sediment data, the physical and chemical properties of the soil and sediment should be described to justify making such a comparison. Typically, sediment background data should be used for sediment site data.
2	Sections 3.3.3 and 3.3.4 (pages 3-3 and 3-4)	Both of these sections contain a typo: "parameter of the concert ring" should probably be "perimeter of the concrete ring". Please check for typos.
3	Section 6.4.1 (page 6-3)	For this section and any other section that states that naphthalene and acetone are laboratory contaminants: Please provide the data that backs up the assertion that these compounds were undetected in the samples based on blank contamination.
4	Figure 2-2	This figure is hard to read and needs to be replaced.

FAX TRANSMITTAL

TNRCC

Protecting Texas by Reducing and Preventing Pollution

DATE: 7/14/97

NUMBER OF PAGES: 3

TO: David Tolbert, Project Manager
Longhorn Army Ammunition Plant
903/679-2814 and 318/459-5112

FROM: TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Diane Poteet
Pollution Cleanup Division/Superfund Investigation Section
512/239-2502
512/239-2449

NOTES:

Please see the attached letter regarding the Group 5 Site Characterization Report.

cc: Chris Villarreal, U.S. EPA
Yolane Hartsfeld, U.S. Corps of Engineers

SUPERFUND INVESTIGATION SECTION

Longhorn Army Ammunition Plant, Group 1 Sites (1, 11, 27 and XX), Proposed Plan of Action
TNRCC COMMENTS

No.	Subject	Comment
1	General	If the Army wants to use soil background data for comparisons to site sediment data, the physical and chemical properties of the soil and sediment should be described to justify making such a comparison. Typically, sediment background data should be used for sediment site data.
2	Sections 3.3.3 and 3.3.4 (pages 3-3 and 3-4)	Both of these sections contain a typo: "parameter of the concert ring" should probably be "perimeter of the concrete ring". Please check for typos.
3	Section 6.4.1 (page 6-3)	For this section and any other section that states that naphthalene and acetone are laboratory contaminants: Please provide the data that backs up the assertion that these compounds were undetected in the samples based on blank contamination.
4	Figure 2-2	This figure is hard to read and needs to be replaced.

Monthly Managers' Meeting
Longhorn Army Ammunition Plant
16 July 1997
Tulsa District Corps of Engineers
Tulsa, Oklahoma

1. The participants were:

Ira Nathan, LHAAP
David Tolbert, LHAAP
Cyril Onewokae, IOC
Wilma Subra, Uncertain Aud.
Jeff Armstrong, AEC
Cliff Murray, Tulsa District
Oscar Linebaugh, EAO
Chris Villarreal, EPA
H. L. "Bud" Jones, TNRCC
Dave Bockelmann, Sverdrup
Vic Heister, Tulsa District
Diane Poteet, TNRCC (teleconference)
Yolane Hartsfield, Tulsa District

2. Ira Nathan opened the meeting and thanked all the participants for attending.

3. The minutes of the previous meeting were reviewed and accepted.

4. Mr. Tolbert stated that the MOU/MOA with the Texas Trustees had been received and forwarded up the Army chain of command.

5. Mr. Villarreal stated that he would be writing a memorandum with respect to the Group 5 sites concurring with the no further action proposal presented by the Army for Sites 52 and 63.
Mr. Armstrong had some queries of Mr. Villarreal about other projects and this process. Mr. Villarreal gave direction on where in the regulations to find appropriate cites to document Mr. Armstrong's concerns.

6. The LTTD's continue to operate at a rate of about 22 tph. No further UXO debris has been encountered since the initial find in the one small, isolated area in BG No. 3, which was safely and completely removed for proper disposal.

7. Analytical results from the excavated trench soil materials is due to begin arriving this week.

8. The Team was briefed by Mr. Tolbert about the management of the slurry water from the trenching operations at BG No. 3. The sub-contractor used potable water to

mix his slurry for trench wall integrity during ICT installation activities. The GWTP began treating the spent water with intent for subcontractor reuse. The recycled water caused the bio-polymers to "break" in one day rather than the required 3 days. The treated slurry water, with regulator approval, has been being used for dust control at the Burning Ground, plant roads, and Landfills 12 and 16. The subcontractor is again using potable water for slurry mixes. Trenches are scheduled for completion next week.

9. At Landfill 12, OHM is receiving the geosynthetic liner system materials this week and anticipates beginning deployment next week.

10. At Site 16, Mr. Bockelmann reported that all the monitoring wells, extraction wells, and piezometers are installed in locations as described in the Work Plan documents. Current work includes sampling of the monitoring wells (expected completion was today, 16 July). Also, work to install pipage between the extraction wells was to be completed 16 July. Sverdrup will begin sampling of extraction wells next week after installation of well pumps.

11. Mr. Bockelmann reported that Radian loaned Sverdrup a chemist and field gas chromatograph to assist in monitoring well and extraction well placement. There was some general discussion about encountered lithology during well(s) installation.

12. Treatment of water from Site 16 was interrupted by decision and following action to treat slurry water from BG No. 3. Will resume when all slurry water has been treated and released from the GWTP for dust control management.

13. Mr. Murray briefed the Team on the May sampling at Harrison Bayou and Goose Prairie Creek. Reported that no water was observed flowing from the seep at LF16. The bayou was mostly dry. No reportable concentrations of chemical constituents were found in Harrison Bayou. Goose Prairie Creek samples had detections of trace estimated concentrations of various compounds (volatile organics and high explosives compounds) at every sampling point (see map in file). Since one sampling point on Goose Prairie Creek was at the boundary of the facility, discussion ensued about sampling outside the facility. TNRCC will take lead and coordinate any such activity with the Army.

14. Ms. Hartsfield briefed the team on projects' status using the Executive Summary.

15. The draft Proposed Plan and Fact Sheet for the Group 1 sites was reviewed and comments incorporated into the Final Proposed Plan and Fact Sheet to be mailed on Monday 21 July.

16. Mr. Bockelmann briefed the Team about Site 16's "final" treatment solutions. He wanted the team to consider using bioremediation technologies to remediate the soil and groundwater. With the extraction well system in place, control of the groundwater will be accomplished. Maximizing indigenous bacteria by supplying nutrients thus enhancing their metabolism of volatile organic compounds in situ. He was tasked to

prepare a proposal and cost estimate for a full-scale pilot study to present to the group in 60 days.

17. Mr. Tolbert informed the team that $325,000 will be returned from cost savings accued during the sump removal activities. This action will be expedited at Mr. Onewokae's request.

17. The next meeting is scheduled to be held 07 August 1997 at 0930 at LHAAP. There being no further business, the meeting was adjourned.

Yolane Hartsfield
Project Manager

020829

Monthly Managers' Meeting
Longhorn Army Ammunition Plant
16 July 1997
Tulsa District Corps of Engineers
Tulsa, Oklahoma

1. The participants were:

James McPherson, LHAAP, (teleconference)
Ira Nathan, LHAAP
David Tolbert, LHAAP
Cyril Onewokae, IOC
Jeff Armstrong, AEC
Cliff Murray, Tulsa District
Dave Bockelmann, Sverdrup
Yolane Hartsfield, Tulsa District

2. Ira Nathan opened the meeting.

3. Mr. Tolbert stated that the meeting had been called to develop the Army's position and plan for addressing environmental concerns at Goose Prairie Creek.

4. Mr. Murray and Mr. Bockelmann briefed the Team on the historical data collected from Goose Prairie Creek. Mr. Tolbert briefed about Plant activities and an accidental release of explosive compounds into Goose Prairie Creed in the 1960's. There was general discussion about sampling results, location of known plumes, and possible source materials/points.

5. Mr. McPherson stated that he wanted the Team to be proactive on this issue and not reactive (as was the case with Harrison Bayou).

6. After much general discussion among the team members, clarifying points at issue, it was decided that the initial plan of action will include:
(a) a hard review of Group 4 data to evaluate potential source points for chemical constituent release into Goose Prairie Creek;
(b) during next sampling round (scheduled for 11 August), using information gathered from review of historical data, locate and collect additional samples from suspected areas which will provide information to determine the presence or confirm the absence of chemical constituents (this will help identify potential/probable source points). One site tentatively selected is the sewage treatment plant area; and,
© develop a plan to identify or reject sources and begin process to initiate a remedial investigation of Goose Prairie Creek in FY98.

There being no further business, the meeting was adjourned.

Yolane Hartsfield

DEPARTMENT OF THE ARMY
LONGHORN/LOUISIANA ARMY AMMUNITION PLANTS
MARSHALL, TEXAS 75671-1059

REPLY TO
ATTENTION OF

July 21, 1997

020830

Dear Resident:

You are invited to a Public Meeting on August 7, 1997 at 7:00 PM in the Karnack High School cafeteria. The purpose of this meeting is to inform you of our proposed plan and to solicit your comments on the No Further Action at the Group 1 Sites at Longhorn Army Ammunition Plant.

Enclosed you will find a "fact sheet" and Proposed Plan that will provide you with further information about the proposed action for this site.

If you have any questions about this meeting, please contact Mr. David Tolbert at 318-459-5109.

James A. McPherson
Commander's Representative

Enclosure

PROPOSED PLAN OF ACTION

FOR

Group 1 Sites
Longhorn Army Ammunition Plant,
Karnack, Texas
July 1997

THE PURPOSE OF THIS PROPOSED PLAN IS TO:

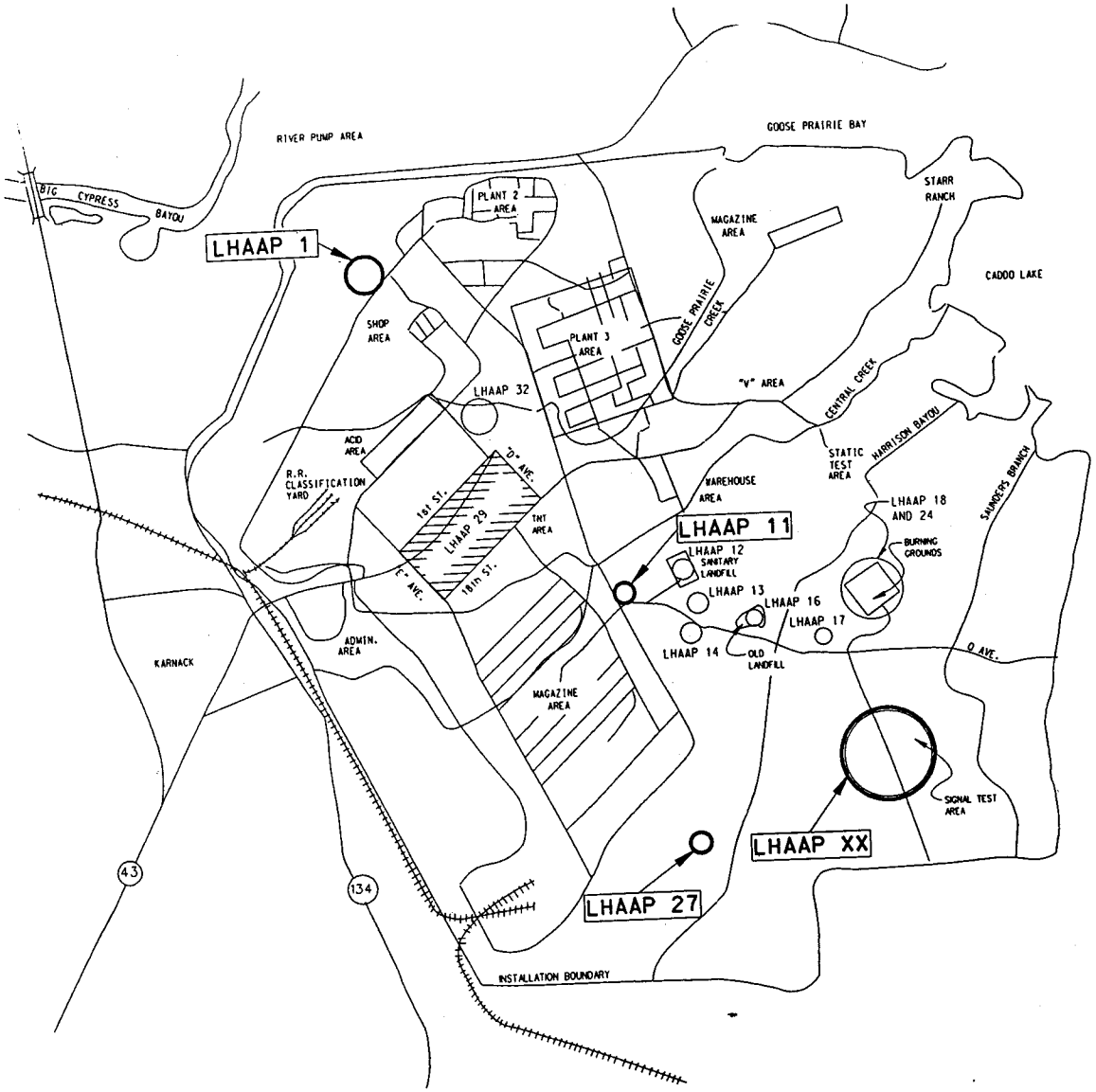
- ✓ Provide history and background about the site;
- ✓ Present summary results of the Department of Army's **Remedial Investigation (RI)**;
- ✓ Recommend that no further remedial action is necessary at the Group 1 Sites;
- ✓ Identify the Department of Army's rationale for recommending no further action;
- ✓ Solicit public review and comment on all the alternatives and information contained in the **Administrative Record**; and
- ✓ Provide information on how the public can be involved in the remedy selection process.

PROPOSED PLAN ANNOUNCED

In this **Proposed Plan*** the United States Department of the Army (U.S. Army) describes its proposal for no further remedial action for Group 1 Sites on Longhorn Army Ammunition Plant (LHAAP). The Longhorn Army Ammunition Plant is on the **National Priorities List (NPL)**. The LHAAP installation is located adjacent to the communities of Karnack, Uncertain, and the western shore of Caddo Lake in Harrison County in the northeast section of Texas. The four sites addressed in this proposed plan, collectively referred to as Group 1, are located in various areas of LHAAP. Site 11, suspected TNT Burial Site, and Site 27, South Test Area, are situated in the south central portion of LHAAP. Site 1, Inert Burning Grounds, is situated in the extreme northwestern portion of LHAAP. Site XX, Ground Signal Test Area, is located in the southeastern portion of LHAAP. This Proposed Plan focuses on these four sites only. The plan includes summaries of investigations conducted at LHAAP and the rationale for recommending no further action. The U.S. Army issues this document as the lead agency for site activities at LHAAP, with the assistance of the Environmental Protection Agency (EPA) and Texas Natural Resource Conservation Commission (TNRCC), which are the regulatory agencies for NPL activities at LHAAP.

The U.S. Army, in consultation with EPA and TNRCC, will finalize the decision that no further remedial action is required at the Group 1 sites only after public comment period has ended and the information submitted during this time is reviewed and considered during the decision-making process.

***Bolded text** defined in glossary.



SITES IN THIS INVESTIGATION

LHAAP 11
LHAAP 1
LHAAP XX
LHAAP 27

3000 0 3000 6000

SCALE IN FEET

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

$ THINK VALUE ENGINEERING - IT SAVES MONEY $	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP SITE LOCATION MAP
CHECKED BY:	
SUBMITTED BY:	FIGURE 1
CHIEF, GEOTECH BR.	

lh310.dgn

020832

The U.S. Army is issuing the Proposed Plan as part of the public participation requirements under the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA), as amended by the **Superfund Amendments and Reauthorization Act** (SARA), also known as the Superfund law [Section 117(a)].

The Proposed Plan summarizes information from the *Remedial Investigation Report for Group 1 Sites and the Baseline Human Health and Ecological Risk Analysis* that can be found in the Administrative Record for LHAAP. Through a **Federal Facility Agreement**, EPA and TNRCC provide technical assistance and review of the activities at LHAAP. The U.S. Army encourages the public to review the information in the Administrative Record in order to gain a better understanding of the sites. The U.S. Army also encourages the public to participate in the decision-making process for the sites by offering comments on the proposed recommendation of no further action and on information contained in the Administrative Record. The Administrative Record is available at the following information repository locations (See shaded block).

Karnack High School
Karnack, TX 75661
(903) 679-3114
Mon. - Thurs. 7 a.m. to 5:30 p.m.

U.S. EPA, Region 6
7th Floor Reception Area
1445 Ross Avenue
Dallas, TX 75202-2733
Toll free 1-800-533-3508
Mon. - Fri. 8 a.m. to 4 p.m.

TNRCC
Library, Building A, Room 102
12100 Park 35 Circle
Austin, TX 78711-3087
(512) 239-0020
Mon. - Fri. 8 a.m. to 5 p.m.

Marshall Public Library
300 S. Alamo
Marshall, TX 75670
(903) 935-4465
Mon. - Fri. 8 a.m. to 4 p.m.

COMMUNITY PARTICIPATION

The public is invited to comment on the Remedial Investigation (RI) Report and the Proposed Plan which are included in the Administrative Record. The public comment period begins July 21, 1997 and ends August 20, 1997. During the public comment period, written comments may be submitted to:

David Tolbert
Environmental Protection Specialist
Longhorn/Louisiana AAP
Doyline, LA 71023

Additionally, comments (oral and written) will be accepted at a public meeting scheduled for August 7, 1997 beginning at 7:00 p.m. at the Karnack High School, Karnack, Texas. All comments received during the public comment period will be included in a document called a **Responsiveness Summary**. The Responsiveness Summary will be attached to the **Record of Decision** (ROD) and will be made available to the public in the information repositories. The ROD will discuss the following: site history, site characteristics, site investigations, human health and environmental risks, and the nine criteria evaluation of remedial alternatives. The ROD will present the U.S. Army's decision regarding future remedial action at the Group 1 Sites and will explain the rationale for the selected site decision. The U.S. Army's recommendation for no further action could change, depending upon new information or discussions resulting from public comments received. Any aspects of the proposed action that are significantly different from the Proposed Plan will be identified and explained in the ROD.

LHAAP GENERAL DISCUSSION

SITE LOCATION

LHAAP is located adjacent to the communities of Karnack (to the west), Uncertain (to the north), and the western shore of Caddo Lake in Harrison County in the northeast section of Texas (Figure 1). LHAAP is 14 miles northeast of Marshall, Texas, and 40 miles west of Shreveport, Louisiana. Sites 11 and 27 are located in the south-central portion of LHAAP. Site 1 is located in the extreme north-western portion of the installation. Site XX is located in the south-eastern portion of LHAAP. Lands surrounding the sites are generally undeveloped and wooded.

An important resource in the area surrounding LHAAP is Caddo Lake. The lake is along the northeast corner of LHAAP and is divided by the Texas-Louisiana State line. This is the largest natural lake in the South. Caddo Lake serves as a site for a variety of recreational activities and is also a public water supply for several communities in Louisiana and is a backup water supply for Shreveport, Louisiana.

SITE HISTORY

LHAAP was established in October 1942, and until fall 1996, the 8,493 acre facility was a government-owned, contractor-operated (Longhorn Division of Thiokol Corporation) facility under the jurisdiction of the U.S. Army. The installation is currently inactive but overseen by the U.S. Army Industrial Operations Command (IOC).

As part of the U.S. Army Installation Restoration Program, LHAAP began an environmental investigation in 1976. Numerous investigations have been conducted at the Group 1 sites during the 1980s and early 1990s by various contractors. The work is funded under the Defense Environmental Restoration Program. The LHAAP installation was added to the National Priorities List on August 30, 1990 (54 Federal Register (FR) 35509). An overview of the past uses of each site is discussed below.

REMEDIAL INVESTIGATION

In December 1991, the U.S. Army, EPA, and TNRCC entered into a **Federal Facility Agreement** to cover the investigation, development, selection and implementation of remedial action undertaken pursuant to

CERCLA, and to address corrective action for sites covered under the LHAAP RCRA permit, Permit No. HQ-50195, February 1992. An RI is ongoing at many sites on LHAAP. The RI for the Group 1 Sites was completed in May 1997.

The goals of an RI are to fully characterize the site and develop sufficient information to make a remedial alternative selection (if needed) that eliminates, reduces, or controls risks to human health and the environment. These goals have been achieved at sites 11, 1, 27 and XX and are reported in the *Longhorn Army Ammunition Plant, Final Remedial Investigation Report, Group 1 Sites*, May 1997, available in the Administrative Record.

CURRENT AND FUTURE HUMAN HEALTH RISKS

An evaluation of potential risks to human health and the environment from any site contaminants was conducted as part of a **risk analysis**. The Risk Analysis for Group 1 Sites is presented as part of the RI and is available in the Administrative Record. A summary of the findings follows.

A human health risk assessment is a procedure which uses a combination of facts and assumptions to estimate the potential for adverse effects on human health from exposure to contaminants found at a particular site. Risks are determined by evaluating known chemical exposure limits and actual chemical concentrations at the site. The actual concentrations are compared to the exposure to a concentration known to have an adverse impact. Carcinogenic risks are expressed in terms of the chance of developing cancer after a lifetime of exposure to the contaminants. Non-carcinogenic risks are based on exposures to concentrations of contaminants greater than concentrations known to have an adverse lifetime non-cancerous impact. Conservative assumptions are used in calculating risks that weigh in favor of protecting human health.

The national risk, or probability, that an individual may develop some form of cancer from everyday sources, over a 70-year life span, is estimated at one-in-four. This one-in-four probability is considered the "natural incidence" of cancer in the United States. To protect human health, the EPA has set the range from one in ten thousand to one in one million (expressed as $1x10^{-4}$ to $1x10^{-6}$) lifetime excess cancer incidents as the remedial goal for Superfund sites. A risk of one in one million means that one person out of one million people could develop cancer as a result of a lifetime exposure to the site contaminants.

The level of concern for non-carcinogenic contaminants is determined by calculating a **hazard index.** If the hazard index exceeds one (1), there may be concern for potential non-cancer effects for lifetime exposure to the site contaminants.

The site-specific risk assessment process begins by evaluating the current site risk, also called the **baseline risk**, posed to human health.

ECOLOGICAL RISK ASSESSMENT

Sections 121(b)(1) and (d) of CERCLA require that decisions regarding disposition of hazardous waste sites include consideration of issues related to both human health and the natural environment (including non-human receptors). Accordingly, ecological risk assessments were prepared for each LHAAP Group 1 site.

Ecological resources at LHAAP and surrounding areas include an abundance and wide variety of terrestrial and aquatic

organisms. Baseline ecological assessments for LHAAP Group 1 sites were conducted as conservative "screening level" assessments as described in Chapters 1 and 2 of current ecological risk assessment guidance (USEPA 1994). Using this approach, site data are used in preliminary, conservative exposure estimates and risk calculations which are heavily-biased in the direction of overestimating risk. This approach is used to ensure that sites that might pose an ecological risk are studied further and not eliminated from consideration with resulting underestimation of ecological risk. It is important to emphasize that the objective of this type of assessment is NOT to derive a "reasonable" indication of exposure and ecological risk. Rather, the sole intent of this approach is to identify, using highly conservative methodology, sites requiring further, more detailed ecological evaluation. Accordingly, results of this type of assessment should not be interpreted as representing true ecological site risks. The only two conclusions to be drawn from a screening level assessment are: (1) there is adequate information to determine that little or no risk of adverse ecological effects exist at a site; or (2) information is not adequate to make an ecological-based decision and further, more detailed evaluation is necessary.

SITE 11, SUSPECTED TNT BURIAL SITE

LOCATION AND HISTORY

Based on information gathered by **USATHAMA (now Army Environment Center),** bulk trinitrotoluene (TNT) may have been disposed of near the intersection of avenues P and Q during the 1940s. Other than the designation of this location by USATHAMA in the early 1980s as the Suspected TNT Burial Site, there is *no confirmed documentation* that TNT burial occurred at this site.

SITE CHARACTERISTICS

The 10-acre site has been inactive since its suspected use in the 1940s (USACE, 1992). The site consists of a relatively flat area of cut grass immediately north of the intersection, bounded by Avenue P on the west, Avenue Q on the south, and the tree line on the north and east. A large forested area extending to Central Creek is present north of the site. Surface drainage from the area flows to ditches along the eastern and western edges of the site, eventually draining to Central Creek. Total surface water flow distance from the site to Caddo Lake via Central Creek is approximately three miles. A small depression, about 100 feet wide, exists on the north side of the site.

Soils encountered at the site consist primarily of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. **Groundwater** is encountered at depths of 4 to 12 feet below ground surface.

REMEDIAL INVESTIGATION RESULTS

Groundwater Investigation

Six groundwater grab samples and three groundwater **monitoring well** samples from newly installed wells were taken at the site during the RI. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. No organic, explosive, or metal contaminants were found in the grab samples except for 0.62 **ug/l** of **1,3,5 trinitrobenzene**. Although the explosive constituent was detected in the grab samples, the explosive contamination was not confirmed

in the monitoring well samples. The following metals were detected in the groundwater monitoring wells (the maximum concentrations found are in parentheses): barium (0.139 **mg/l**), chromium (.049 mg/l), lead (.016 mg/l), and nickel (.051 mg/l). All detected metals concentrations are approximately at or below background levels.

Soil Investigation

The soil investigations at Site 11 included 33 soil samples from nine borings. The following compounds were detected in the soil (the concentrations found are shown in parentheses): **methylene chloride** (14-32 **ug/kg**), **acetone** (23-80 ug/kg), and **di-n-butyl phthalate** (440-755 ug/kg). Acetone was detected in field blanks indicating field contamination. Di-n-butyl phthalate was found in the laboratory method blank and is a common laboratory contaminant along with methylene chloride. The following metals were detected in the soil (the range of concentrations found are in parentheses): arsenic (0.3 -9.7 **mg/kg**), barium (1.5 - 167 mg/kg), chromium (1.1 - 18.5 mg/kg), lead (1.6 - 16 mg/kg), nickel (1.5 - 15.1 mg/kg) . All metals detected were at concentrations approximately at or below background levels.

Surface Water and Sediment Investigation

Two surface water and two sediment samples were collected during the RI. The following metals were detected in the surface water (the maximum concentrations found are in parentheses): barium (0.18 mg/l), and lead (0.011 mg/l). The metals detected are approximately at or below background levels.

The following metals and anions were detected in the sediments: arsenic (3.9 mg/kg), barium (41.7 mg/kg), lead (13 mg/kg), nickel (3.1 mg/kg), chloride (44 mg/kg) and sulfate (30 mg/kg). No organic or explosive type contaminants were detected. All metals and anions detected were at concentrations at or below background levels.

HUMAN HEALTH RISK ASSESSMENT

Chemicals of Potential Concern (COPC)

An initial step in selection of COPCs is comparison of site data with background concentrations. Most metals detected in all media at the site were below background levels. However, due to detection of low levels of methylene chloride and single detection of two metals exceeding background ranges in site soils, risk evaluations were performed for the site. All detected chemicals were retained as COPC for evaluation of total cumulative risk. The chemicals considered in this evaluation include: methylene chloride, arsenic, barium, chromium, lead, mercury, nickel, selenium, and thallium.

Risk Analysis

Based on an analysis of site data and criteria for performing a risk analysis, it was concluded that the conditions at the site do not pose an unacceptable risk to human health.

ECOLOGICAL RISK ASSESSMENT

Based on ecological methodology used in the risk assessment, three metals (chromium, lead, and nickel) were identified as main contributors to screening-level risk estimates. Further evaluation of data for Site 11 revealed that these metals exist at concentrations approximating background levels for the facility. As such, it is the conclusion of this screening-level assessment that no ecological concerns are associated with Site 11 consituents and that further ecological evaluations and remediation are unwarranted.

SITE 1, INERT BURNING GROUNDS

SITE LOCATION AND HISTORY

The Inert Burning Grounds were originally used during World War II by Monsanto Chemical Company for burning trash, ashes, scrap lumber, and waste from burned 2,4,6-TNT. Bulk 2,4,6-TNT may also have been burned at the site. The site was not used between August 1945 and February 1952 when LHAAP was in a standby status. Universal Match Corporation later used the site to burn wastes, including photo flash powder, for a few years during the 1950s until most burning operations were transferred to the Burning Ground No. 2/Flashing Area (Site 17) located on the installation. Intermittent, small-scale burning operations may have continued at the site into the early 1960s. It is suspected that burning operations were conducted in one or more burn pits or pans that were subsequently filled or covered. Burn residues were most likely not removed. It is also suspected that some wastes may have been dumped without burning and were subsequently covered by or mixed with fill material.

SITE CHARACTERISTICS

Site 1 is about 1 ½ acres in size and is lightly timbered. Current vegetation patterns serve as only a rough indication of past disposal areas due to considerable regrowth of trees during the 25 or more years that have elapsed since the site was used for waste disposal. The area of investigation comprises about 10 acres. Surface drainage flows in a southeasterly direction to Goose Prairie Creek. Total surface drainage distance from the site to Caddo Lake is approximately four miles via Goose Prairie Creek.

Soils encountered at Site 1 consist of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. Groundwater is encountered at approximately 10 feet below ground surface.

REMEDIAL INVESTIGATION RESULTS

Groundwater Investigation

Twelve groundwater grab samples and seven groundwater monitoring well samples (from newly installed wells) were obtained from Site 1 during the RI. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. No explosive or metal contaminants were found in the grab samples. The only explosive to appear in the monitoring well samples was **2,6-dinitrotoluene (2,6 DNT)** which was detected at 14 ug/l. Acetone (12 and 19 ug/l) and **2-butanone** (11 and 18 ug/l) were also detected. The following metals and anions were detected in the groundwater monitoring wells which were approximately at or below background levels (the maximum concentrations found are in parentheses): barium (0.19 mg/l), chromium (0.056 mg/l), lead (0.041 mg/l), chlorides (13.3 mg/l), nitrate/nitrite (3.5 mg/l), sulfate (3490 mg/l).

Soil Investigations

The soil investigations at Site 1 included 115 soil samples from 17 borings. The following compounds were detected in the soil (the concentrations found are shown in parentheses): **toluene** (6.7 ug/kg), **xylene**

(30.6 ug/kg), **styrene** (6 ug/kg), acetone (10-32 ug/kg), methylene chloride (7-20 ug/kg), di-n-butyl phthalate (330-3580 ug/kg), and **bis(2-ethylhexyl) phthalate** (330-1200 ug/kg). The phthalates detected were attributed to low level contamination in the laboratory during analyses. Methylene chloride is also a common laboratory contaminant. The following metals were detected in the soils (the concentrations found are shown in parentheses): arsenic (0.057-6 mg/kg), barium (17.3-18.8 mg/kg), chromium (1.7-32.1 mg/kg), lead (4-75 mg/kg), nickel (1.5-44.4 mg/kg). All metals detected are approximately at or below background levels.

Surface Water and Sediment Investigation

During the RI, 10 surface water and 13 sediment samples were collected. The only organic compound detected in the surface water at Site 1 was toluene (6.3 ug/l). The following metals and anions were detected in the surface water (the concentrations found are in parentheses): barium (0.052-0.47 mg/l), lead (0.005-0.045 mg/l), chlorides (3.8-17 mg/l), sulfates (2-69.5 mg/l). All metals and anions detected are approximately at or below background levels.

The following compounds were detected in the sediments (the concentrations found are in parentheses): acetone (57-94 ug/kg), 2-butanone (13 ug/kg), **benzoic acid** (2300-2700 ug/kg) and methylene chloride (13 ug/kg). No explosives were found in any sample. The following metals and anions were detected in the sediments (the concentrations found are in parentheses): arsenic (0.76-5.1 mg/kg), barium (13.4-88.4 mg/kg), chromium (4.4-21 mg/kg), lead (3.6-13 mg/kg), nickel (1.2-6.3 mg/kg), chlorides (44-1060 mg/kg), sulfates (30 - 74.6 mg/kg). All metals detected are approximately at or below background levels

HUMAN HEALTH RISK ASSESSMENT

Chemicals of Potential Concern

COPCs in site soils and ditch sediments included several organic compounds, a variety of polynuclear aromatic hydrocarbons, and metals. COPCs in groundwater included organics and metals. With the exception of a few chemicals eliminated from evaluation due to detection in blank samples or not detected in verification sampling, all detected chemicals were carried through risk quantification procedures.

Risk Analysis

Based on an analysis of site data and criteria for performing a risk analysis, it was concluded that the conditions at the site do not pose an unacceptable risk to human health.

ECOLOGICAL ASSESSMENT

Based on ecological methodology used in the risk assessment, four metals (antimony, chromium, lead, and nickel) were identified as main contributors to screening-level risk estimates. Further evaluation of data for Site 1 revealed that these metals exist at concentrations approximating background levels for the facility. As such, it is the conclusion of this screening-level assessment that little or no ecological concerns are associated with Site 1 and that further ecological evaluations and remediation are unwarranted.

SITE XX, GROUND SIGNAL TEST AREA

SITE LOCATION AND HISTORY

The Ground Signal Test Area has been used intermittently since April 1963 for aerial and on-ground testing and destruction of a variety of devices, including red phosphorus smoke

wedges, infrared flares, illuminating 60 and 81 mm mortar shells, illuminating 40 to 155 mm cartridges, button bombs, and various types of explosive simulators. Prior to the recent rocket motor burn-outs at the site for the **INF Treaty**, the site was used intermittently over a 20-year period for testing and burn-out of rocket motors from Nike-Hercules, Pershing, and Sargent missiles. About 1970, one of the Sargent rocket motors was inadvertently destroyed when it exploded in an excavated pit near the center of the site just west of the road crossing the site. Debris from the explosion was reportedly placed in the resulting crater and the crater was backfilled. Since late in 1988, the site has also been used for the burn-out of rocket motors in Pershing missiles destroyed in accordance with the INF Treaty between the United States and the former Soviet Union.

SITE CHARACTERISTICS

The Ground Signal Test Area is in the southeastern portion of LHAAP. Access to the site is provided by an asphalt paved road that intersects Long Point Road just east of its intersection with Avenue Q. The access road proceeds in a general south-southeasterly direction for about 0.4 mile to the center of the site and continues for another 0.7 mile to the southern LHAAP boundary. Approximately 70 percent of the site is located within the watershed of Saunders Branch. The remaining 30 percent lies within the watershed of Harrison Bayou. Both of these streams flow into Caddo Lake. The total surface water flow distance from the site to Caddo Lake via Saunders Branch and its tributaries is about 2.0 miles and via Harrison Bayou and its tributaries is about 2.3 miles.

Surface water runoff from the Saunders Branch watershed portion of the site is collected by drainage ditches along the circular dirt road forming the outer margin of the site. These ditches converge to form a northeast-trending drainage way that carries the runoff to Saunders Branch. Surface water runoff from the remainder of the site is collected by drainage ditches alongside the circular road or by the drainage ways extending into the southwestern part of the site. The drainage ditches and drainage ways converge to form a drainage way that conveys the runoff onto the floodplain of Harrison Bayou. The site encompasses an area of approximately 80 acres.

Soils encountered at Site XX consist of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. Groundwater is encountered at 10 to 15 feet below ground surface.

REMEDIAL INVESTIGATION RESULTS

Groundwater Investigation

Seven groundwater grab samples and two groundwater monitoring well samples were obtained from Site XX during the RI. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. No organics or explosives were detected in any groundwater samples (grab samples or monitoring wells). The following metals and anions were detected in the groundwater monitoring wells (the maximum concentrations found are in parentheses): barium (.11 mg/l), nickel (0.157 mg/l), sulfates (1622 mg/l), chlorides (1000 mg/l). All metals and anions detected are approximately at or below background levels.

Soil Investigations

The RI soil investigations at Site XX included 115 soil samples from 17 borings. The following compounds were detected in the soil (the concentrations found are shown in parentheses): acetone (10,300 ug/kg), **trichloroethylene** (42 ug/kg), and methylene chloride (18 ug/kg). Methylene chloride and acetone are common laboratory contaminants. The following metals were detected in the soil (the range of concentrations found are in parentheses): arsenic (1 -328 mg/kg), barium (20.2 - 227.8 mg/kg), chromium (4.9 - 28.9 mg/kg), lead (4-27.6 mg/kg). All metals are approximately at or below background levels.

Surface Water and Sediment Investigation

Seven sediment samples and seven surface water samples were collected during the RI. No volatiles, semivolatiles, or explosives were detected in any of the samples, with the exception of phthalates in four of the sediment samples. Phthalates are a common laboratory contaminant. The following metals and anions were detected in the surface water (the concentrations found are in parentheses): barium (0.06-0.13 mg/l), chlorides (2.6 - 31.0 mg/l), nitrate/nitrites (0.09 - 0.3 mg/l), sulfates (2.0- 32 mg/l).

The following metals and anions were detected in the sediments (the concentrations found are in parentheses): arsenic (0.9-3.5 mg/kg), barium (23.3 - 126 mg/kg), chromium (3.5-9.8 mg/kg), lead (4-9 mg/kg), nickel (3.1-14.7 mg/kg). All metals and anions detected are approximately at or below background levels.

HUMAN HEALTH RISK ASSESSMENT

Chemicals of Potential Concern

COPCs in site soils and ditch sediments included several metals at levels approximating background concentrations. COPCs in groundwater included several metals within background ranges and below drinking water maximum contaminant levels (MCLs). Due to failure to detect organic compounds through phase 2 verification soil-gas sampling, acetone and methylene chloride were eliminated as COPCs.

Risk Analysis

Based on an analysis of site data and criteria for performing a risk analysis, it was concluded that the conditions at the site do not pose an unacceptable risk to human health.

ECOLOGICAL RISK ASSESSMENT

Based on ecological methodology used in the risk assessment, two metals (chromium and nickel) were identified as main contributors to screening-level risk estimates. Further evaluation of data for Site XX revealed that these metals exist at concentrations approximating background levels for the facility. As such, it is the conclusion of this screening-level assessment that little or no ecological concerns are associated with Site XX and that further ecological evaluations and remediation are unwarranted.

SITE 27, SOUTH TEST AREA

SITE HISTORY

The South Test Area was constructed in 1954 and was used by Universal Match Corporation for testing photoflash bombs that were produced at LHAAP until about 1956. The bombs were tested by exploding them in the air over an elevated, semi-elliptical earthen test pad within the floodplain of Harrison Bayou. Testing was observed and controlled from a building on a hilltop 1,000

feet west-northwest of the test pad. Bombs awaiting testing were stored in three earth-covered concrete bunkers a few hundred feet west of the observation building.

During the late 1950s, illuminating (signal) devices were disabled within pits excavated in the vicinity of the test pad. During the early 1960s, leaking production items (possibly 3- to 4-pound canisters of white phosphorus) were disabled in the vicinity of the test pad. In the early 1980s, approximately 52,000 ½- and 1-pound photoflash cartridges were destroyed in a 500-square foot area situated about 300 feet east of the observation building and immediately north of the road extending from the observation building to the test pad. The South Test Area has apparently not been used since the early 1980s.

SITE CHARACTERISTICS

The South Test Area is in the south central portion of LHAAP. The earthen test pad is approximately 2,000 feet southeast of Avenue P and the magazine area. The entrance to the test area is on Avenue P approximately 1,700 feet northeast of its intersection with Avenue E. A deteriorated asphalt and gravel road runs from the entrance to the test pad. The concrete bunkers and observation building previously described are located alongside the road approximately halfway between the entrance and the test pad. A circular, 50-foot wide fire lane with a 2,000-foot diameter is centered at the test pad. The fire lane was constructed in 1954 and was apparently maintained until the early 1960s. It is now partially overgrown with brush and small trees. Site 27 lies within the Harrison Bayou Flood Plain. Total surface water flow distance from the site to Caddo Lake via Harrison Bayou is approximately three miles.

The site boundary is based on a study of historical aerial photographs, current vegetation patterns, and field observations. The site covers an area of approximately 6.6 acres.

Soils encountered at Site 27 consist of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. Groundwater is encountered at 7 to 9 feet below ground surface.

REMEDIAL INVESTIGATION RESULTS

Groundwater Investigation

Ten groundwater grab samples and four groundwater monitoring well samples (from newly installed wells) were obtained from Site 27 during the RI. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. No explosives were found in the groundwater grab samples. The following metals and anions were detected in the groundwater monitoring wells (the maximum concentrations found are in parentheses): barium (0.097 mg/l), chromium (.053 mg/l), nickel (.37 mg/l), chloride (3700 mg/l), and nitrate (1.17 mg/l). No explosive, semivolatile or volatile organics were detected in any of the monitoring well samples. All metals and anions detected are approximately at or below background levels.

Soil Investigations

The RI soil investigations at Site 27 included 47 soil samples from 14 borings. The following metals were detected in the soil (the range of concentrations found are in parentheses): arsenic (0.4-5.2 mg/kg), barium (9.8-639 mg/kg), chromium (1.6-22.2 mg/kg), lead (2-26.3 mg/kg), nickel (1-18.6 mg/kg).

All metals detected are approximately at or below background levels. No explosives or volatile organic compounds were detected in any of the soil samples.

Surface Water and Sediment Investigation

Four sediment and four surface water samples were collected during the RI. The only organic compound found in the sediments was di-n-butylphthalate found in two of the samples. The following metals and anions were detected in the sediments (the concentrations found are in parentheses): arsenic (0.7-1.1 mg/kg), barium (39-254 mg/kg), chromium (1.9-5.2 mg/kg), lead (4-9 mg/kg), nickel (2.8-6 mg/kg), nitrate/nitrite (2.17-2.36 mg/kg), sulfate (30-50 mg/kg). All metals detected are approximately at or below background levels

No volatiles, semivolatiles, or explosives were found in the surface water. The following metals and anions were detected in the surface water (the concentrations found are in parentheses): barium (0.11-0.29 mg/l), lead (0.015 mg/l), chlorides (15.1-48.7 mg/l), nitrate/nitrite (0.2-0.33 mg/l), sulfate (30-50 mg/l). All metals detected are approximately at or below background levels.

HUMAN HEALTH RISK ASSESSMENT.

Chemicals of Potential Concern

COPC in site soils and ditch sediments included several metals at levels approximating background concentrations. Detected COPCs in groundwater included metals within background ranges and below drinking water MCLs with the exception of nickel. All detected chemicals, including nickel, were not eliminated from evaluation, and all were carried through risk quantification procedures.

Risk Analysis

Based on an analysis of site data and criteria for performing a risk analysis, it was concluded that the conditions at the site do not pose an unacceptable risk to human health.

ECOLOGICAL RISK ASSESSMENT

Based on ecological methodology used in the risk assessment, four metals (barium, chromium, lead, and nickel) were identified as main contributors to screening-level risk estimates in surface and subsurface soils. Further evaluation of data for Site 27 revealed that these metals exist at concentrations approximating background levels for the facility. As such, it is the conclusion of this screening-level assessment that little or no ecological concerns are associated with Site 27 and that further ecological evaluations and remediation are unwarranted.

FEASIBILITY STUDY (FS)

An FS was not conducted for Group 1 Sites. The primary objective of a FS is to develop and present alternatives for remedial action when appropriate for a particular site to protect human health and the environment by eliminating, reducing, and/or controlling risks posed by the site. Based on the results and evaluation of the data in the RI, the U.S. Army believes that remedial action is not warranted and thus a Feasibility Study of alternative remedial actions is not necessary.

EVALUATION OF NO ACTION PROPOSAL

The U.S. Army proposes no remedial action at Group 1 Sites. This proposed decision is based on the results of the studies and surveys summarized above and presented in detail in documents contained in the Administrative Record.

The determination of the need for no

remedial action at the sites is pursuant to the following nine criteria.

- **Overall Protection of Human Health and the Environment:** Based on an analysis of site data and criteria for performing a risk analysis, it was concluded that the sites do not pose an unacceptable risk to human health or the environment. There is no risk identified as a result of past activities.
- **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs):** The RI was conducted in accordance with CERCLA as amended by SARA and the **National Oil and Hazardous Substances Pollution Contingency Plan**. Since no further action is being proposed, further compliance with ARARs is not necessary.
- **Long-term Effectiveness and Permanence**: Although chemicals of concern are identified, future use scenarios are evaluated in the risk assessment and no future remedial activity is found to be necessary. Therefore, this criteria is not applicable.
- **Reduction of Toxicity, Mobility or Volume through Treatment:** This criteria is not applicable since no remedial action is warranted.
- **Short-Term Effectiveness:** No short term risks were identified during the RI. Since no further action is recommended, short term risks of exposure from future response actions are not present.
- **Implementability:** Since no further action is recommended implementability is not an issue.
- **Cost:** Since no further action is recommended cost is not an issue.
- **Regulatory Acceptance:** TNRCC and EPA have been consulted throughout the investigations at Group 1 Sites. Both agencies have evaluated the U.S. Army's Proposed Plan for no remedial action at the site and have provided comments.
- **Community Acceptance:** Community comments will be an important consideration in the final decision for the site. A public meeting is scheduled for August 7, 1997 to receive verbal and written public comments. Written comments will be received from July 21, 1997 through August 20, 1997.

CONCLUSIONS AND RECOMMENDATIONS

The RI for Group 1 Sites, under the Federal Facility Agreement between EPA, TNRCC, and the U.S. Army, was conducted to characterize the nature and extent of contamination and to determine the most appropriate remedy. The U.S. Army conducted the field investigation for the RI in 1996 and 1997 and determined that the minute amount of contamination detected that was associated with the suspected or reported activities in these locations presented no unacceptable risk to human health or the environment.

The U.S. Army proposes to take no further action at the Group 1 Sites. This Proposed Plan for no further remedial action is based on the Baseline Risk Analysis for all Group 1

Sites finding no **unacceptable risk** to human health or the environment.

In summary, based on the information available and studies performed, the U.S. Army believes that no further remedial action is warranted at Sites 11, 1, XX and 27.

FOR MORE INFORMATION

For more information about the public involvement process or if you have questions about site activities at Longhorn Army Ammunition Plant Group 1 Sites, please contact:

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GLOSSARY

Acetone - A manufactured chemical, also found naturally in the environment. It is a colorless liquid, evaporates easily , is flammable, and dissolves in water. It is commonly used to make plastic, fibers, drugs and other chemicals. It occurs naturally in plants, trees and forest fires.

Administrative Record - A file which is maintained and contains all information used to make the decision on the selection of a remedial action under the Superfund program. The file is available for public review and a copy is located at or near the site.

Applicable, Relevant, and Appropriate Requirements (ARARs) - The Federal and State statutory and regulatory requirements that a selected remedy must meet. ARARs are one of nine criteria used to evaluate remedial alternatives for a site.

Benzoic Acid - Occurs in nature in free and combined form, mostly found in berries. Is found naturally in a solid state.

Butyl Benzyl Phthalate - A compound used as a plasticizer.

bis (2 ethylhexyl) Phthalate - A manufactured chemical used as a plasticizer.

2-Butanone - A manufactured chemical, but also present in the environment from natural sources. It is a colorless liquid with a sharp, sweet odor. Most common use is in paints and other coatings.

Chemical of Concern - Chemicals that are potentially site-related and whose data are of sufficient quality for use in the quantitative risk assessment.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) - This law authorizes the Federal Government to respond directly to releases (or threatened releases) of hazardous substances which may be a danger to public health, welfare, or the environment. U.S. EPA is responsible for managing the CERCLA program.

Defense Environmental Restoration Program - This program was formally established by Congress. It provides centralized management for the cleanup of Department of Defense hazardous waste sites consistent with the provisions of the CERCLA as amended by SARA and the National Contingency Plan and Executive Order 12580, Superfund Implementation.

Di-n-butyl Phthalate - An odorless, colorless, oily liquid. A man-made chemical that is added to plastics.

2,6 -Dinitrotoluene - A pale yellow solid and one of six possible forms of the chemical. It is used to produce ammunition and explosives and to make dyes.

Feasibility Study - A study that identifies and evaluates alternatives for addressing site contamination at a Superfund site.

Federal Facility Agreement - An agreement entered into between the U.S. Army, the Environmental Protection Agency and usually the State to cover all phases of remediation.

Groundwater - Water found beneath the Earth's surface that fills pores between soil and gravel particles to the point of saturation. When it occurs in a sufficient quantity, groundwater can be used as a water supply.

Hazard Index - A sum of more than one hazard quotient for multiple substances and/or multiple pathways. It is a numerical way to indicate the level of concern for a site.

Hazard Quotient - The ratio of a single substance exposure level over a specified time period (e.g. subchronic) to a reference dose for that substance derived from a similar exposure period.

INF Treaty - Intermediate-Range Nuclear Force Treaty

Methylene Chloride - A heavy (with respect to the weight of water), colorless liquid with a mild, sweet odor. Widely used as a solvent in paint strippers.

mg/kg - milligrams per kilogram

mg/l - milligrams per liter

Monitoring Wells - Special wells drilled at specific locations on or off of a site where groundwater can be sampled at selected depths and studied to determine such things as the direction in which groundwater flows and the types and amounts of contaminants present.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - Provides the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

National Priorities List - U.S. Environmental Protection Agency's list of the top priority hazardous waste sites in the United States.

Proposed Plan - A document that explains the alternatives considered for a remedial action, identifies the preferred alternative with supporting information, and solicits public review of and comments on the process(es) described therein.

Record of Decision (ROD) - A document that describes the cleanup action or remedy selected for a site, the basis for the choice of that remedy, public comment on alternative remedies, responses to comments, and the cost of the remedy.

Remedial Investigation - An investigation to determine the nature and extent of contamination at a Superfund site and the problems that the contamination causes. The RI is performed prior to a Feasibility Study.

Responsiveness Summary - A summary of the written and/or oral comments received during the public comment period after issuance of the Proposed Plan. The responses to these comments, which highlight community concerns regarding a site, are included in the summary.

Risk Analysis - An evaluation performed to assess the conditions at a Superfund site and determine the potential for adverse impacts to human health and the environment.

Styrene - A synthetic chemical that is a colorless liquid that evaporates easily and has a sweet smell. It is used to produce products such as rubber, plastic, insulation, fiberglass, pipes, automobile parts, food containers, and carpet backing.

Superfund Amendment and Reauthorization Act of 1986 (SARA) - This law authorizes the Federal Government to respond directly to releases (or threatened releases) of hazardous substances which may be a danger to public health, welfare, or the environment.

Toluene - A light (with respect to the weight of water) nonflammable liquid compound that resembles benzene but is less volatile, less flammable, and less toxic. Toluene is used chiefly as a solvent and a raw material for trinitrotoluene (TNT).

Trichloroethylene - A heavy (with respect to the weight of water) nonflammable, colorless liquid compound with a somewhat sweet odor and a sweet, burning taste. Trichloroethylene is used mainly as a solvent to remove grease from metal parts.

ug/kg - micrograms per kilogram

ug/l - micrograms per liter.

USATHAMA - U.S. Army Toxic and Hazardous Materials Agency (now known as the Army Environmental Center [AEC])

Xylene - A A light (with respect to the weight of water), clear, colorless liquid with a sweet odor. Obtained from crude petroleum and used widely in many products such as paints, glues, and pesticides.

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GROUP 1 SITES
LONGHORN ARMY AMMUNITION PLANT
PUBLIC COMMENT PERIOD

The 30-day public comment period for the Group 1 Sites will begin on July 21, 1997 and end on August 20, 1997. Your written comment **MUST** be postmarked by August 20,1997.

U.S. Army would like to receive comments on the Remedial Investigation, Group 1 Sites and Administrative Record file for the Group 1 Sites. All significant comments will be addressed in the Responisveness summary for the sites. If you would like to receive a copy of the Responsiveness Summary, please include your full name and address below.

Name _____
Address _____
City _____
State _____ Zip _____

020849

Monthly Managers' Meeting
Longhorn Army Ammunition Plant
7 August 1997
Longhorn AAP, Karnack, Texas

1. The participants were:

James McPherson, LHAAP
Ira Nathan, LHAAP
David Tolbert, LHAAP
Diane Poteet, TNRCC
Chris Villarreal, EPA
Oscar Linebaugh, EAO
Steve Brunton, Sverdrup
Darrell Hudson, Caddo Lake Institute
Roy Darville, Caddo Lake Institute, ETBU
Bryan C. Smith, Radian
Alexandrine Randriamabefer, Caddo Lake Inst. (teleconference)
Sara Kneipp, Caddo Lake Institute
Loretta Turner, Tulsa District
Yolane Hartsfield, Tulsa District
Ruth Culver, Uncertain Audubon
Wilma Subra, Uncertain Audubon
Cyril Onewokae, IOC
H. L. "Bud" Jones, TNRCC
Dwight Shellman, Caddo Lake Inst.
Dudley Beene, EAO
Becky Gullette, Caddo Lake Institute
Tom Hardaway, Caddo Lake Institute
Dave Bockelmann, Sverdrup
Mike Buttrame, Caddo Lake Institute
Jeff Armstrong, AEC
Cliff Murray, Tulsa District

2. James McPherson opened the meeting, thanked all the participants for attending and welcomed the representatives from the Caddo Lake Institute.

3. The minutes of the previous meeting were reviewed and accepted.

4. Mr. Tolbert stated that the MOU/MOA with the Texas Trustees had been received and forwarded up the Army chain of command. James McPherson noted that he had responded to the Texas Trustees informing them that the documentation had been forwarded up the chain of command. He explained to them why the proposed meeting has been postponed. Mr. Onewokae stated that he had taken the Army lead with Army legal since Lonestar AAP is also a part of the Trustees' MOU/MOA scope.

5. At Site 16, Mr. Bockelmann reported that all the monitoring wells, extraction wells, and piezometers are installed and wells have been sampled. Results are pending. He stated that Sverdrup should be ready to start pumping within two weeks. Expected flow rate from the extraction wells has been revised downward from 10 gpm to 5.5-6 gpm (total system deliverability for this time of year).

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6. Slurry water from BG No. 3 continues to be treated at the GWTP. Expect completion of slurry water treatment within 2 weeks. Radian proposed and the team agreed that it would be prudent to flush the plant with potable water after completion of slurry water treatment. Radian will run the plant for 2 8-hour tours using potable water prior to initiating treatment of groundwater.
7. The meeting was turned over to Ms. Hartsfield to review the Executive Summary.

8. Group 1 Sites. The public meeting for the Group 1 Sites was scheduled for the evening of 7 August to inform the public about the Army's "no further action" plan for the Group 1 Sites. We continue to maintain the schedule for submission of the ROD by 30 September 1997.

9. Group 2 Sites. Schedule of activities for the investigative effort at the Group 2 sites is forthcoming per Mr. Murray, technical manager. Mr. Tolbert noted that soil samples collected from Site 29 had been sent to WES for analysis and pilot study using worms to biodegrade residual explosive compounds in soil. The soil samples were analyzed and found to have explosive compounds concentrations lower than what would be required for the study. Since these samples were collected where historically the highest residual concentrations have been, the pilot study has been canceled.

10. Group 4 Sites. Still awaiting funding. It was noted that if funding is not received this FY, that the contract will be renegotiated and awarded in FY98. Sampling of Goose Prairie Creek in September will include additional samples keyed to ascertaining information about the source of compounds entering into the Creek. There was general discussion about potential sources, generally Group 4 sites with Site 29 from Group 2 included. It was agreed to let members from the Caddo Lake Institute observe the next sampling of Goose Prairie Creek.

11. Group 5 Sites. Sverdrup will incorporate final regulatory comments into document and submit Final SI Report which will be distributed among the LHAAP team.

12. Burning Grounds #3. It was noted that the LTTDs continue to treat source material at a rate of about 22 tph. Mr. Villarreal asked for a copy of the analyses from the testing of the excavation trench soils. Ms. Poteet also wants a copy. Radian to compile and submit through EAO and Tulsa District.

13. Landfill Caps. The capping of Landfills 12 and 16 continue on schedule.

14. Landfill 16. The remedial investigation effort at Landfill 16 continues. Ms. Poteet requested a copy of the final work plan documentation. Mr. Murray said same was forthcoming. Sampling at Harrison Bayou, Goose Prairie Creek, and the Perimeter wells is now scheduled for the first week in September.

15. DERA Sumps. It was noted that the TNRCC regulator has changed and that that has delayed receiving final approval from the TNRCC.

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16. Mr. Culver again requested a copy of the DERPMIS. Mr. Tolbert explained that the regulators were still commenting about the status (RCRA vs. CERCLA) of some sites, and that funding has not been available to finalize the document.

17. Mr. Shellman stated that the Caddo Lake Institute has been engaged in sampling Caddo Lake for more than a year, doing mostly water quality parameters. He stated that the Institute wanted to expand into testing for volatile organic compounds, semivolatile organic compounds, and metals. The Institute is designing protocols now for the lake, are surveying to locate wells around the lake, and will follow up with sampling and analyses. Mr. Shellman reported that the Institute had noted high coliform counts in surface water runoff into Goose Prairie Bayou. Mr. Onewokae asked for copies of the Caddo Lake Institute Protocols and their Sampling and Analysis Plan when it is completed. Mr. Shellman noted that the Institute was interested in joint efforts and offered their help in sample collection. Mr. Jones suggested that split sampling would help to ensure representative and valid results. There was general discussion about off-site sampling. Mr. Armstrong noted that the Army does not sample off-post without DOD and/or Army HQ written permission. Mr. McPherson stated that joint efforts may be possible but would need to work out details on sharing information on sampling protocols and results. Any cooperative efforts would include the TNRCC, EPA, and Texas Trustees.

18. Mr. Murray reported that the sampling data from the May sampling event has been validated.

19. Mr. McPherson responding to a query about excessed property and briefed the team on that on-going effort.

20. The next meeting is scheduled to be held 09 September 1997 at 1000 at LHAAP. There being no further business, the meeting was adjourned.

Yolane Hartsfield
Project Manager

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TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

August 22, 1997

James A. McPherson, Commander's Representative
Longhorn/Louisiana Army Ammunition Plant
Attn: SIOLH-CR
P.O. Box 658
Doyline, LA 71023

CERTIFIED MAIL
Z 746 032 976
RETURN RECEIPT REQUESTED

Re: Longhorn Army Ammunition Plant
Group 2 - Use of Treated Ground Water for Dust Control

Dear Mr. McPherson:

As you requested in your letter dated August 13, 1997, which we received on August 19, 1997, by this letter the Texas Natural Resource Conservation Commission (TNRCC) staff provides written concurrence of the verbal agreement reached on August 12, 1997 between the parties of the Federal Facility Agreement regarding the above matter. The TNRCC concurs with the Army's request to use treated water from the Groundwater Treatment Plant located near Burning Ground No. 3 for dust control and suppression, as needed, during landfill cap construction activiites at Landfills 12 and 16. As we discussed, the TNRCC concurs based on the Army's agreement to: 1) use the treated water as stated and not for the purpose of avoiding proper disposal; and 2) use runoff controls so as to prevent harmful discharges into state waters or into other areas outside the landfill caps construction area. If you have any further questions regarding this matter, please call me at (512) 239-2502.

Sincerely,

Diane R. Poteet
Project Manager (MC-143)
RI/FS II Unit
Superfund Investigation Section
Pollution Cleanup Division

cc: Chris Villarreal, EPA Region 6 (6SF-AP)
Yolane Hartsfeld, COE Tulsa District (CESWT-PP-EA)
Oscar Linebaugh, COE Eastern Area Office (CESWF-AD-E)