LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 4 of 13

1994

Bate Stamp Numbers
008385 - 008663

Prepared for:

Department of the Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

1995

VOLUME 4 of 13

1994

W. **Title:** **Letter - Subject: EPA's Comments On Chemical Data Acquisition Plan Addendum For The RI Sites 11,1,xx,27 (Group #1)**
Attach(s): **Comments**
Group(s): **1**
Site(s): **LHAAP-1 Inert Burning Grounds**
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 or LHAAP-XX Ground Signal Test Area
Location: **Longhorn Army Ammunition Plant, Marshall, Texas**
Agency: **Environmental Protection Agency**
Author(s): **Lisa Marie Price, Environmental Protection Agency**
Recipient: **David Tolbert, Longhorn Army Ammunition Plant**
Date: **July 29, 1994**
Bate Stamp: **008385 - 008388**

X. **Title:** **Final Workplan Addendum - Phase I Investigation Of 125 Waste Process Sumps And 20 Waste Rack Sumps for Remedial Investigation (RI)**
Soil and Groundwater Background Concentration Study
Group(s): **4**
Site(s): **LHAAP-35 Process Wastewater Sumps - Various**
LHAAP-36 Explosive Waste Pads
Location: **Longhorn Army Ammunition Plant, Marshall, Texas**
Agency: **U.S. Army Corps Of Engineers, Tulsa District**
Author(s): **U.S. Army Corps Of Engineers, Tulsa District**
Recipient: **U.S. Army, Longhorn Army Ammunition Plant**
Date: **August, 1994**
Bate Stamp: **008389 - 008409**

Y. **Title:** **Final Workplan - Phase II Investigations Of 125 Waste Process Sumps and 20 Waste Rack Sumps for Remedial Investigation (RI)**
Group(s): **4**
Site(s): **LHAAP-35 Process Wastewater Sumps - Various**
LHAAP-36 Explosive Waste Pads
Location: **Longhorn Army Ammunition Plant, Marshall, Texas**
Agency: **U.S. Army Corps Of Engineers, Tulsa District**
Author(s): **U.S. Army Corps Of Engineers, Tulsa District**
Recipient: **U.S. Army, Longhorn Army Ammunition Plant**
Date: **August, 1994**
Bate Stamp: **008410 - 008593**

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Z. **Title:** Final Workplan - Phase II Workplan Addendum For Remedial Investigation (RI)
Group(s): 1
Site(s): LHAAP-1 Inert Burning Ground
LHAAP-11 Suspected TNT Burial Site At Avenues P & Q
LHAAP-27 South Test Area
LHAAP-54 Or LHAAP-XX Ground Signal Test Area
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Company: Sverdrup Environmental, Inc.
Author(s): Sverdrup Environmental, Inc.
Recipient: U.S. Corps Of Engineers, Tulsa District
Date: August, 1994
Bate Stamp: 008594 - 008663

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JUL 2 9 1994

CERTIFIED MAIL: RETURN RECEIPT REQUESTED

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

Re: Draft Chemical Data Acquisition Plan Addendum for
Sites 11, 1/1A, XX, 27 for
Longhorn Army Ammunition Plant

Dear David:

Pursuant to the Federal Facility Agreement for the Longhorn Army Ammunition Plant, EPA is submitting comments on the Draft Chemical Data Acquisition Plan Addendum for Sites 11, 1/1A, XX, 27 for Longhorn Army Ammunition Plant and conditionally approving the plan. The conditions for final approval are that all of EPA's comments are addressed and the appropriate changes made to the document. EPA's comments are included as an enclosure to this letter. Upon receipt of the revised Chemical Data Acquisition Plan by EPA, the document will be considered final and approved.

If you have any questions about EPA's comments or any other matter, please contact me at my new phone number (214) 665-6744.

Sincerely,

Lisa Marie Price
Remedial Project Manager
Superfund Texas Enforcement

Enclosure

cc: Lieutenant Colonel Lawrence J. Sowa
Commanding Officer, U.S. Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671-1059

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Tulsa District Corps of Engineers
P.O. Box 61
Attn: Mr. Ross Nguyen
CESWT-PP-E
Tulsa, OK 74121-0061

Mike Moore, Superfund
Texas Natural Resource Conservation Commission
P.O. Box 13087
Capital Station
1700 N. Congress Avenue
Austin, TX 78711-3087

Draft Chemical Data Acquisition Plan Addendum for Sites 11, 1/1A, XX, 27 for Longhorn Army Ammunition Plant EPA's Comments 7/19/94

Comment #1

Section 4, page 8 of 33, LHAAP XX- I don't think the text truly reflects the agreement that EPA, TNRCC and the Army reached regarding the phase 2 RI investigation for site XX. According to EPA's records, the order of events is as follows: 1) conduct soil gas survey; 2) if no concentrations of acetone are detected during the soil gas survey, a 10-foot soil boring will be drilled near SB-19 with soil samples collected and analyzed; **OR** 3) if concentrations of acetone are detected during the soil gas survey, a monitoring well will be installed at the location of the highest concentration with soil and groundwater samples collected and analyzed. If EPA's recollection is correct, please clarify the text. If EPA's recollection is incorrect, please notify EPA.

Comment #2

Section 4.1, page 12 of 33 and Section 4.1.1.3, page 13 of 33: It is unacceptable under any circumstances to collect soil boring samples from the cuttings of the auger flights. Samples should only be collected by split spoon or Shelby tube. There are tools available (eg. traps) for sample collection in trouble soil conditions.

Comment #3

Section 4.1.2, page 13 of 33: Given the potential for extensive DNAPL contamination at the Longhorn Army Ammunition Plant, EPA does not believe that flight augers provide sufficient protection from cross contamination between shallow and deeper water zones. Although not particularly applicable to the Group #1 sites, EPA requests that all reference to this method of deeper water zone protection be deleted. If drilling a boring or installing a monitoring well is required in an area of suspected DNAPL contamination, EPA requests that casing be used to isolate water zones. Refer to EPA's June 7, 1994, and July 13, 1994, letters regarding the development of a work plan detailing procedures to be used during the drilling, installation, development and sampling of wells in suspected or known DNAPL-contaminated environments. Development of this work plan is paramount!

Comment #4

Section 4.2.1.5, page 17 of 33; Section 4.2.1.6, pages 17 and 18 of 33; and Section 4.2.5, page 19 of 33: Refer to EPA's July 13, 1994, letter regarding the use of compatible materials for seal and grout in DNAPL-contaminated environments.

Comment #5 — Section 4.7.1, pages 28 and 29 of 33: Headspace analysis should only be used as a screening tool. If any contamination is present, it should be noted. However, the lack of detection of contamination does not mean that contamination is not present. Therefore, the degree of contamination cannot be determined using this field screening technique nor should field screening be used to separate drilling materials into potentially contaminated and uncontaminated fractions. EPA requests that the use of Draeger tubes be discontinued and that a flame-ionization detector or OVA be used.

Comment #6 — Section 4.7.2, page 29 of 33: See EPA's July 13, 1994, letter regarding the soil gas survey technique.

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LONGHORN ARMY AMMUNITION PLANT

SOIL AND GROUNDWATER BACKGROUND CONCENTRATION STUDY
PHASE I INVESTIGATIONS OF 125 WASTE PROCESS SUMPS AND 20 WASTE RACK SUMPS

FINAL WORK PLAN ADDENDUM

Prepared For:
Longhorn Army Ammunition Plant
Karnack, Texas

Prepared By:
U.S. Army Corps of Engineers
Tulsa District

AUGUST 1994

Executive Summary

To evaluate the impact of operations associated with explosive manufacturing and disposal upon the area covered by Longhorn Army Ammunition Plant (LHAAP) the background concentrations of naturally occurring elements in the soil and groundwater must be determined. The field work in this phase of investigation involves the drilling of 10 foot deep borings at 12 randomly chosen locations to collect soil samples to be analyzed for 19 naturally occurring metals. The locations were chosen at random after excluding locations which could have possibly been affected by activities conducted at LHAAP. Areas near production operations, downwind from burning grounds, hydraulically down gradient from waste disposal sites and proximal to heavily traveled roadways and railways were excluded from prospective sampling locations. The results from the chemical analysis of these soil samples will be statistically analyzed to determine the statistical mean for the 19 metals for which analytical tests were conducted. The calculated background values will be used to determine disposal and/or treatment requirements of soils collected during previous investigations and remediation operations.

In addition to the soil sampling during field operations, a 2 well cluster of groundwater monitoring wells will be installed to measure background concentrations of inorganic compounds at a location at the northwest edge of LHAAP. At this location the shallow groundwater will be monitored as well as groundwater from a deeper interval. Chemical analyses of water from these wells as well as chemical data from 3 previously existing perimeter wells will be used to determine the statistical mean of the inorganic compounds in groundwater flowing into the LHAAP. The calculated values of natural concentrations of these inorganic compounds will be used to evaluate impact of plant operations upon groundwater on LHAAP.

Table Of Acronyms and Abbreviations

BG	Background
CDAP	Chemical Data Acquisition Plan
COE	United States Army Corps of Engineers
EPA	United States Environmental Protection Agency
HSP	Health and Safety Plan
IDW	Investigation Derived Waste
LHAAP	Longhorn Army Ammunition Plant
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
SQL	Sample Quantitation Limit
UCL	Upper Confidence Limit
USCS	Unified Soil Classification System
USGS	United States Geological Survey

LONGHORN ARMY AMMUNITION PLANT
SOIL AND GROUNDWATER BACKGROUND CONCENTRATION STUDY
PHASE I INVESTIGATIONS OF 125 WASTE PROCESS SUMPS AND 20 WASTE RACK SUMPS
WORK PLAN ADDENDUM

TABLE OF CONTENTS

1. Introduction.

This work plan presents the scope of soil sampling to supplement Phase I investigation activities performed to characterize possible contamination at 125 waste process sumps and 20 waste rack sumps at the Longhorn Army Ammunition Plant (LHAAP). To quantify potential releases of inorganic constituents from the sites under investigation, it is necessary to have a body of data from an uncontaminated area with which to compare the data from an investigated site. The scope of this addendum to the Phase I Work Plan of this project is to gather soil samples from areas unaffected by plant operations and compute the background concentration of inorganic chemical constituents in the soil in the plant area. The ultimate goal of these investigations is to provide data which can be used to determine the impact of LHAAP activities upon the environment. The results will be used in the sumps investigation as well as other site investigations. Activities for this additional Phase I investigation will include drilling of shallow borings, chemical testing of soils, and the installation of additional groundwater monitoring wells. These additional monitoring wells will be used to supplement existing chemical data in the determination of groundwater background concentration levels. Proposed sampling methods and sampling frequency are presented in section 2 of this work plan along with a discussion of how the data will be interpreted and reported. The Chemical Data Acquisition Plan (CDAP) as referenced in Appendix A of the Phase I Work Plan is to be observed. The Site Specific Health and Safety Plan (HSP) can be seen in Appendix B of the Phase I Work Plan.

2. Phase I Field Work Plan.

2.1. Statistical Sampling Strategy for Soil Sampling.

Based on an assessment of the soil and geologic characteristics of the LHAAP site, including stratigraphic and lithologic characteristics, the plant has been determined to be underlain by the Wilcox formation consisting of interbedded sands, silts and clays. Since no distinct geographic delineations of the site appear horizontally across the facility, a stratified random sampling is unnecessary and simple random sampling is preferred.

A total of 19 variables (metals) will be analyzed in each sample. Table 1 lists the metals to be tested with the chemical abbreviation for each metal and the EPA approved analytical method to be used. Reported with analytical results will be the sample quantitation limit (SQL) for each sample analyzed as defined on pages 47 and 49 of Section 3.2.4 of *Guidance for Data Useability in Risk Assessment* (EPA/540/G-90/008). The determination of the required sample size is

Table 1

Aluminum (Al)	6010	Cobalt (Co)	6010	Mercury (Hg)	7470
Antimony (Sb)	6010	Copper (Cu)	6010	Potassium (K)	7610
Arsenic (As)	7060	Iron (Fe)	6010	Selenium (Se)	7740
Barium (Ba)	6010	Lead (Pb)	7421	Silver (Ag)	6010
Cadmium (Cd)	6010	Magnesium (Mg)	6010	Strontium (Sr)	6010
Calcium (Ca)	6010	Manganese (Mn)	6010	Zinc (Zn)	6010
Chromium (Cr)	6010				

dependent upon an estimate of the population standard deviation. Since all 19 variables are of equal importance, 19 separate sample sizes were calculated; one for each variable. The final sample size to be used is largest of the 19 computed. By doing so, oversampling will occur to varying degrees among certain variables but in no case will any variable be undersampled.

The t value used in all cases (t=1.96) corresponds to a confidence level of 95 percent. The total population size is equal to the total number of cells in the grid (discussed later in this section). To calculate the required sample size, an alpha level describing the level of confidence of 0.05 (5%) was used. The acceptable bound on error used in estimation of sample size was determined to be 30 percent of the mean level of each metal. The data used to derive these estimates of the population parameters consists of six samples collected by the Tulsa District Corps of Engineers in 1993. For calculation of actual background statistics derived from the analysis of collected field data, a confidence level of 95 percent will be used (i.e. 0.05 will be used for alpha - the probability of Type I error) and 0.15 will be used for beta - the probability of Type II error. Figure 1 shows the locations of the 3 previous background samples that will be included in the background evaluation. To calculate the statistics needed for determination of sample size for those variables whose measurements were below detection limits, a random number between zero and the detection limit was generated. For actual calculations using collected field data when measurements are below the sample quantitation limit, a value based on the SQL will be used depending on the quantitation limit provided by the analytical laboratory.

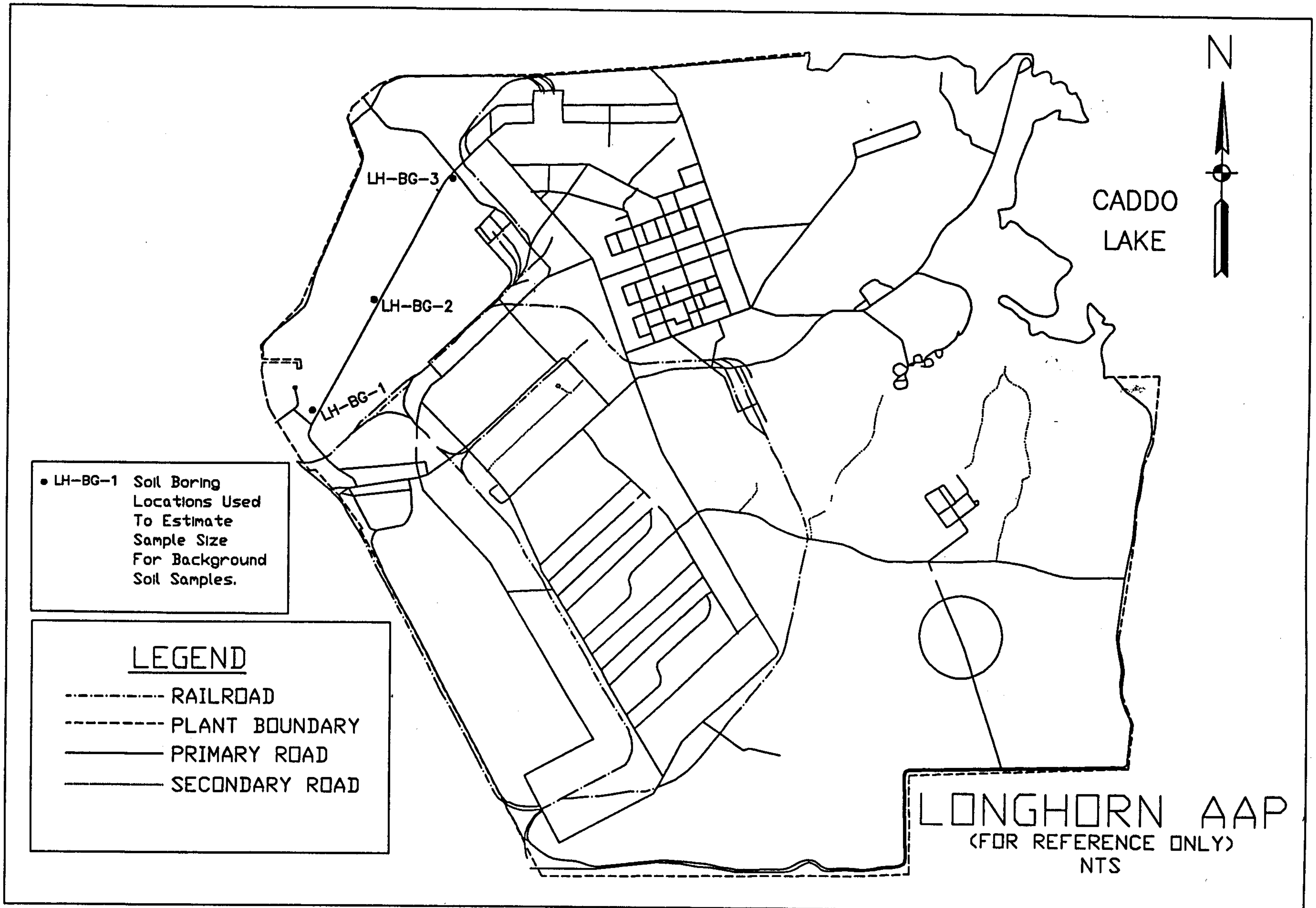

Figure 1

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The largest computed size was 42 units required to estimate the mean manganese (Mn) level within +/- 119 mg/kg at a 95 percent level of confidence. The sampling size calculation results are shown in Table 2. A total of 12 borings are planned with 3 samples to be collected from each boring. In addition, the previous 6 background samples will be combined with these new samples. This would result in a total of 42 samples for the statistical calculation of background values.

In order to ensure independent random sampling, the entire LHAAP has been overlaid with a grid pattern. Each cell within the grid measures 200 feet x 200 feet (0.92 acre). This cell size was judgéd to be small enough to maintain strict homogeneity of relevant physical characteristics. The cells were identified by numbering the rows and columns. An exclusion zone was defined to exclude those areas that have potential of being impacted by past and present operations at the plant. That zone is shown in Figure 2 and represents approximately 5900 acres or 70 percent of the area of the plant. Areas excluded were areas which were (1) near heavily traveled roadways; (2) near intersections where accidents or spills were most likely; (3) near and downwind from burn and test sites; and (4) on or adjacent to production or waste disposal facilities. The total population size is equal to the total number of cells in the grid overlaying the plant (approximately 9230 cells) inclusive of the exclusion zone.

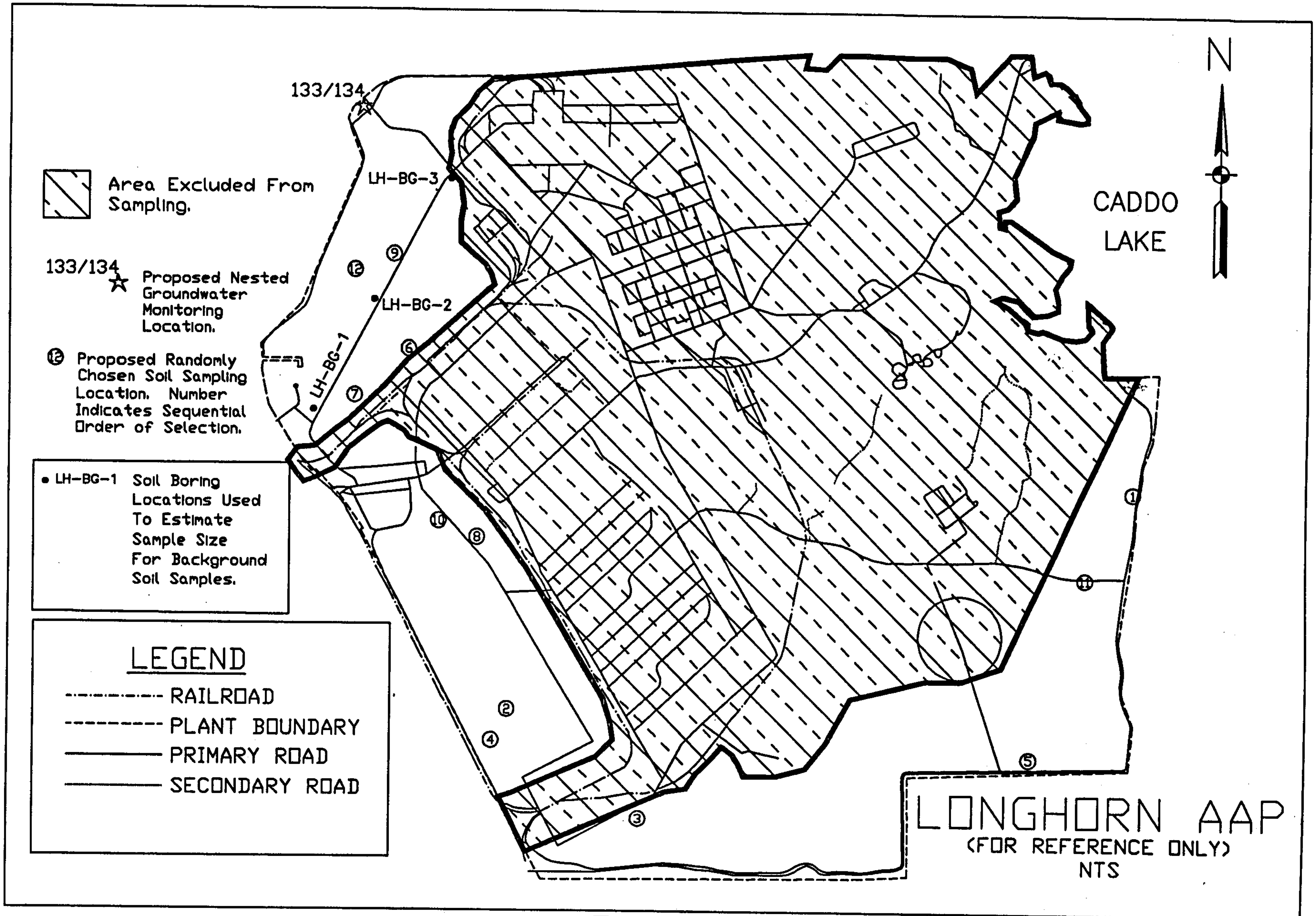
A random number generator was used to obtain a list of random number coordinates which were used to select the required number of samples. If a selected cell was totally or partially covered by the excluded area, that cell was excluded and the next random coordinate pair was used as the replacement. Additionally, if the location was spotted on the USGS topographic map and found to be in a low lying or swampy area that site was excluded. This was necessary in an attempt to obtain at least 10 feet of soil above the water table. These 12 locations are shown

	Table 2.	Sample Size	Calculations.	Units=mg/Kg
Metal	Mean*	Standard Deviation	Bound On Error (.30 x mean)	Calculated Sample Size
Aluminum	10585	4178	3175.5	7
Antimony	1.903	1.348	0.5709	21***
Arsenic	2.35	0.817	0.705	5
Barium	96.483	71.974	28.9449	24
Cadmium	0.644	0.253	0.1932	7***
Calcium	1319.83	891.53	395.949	19
Chromium	15.617	5.387	4.6851	5
Cobalt	9.783	9.194	2.9349	38
Copper	8.517	9.913	2.5551	37
Iron	21633	11126	6489.9	11
Lead	6.8	2.105	2.04	4
Magnesium	2553	1716**	765.9	19
Manganese	397.4	393**	119.22	42
Mercury	0.032	0.019	0.0096	15***
Potassium	936	765	280.8	28
Selenium	0.628	0.342	0.1884	13***
Silver	0.412	0.372	0.1236	35***
Strontium	21.58	15.81	6.474	23
Zinc	37.48	31.4	11.244	30

* All statistics calculated from COE borings LH-BG-01, LH-BG-02 and LH-BG-03, with non-detects replaced by random numbers in the interval [0, Detection Limit].

** Standard deviation estimated as Range/4.

*** Sample size estimates based on non-detect values in analysis.



133/134
Area Excluded From Sampling.
133/134 Proposed Nested Groundwater Monitoring Location.
⑫ Proposed Randomly Chosen Soil Sampling Location. Number Indicates Sequential Order of Selection.
LH-BG-1 Soil Boring Locations Used To Estimate Sample Size For Background Soil Samples.
LEGEND
RAILROAD
PLANT BOUNDARY
PRIMARY ROAD
SECONDARY ROAD
LH-BG-3
LH-BG-2
LH-BG-1
CADDO LAKE
N
LONGHORN AAP
(FOR REFERENCE ONLY)
NTS

Figure 2

on Figure 2.

2.2. Description of Field Work for Soil Sampling.

The field work will consist of drilling at least 12 shallow borings as described in the previous section as well as the installation of 2 nested monitoring wells in the northwest corner of the facility. That nested well location is denoted as 133/134 on Figure 2. As mentioned earlier, these soil sampling locations were randomly chosen as representative of areas unaffected by operations conducted at the plant taking into account such things as the prevailing wind direction and surface water runoff flow direction. The locations are generally located around the western, southern, and southeastern perimeter of the plant in positions up gradient from road surfaces to minimize contamination from runoff. Additionally, the locations are upwind (prevailing south winds) from incineration sites to minimize fallout from burning operations. The individual locations were chosen randomly as described in Section 2.1. The chemical analysis of these new borings will be combined with the analysis from three of the previous background soil samples (samples LH-BG-1, LH-BG-2 and LH-BG-3) shown on Figure 1.

Each boring will be drilled to a depth of 10 feet or the top of groundwater, whichever is less. Two sampling intervals will be tested - surface (0-6") and subsurface (2'-10'). To obtain a sufficient number of media-specific (coarse and fine grained) surface samples, some surface samples may be collected independent of deeper samples. Those additional surface locations will be indicated upon the final summary background report. The cored section from the subsurface interval (2'-10') will be placed on a clean impermeable surface for inspection. The cored interval will be visually evaluated and logged. Each interval will be sampled for coarse-grained and fine-grained media. The coarse-grained sample will represent the coarsest grained material present in the 2-10' interval and the fine-grained sample will be representative of the finest grained material present in this interval. When locating the boring location an attempt will be made to identify coarse-grained and fine-grained surface sediments for sampling variety. Soil samples will be analyzed for the 19 total metals listed in Table 1 as well as physical characteristics such as moisture content, Atterberg limits, and grain size distribution.

Soil samples to be included in the background concentration study will also be taken from shallow monitoring well 133. Chemical and physical analyses described in the paragraph above will be performed.

Field activities will require the use of a hand auger, or similar hand tools, and a drilling rig.

Supporting activities will include procuring sample supplies and materials, and surveying boring and well locations and elevations. All field work will be conducted in accordance with the site specific CDAP and the HSP as found in Appendices A and B, respectively, of the Work Plan for Phase I Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps (June 1993).

2.2.1. Access Permits. Permits for drilling will be obtained under agreement by the Longhorn Army Ammunition Plant Environmental Division.

2.2.2. Procurement. Appropriate materials will be ordered and support contracts obtained as soon as funding is available. Materials include sampling materials and personal protective clothing. Support contracts which may be procured include contracts for on-site waste storage and surveying.

2.2.3. Soil Sampling. Procedures set forth in the CDAP and HSP as found in Appendices A and B, respectively, of the Work Plan for Phase I Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps (June 1993) will be followed for the soil sampling.

Samples will be collected using a splitspoon or similar sampling device. In boring locations where it is prohibitive to use a drilling rig, soil samples will be collected using hand augers or other appropriate hand sampling devices. Care will be taken so that minimal disturbance to the sample occurs when hand sampling devices are used. Prior to the commencement of drilling operations all boring locations will be surveyed resulting in x, y, and z locations in the state plane coordinate system.

All background soil borings, once completed, will be backfilled with materials removed from that boring.

A geologic log will be prepared for each boring. Logs will be completed on an ENG1836 form. Drill logs shall subscribe to the following requirements: (1) Logs shall be prepared in the field, as borings are drilled, by a qualified drilling and sampling inspector. (2) Borehole depth information shall be from direct measurements (3) All relevant information blanks in the log heading and log body shall be completed. If surveyed horizontal control is not available at the time of drilling, location sketches referenced by measured distances or prominent surface features, shall be shown on, or attached to the log. (4) Each and every material type encountered shall be described in column c of the log form. (5) Unconsolidated materials shall be described using the descriptive Unified Soil Classification System (USCS) which shall include consistency of cohesive materials or apparent density of non-cohesive materials; moisture content assessment, e.g., moist, wet, saturated, etc.; color; and other descriptive features (bedding characteristics, organic materials, macrostructure of fine-grained soils; e.g., root holes, fractures, etc.). (6) Stratigraphic/lithologic changes shall be identified in column c by a solid horizontal line at the appropriate scale depth on the log which corresponds to measured borehole depths at which changes occur. (7) Logs shall clearly show in columns e and f, the depth intervals from which all samples are collected. (8) Logs shall identify the depth at which water is first encountered, the depth to water at the completion of drilling and the stabilized depth to water. The absence of water in borings shall also be indicated. Stabilized water level data shall include time allowed for levels to stabilize. (9) Logs shall show borehole and sample diameters and depths at which drilling or sampling methods or equipment change. (10) Logs shall show total depth of penetration and sampling. (11) Any special drilling or sampling problems encountered shall be recorded on logs, including descriptions of problem resolutions.

2.3. Description of Field Work for Monitoring Well Installation.

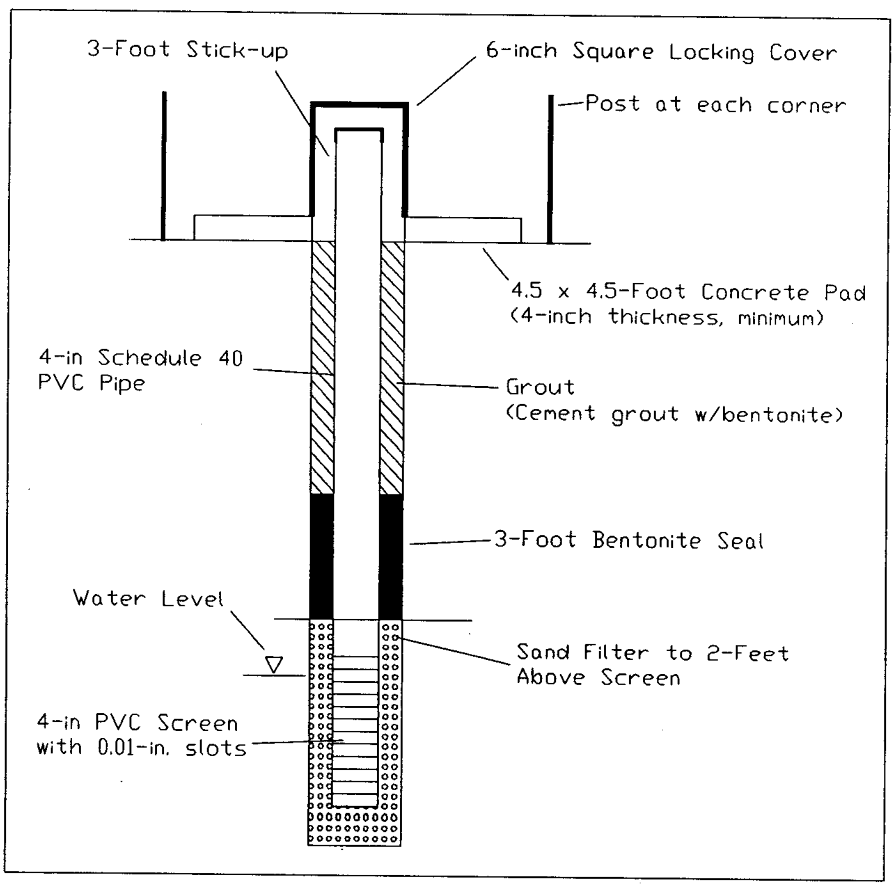
A clustered groundwater monitoring well installation will be installed coincident with soil sampling at the remote location labeled 133/134 on Figure 2 in the northwest portion of LHAAP. This groundwater monitoring installation will be used in the groundwater background concentration study being conducted simultaneously with the soil background concentration study as well as serve as an up gradient monitoring well for the sumps monitoring wells to be installed to the southeast of this location. With the drilling rig mobilized for the background soil sampling program, the remote sampling location provided by 133/134, and the need for an additional groundwater monitoring location, the placement of a monitoring well installation at the same time as the sampling operations will be an efficient use of resources. Two groundwater depths will be monitored in the well cluster configuration.

During drilling operations for the deeper monitoring well, well #134, soil samples will be collected every 5 feet or at a change in soil material. These samples will be tested for moisture content, Atterberg limits and grain size distribution.

Following the well installations, water samples from both wells will be sampled for the same nineteen (19) metals as the soils as well as volatile organics (EPA method 8240), semi-volatile organics (EPA method 8270) and explosives (EPA method 8330).

2.3.1. Shallow Groundwater Monitoring Well Installation. Monitoring well 133 will be drilled and logged into the uppermost water bearing interval. Drilling will be continued 25' into the upper water bearing interval or to a confining layer at least 2 feet thick, whichever is encountered first. This well will screen the entire saturated zone up to 20' of screen. A typical well installation is shown in Figure 3.

Figure 3. Typical Well Schematic.



2.3.2. Deeper Groundwater Monitoring Well Installation. A deeper well, well #134, will be installed at the same location as the shallow well (133). Monitoring well 134 will be installed in a separate well bore located approximately 10 feet from the shallow well (133). If a shallow confining bed is located in the shallow wellbore (133), the deeper well (134) will be installed beneath this confining layer at the base of the next lower saturated zone, with the upper zone sealed off to preclude cross-contamination when penetrating the confining bed. If the deeper zone is greater than 20 feet thick, well 134 will screen the bottom 20 feet of the interval. The depth of each well screen placement will depend on the stratigraphy identified from subsurface data obtained at the site.

If no confining layer is encountered in the monitoring well 133, well 134 will be drilled to a depth of 100 feet or to a confining layer at least 2 feet thick. If drilled to a depth of 100 feet, the lowermost 20 feet will be screened and completed as indicated in Figure 3. If a confining layer 2 feet or more in thickness is encountered, the upper zone will be protected by surface casing prior to drilling into the deeper aquifer. The well will then be drilled to the next confining layer with a thickness of 2 feet or more or to a depth of 100 feet with a screen of not more than 20 feet set at the midpoint of this aquifer interval. If this interval is less than 20 feet thick, the screen will be sized to test only that lower aquifer.

2.4. Investigation Derived Wastes.

Drill cuttings generated during boring operations and monitoring well installation will be spread uniformly at the boring/monitoring well site. Due to the remote locations of the investigation sites, the possibility of contamination of these sites is extremely small. If any indication of contamination is detected, drill operations will be terminated, the hole grouted and a report of possible contamination prepared for LHAAP and the regulatory agencies.

2.5. Equipment Decontamination.

All equipment used for drilling and soil sampling which is placed down-hole will be decontaminated using a high pressure washer prior to drilling each boring. In addition, prior to taking each sample, the sampling device (i.e. splitspoon etc.) will be decontaminated according to the CDAP found in appendix A. For purposes of decontamination, a station will be set up at a location designated by the Longhorn Army Ammunition Plant Environmental Coordinator for decontamination purposes. The decontamination station will consist of an above ground collection basin constructed to prevent decontamination fluids from escaping onto the ground. A pump will be used to pump the decontamination fluids from the collection basin to an appropriate liquid storage tank. All decontamination fluids will be containerized and tested. The disposal requirements for the drummed IDW will be contingent upon laboratory results. Uncontaminated fluids will be treated by the facility water treatment plant. Treatment for contaminated fluids is under evaluation. All water used for the decontamination will be clean potable water.

3. Sample and Data Analysis.

3.1. Sample and Data Management.

In accordance with the CDAP (Appendix A of original Work Plan) field personnel will package all samples for shipment via overnight carrier and will coordinate sample transportation and analysis with the Corps of Engineers Southwestern Division analytical laboratory.

3.2. Data Evaluation.

The physical and chemical data generated during the investigations from soil and groundwater samples will be evaluated, interpreted, and summarized in two separate reports. For soil samples, the chemical data generated during this phase of investigation will be compared to the site specific background chemical results collected in the initial Phase I investigation. Each report will include a map of the plant, a description of the chemical results, a description of statistical procedures used and tables of the statistical results. A table showing the frequency of detection and range of detections per inorganic analyte for all background samples taken across the facility will be presented. Statistical results will include the geometric mean, arithmetic mean, sample standard deviation, and normal and/or log-normal upper confidence limits (UCL's) for each constituent. Statistical treatment of the data will be performed in accordance with procedures given in the EPA documents - *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance, April 1989*, (EPA/530-SW-89-026) and *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance, July 1992)*.

008408

Comments on Draft Work Plan
Soil and Groundwater Background Concentration Study
Longhorn Army Ammunition Plant
Karnack, Texas
25 August, 1994

Reviewer: Lisa Marie Price, EPA Remedial Project Manager, Superfund Texas Enforcement
Respondent: Cliff Murray, CESWT-EC-GS, Tulsa District, USACE, Engineering Geology & Soil Mechanics Section

Comments on Draft Final Work Plan

Comment #	Page/ Section	Comments	Respondent's Comment
1	General	Refer to Section 5.3 of the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A)* regarding the use of Sample Quantitation Limits (SQL). EPA requests that SQL's be used since SQL's are the most appropriate limits to consider when evaluating non-detected chemical s (Section 5.3.4).	SQL's will be reported with all analysis results..
2	General	When the background information is presented, a table should be provided which shows frequency of detection and range of detections per inorganic analyte for all background samples taken across the facility. As per Comment 2 (1?), SQL's should be used rather than non-detects. In addition, the mean concentration (calculate geometric and then transform mean back) or the 95% Upper Confidence Limit (UCL) concentration (based upon arithmetic averages) should be given (as opposed to the 90 percent noted on page 3 of the work plan) and shown on this table. Refer to *Guidance for Data Useability in Risk Assessment* for more information on use and presentation of information.	The requested information will be calculated and presented in Table format. A 95% Upper Confidence Limit will be calculated and given in the table. As in the response to Comment #1, the SQL's will be used when a chemical is not detected.

Comments on Draft Work Plan
Soil and Groundwater Background Concentration Study
Longhorn Army Ammunition Plant
Karnack, Texas
25 August, 1994

Reviewer: Lisa Marie Price, EPA Remedial Project Manager, Superfund Texas Enforcement
Respondent: Cliff Murray, CESWT-EC-GS, Tulsa District, USACE, Engineering Geology & Soil Mechanics Section

Comments on Draft Final Work Plan

Comment #	Page/ Section	Comments	Respondent's Comment
3	1/1.0	Change the following sentence to read: "The ultimate goal of these investigations is to provide data which can be used to determine the impact of LHAAP activities upon the environment. The results will be used in the sumps investigations as well as other site investigations."	Text was changed as suggested.
4	2/2.1	There is nothing uniform about the Wilcox Formation and the distribution of interbedded sands, silts and clays underlying the site. The term "uniform" implies homogeneity.	The passage has been changed to "...the plant has been determined to be underlain by the Wilcox formation consisting of interbedded sands, silts and clays."
5	3/2.1	1st paragraph: Refer to Section 4.4 of the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A)* regarding background sampling. The error rate identified in the work plan is 25 percent, however, the *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A)* states that the alpha should be 0.05 with ß being 0.15.	In this work plan, for the determination of sample sizes, the bound on error of estimation was set at 25% and changed in the final draft to 30%. The error rate or level of confidence was set at alpha = 0.10 and changed to 0.05 (confidence level = 95%). For final calculations, alpha = 0.05 and beta = 0.15 will be used.

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LONGHORN ARMY AMMUNITION PLANT

PHASE II INVESTIGATIONS OF 125 WASTE PROCESS SUMPS AND 20 WASTE RACK SUMPS

FINAL WORKPLAN

Prepared For:

Longhorn Army Ammunition Plant

Karnack, Texas

Prepared by:

U.S. Army Corps of Engineers

Tulsa District

August 1994

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LIST OF ACRONYMS

AEC	Army Environmental Center
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DERA	Defense Environmental Restoration Account
DM	Data Management
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
IDW	Investigation Derived Wastes
LHAAP	Longhorn Army Ammunition Plant
OSHA	Occupation Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbons
PID	Photoionization Detector
POC	Point of Contact
PQLs	Practical Quantitation Limits
PVC	Polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
RI/FS	Remedial Investigation/Feasibility Study
SOPs	Standard Operating Procedures
SSHP	Site Safety and Health Plan
SVOCs	Semivolatile Organic Compounds
SWD	Southwestern Division Laboratory
TNRCC	Texas Natural Resource Conservation Commission
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

This workplan presents the scope for the Phase II investigation of 125 sumps and 20 waste racks at Longhorn Army Ammunition Plant (LHAAP). This workplan contains a Chemical Data Acquisition Plan (CDAP) and a Site Safety and Health Plan (SSHP). Also included in this workplan are appendices that support the above plans, including, but not limited to, standard operating procedures (SOPs) for field investigation, laboratory methods and detection limits.

The workplan overview section provides the background, goals and objectives of the Phase II Sumps Investigation at LHAAP. Also included is the approach and schedule that will be used to meet these objectives.

1.1 Site Description

1.1.1 Location. Longhorn Army Ammunition Plant is located in northeast Texas, 15 miles east of Marshall, Texas in Harrison County (Fig 1).

1.1.2 Background. Adjacent to Karnack, Texas, LHAAP was established in 1942 for the production of 2,4,6-trinitrotoluene of which production ceased in 1945 with the ending of World War II. Current activities at LHAAP include loading, assembling, and packing of pyrotechnic, illuminating and signal ammunition and solid propellant rocket motors.

The sites of concern for this investigation consist of locations in the vicinity of 125 process waste sumps and 20 sumps associated with process waste racks distributed among 76 buildings/locations across LHAAP. The majority of the sumps are located within the two main production areas: Plant 2 and Plant 3. Other sumps are located within the Igniter Area, the Burning Grounds Area, the 400 area, the Shops Area, the Y-Area and the Static Test Area. Refer to digitized maps A, B and C in Appendix A.

1.1.3 Previous Studies and Results. BCM Engineers, retained by the LHAAP Operating Contractor (Thiokol Corporation), conducted a study to evaluate

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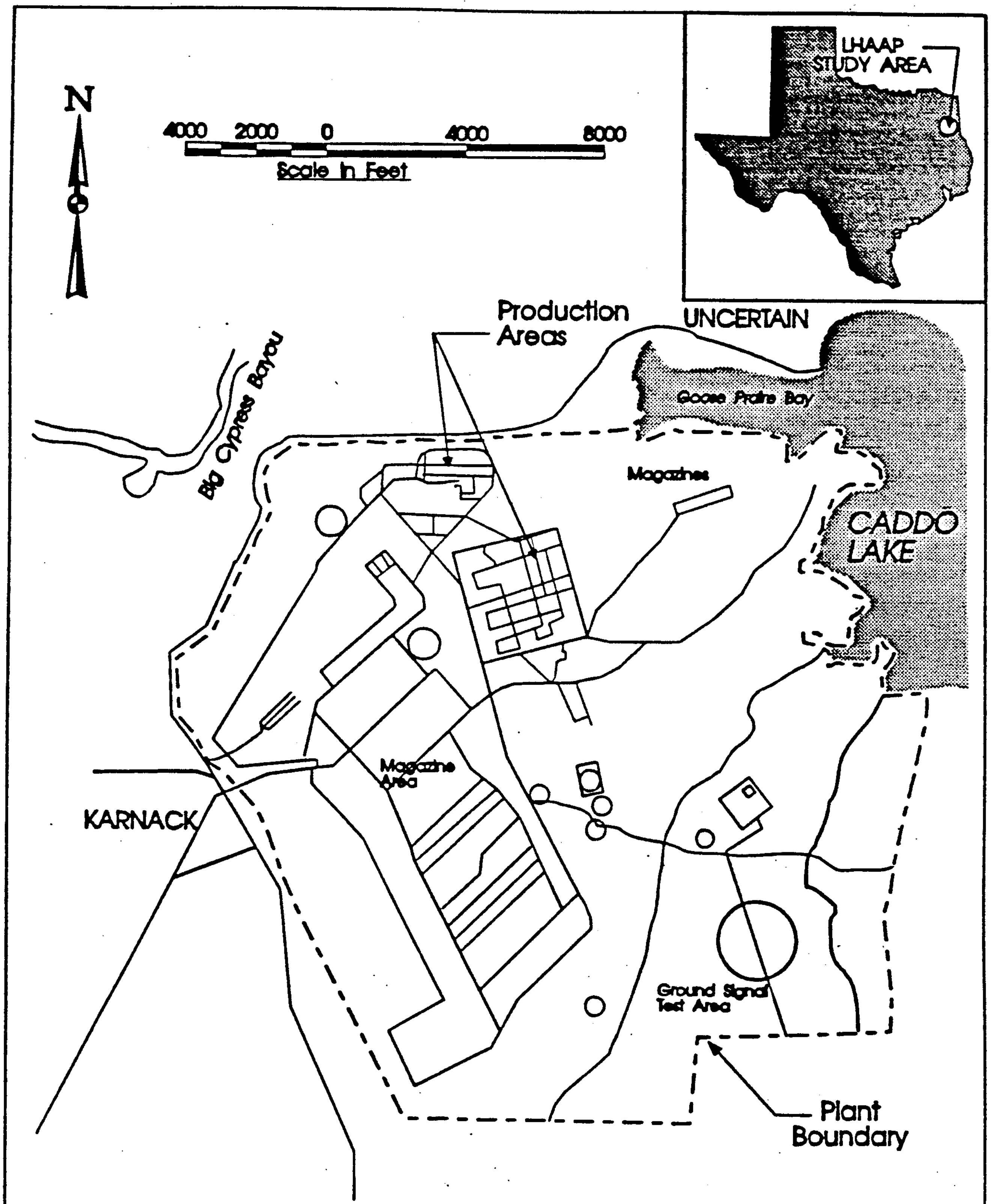

Figure 1
Longhorn Army Ammunition Plant
Harrison County, Texas

the integrity of 12 randomly selected sumps systems. The data generated during this study indicated the presence of contamination in the soil adjacent to the 12 sumps.

As a result of this previous investigation and under the direction of the LHAAP, the U.S. Army Corps of Engineers (USACE) Tulsa District prepared a scope of work for Phase I investigative activities which required the determination of possible soil contamination at 125 waste process sumps, 20 waste rack sumps, and corresponding drain lines which extend from the buildings out to the sumps. During the Phase I field activities, soil samples were collected from borings adjacent to each sump site and analyzed for 19 metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). Cyanide, TPH and explosives were also analyzed for in areas where these constituents may have been used. The data obtained from soil samples collected during the Phase I investigation are presented in the Report of Phase I Investigations of 125 Waste Process Sumps and 20 Waste Racks. Data generated during the Phase I field activities is presently being used to establish base-wide background levels. The presence of non-naturally occurring constituents in the soils have resulted in the recommendation, by the USACE, to investigate the possible contamination of the groundwater.

1.1.4 Regulatory Overview. Remedial investigations of the 125 process waste and 20 waste rack sumps are being conducted under a Federal Facilities Agreement (FFA) between the Department of the Army, U.S. Environmental Protection Agency (EPA), and the Texas Natural Resource Conservation Commission (TNRCC). Under the direction of LHAAP, the U.S. Army Corps of Engineers (USACE) has conducted a Phase I Sumps Investigation as part of a remedial investigation carried out under the Remedial Investigation/Feasibility Study (RI/FS) program. Activities to be performed during Phase II are outlined in this workplan and will be conducted in accordance with the requirements of the

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 120 Federal Facilities Agreement.

2.0 TECHNICAL APPROACH

In order to accomplish the RI/FS objectives, data will be collected to characterize the nature and extent of groundwater contamination. In addition, data will be gathered to support the development of a risk assessment.

2.1 Risk Assessment - Sampling during this investigation will generate data which will address requirements for the Human Health Evaluation portion of the Risk Assessment. Data collection for use in the development of a Ecological Risk Assessment will be discussed under a separate workplan. A health risk assessment is a qualitative and quantitative evaluation made on the basis of scientific evidence of the relationship between potential exposure to toxic substances and the potential occurrence of adverse effects. Potential risks from toxic substances to human populations and the environment are a function of two factors: hazard and exposure. To induce adverse health effects, a chemical must possess toxic properties and exist at significant levels in the environment.

2.2 Quality Assurance/Quality Control (QA/QC) - Procedures for QA/QC sampling and analysis will be strictly adhered to during this investigation. The QA/QC procedures will ensure that data generated during the investigation are valid and can be used to support future records of decisions. QA/QC procedures include the following activities:

- defining sampling and analytical techniques;
- confirming sample identity;
- establishing Precision, Accuracy, Representativeness, Comparability and Completeness of reported data;
- documentation of analytical procedures during sample analysis and constituent concentration levels;
- establishing detection limits for analytes; and
- establishing any bias arising from field sampling or laboratory analytical activities.

QA/QC objectives are detailed in section 4.0 of the CDAP (Appendix B).

2.3 Data Management - The data management (DM) activities associated with the work during this investigation will be primarily concerned with the gathering of information and organizing it into a logical format for each site and the reporting of large volumes of field and laboratory analytical data generated during field activities. The DM activities will allow for the electronic storage, access, and communication of these data to LHAAP and USACE.

Data will be required on electronic media as specified in the "Guidance for Submittal of Data on Electronic Media for the Tulsa District HTRW Project Database" (Appendix C).

3.0 OVERVIEW.

A phased approach will be used to conduct the Phase II sumps investigation activities. The Phase II investigation will be conducted to determine whether contaminants have migrated from the sumps into the groundwater. Determination of the need for additional soil sampling to define the extent of contamination will be made after an evaluation of the results of the background concentration study, which should be completed in January 1995, has been made. LHAAP currently has plans to remove some of these sumps. Any additional field activities to define the nature and extent of soil contamination will be presented as an addendum to this workplan.

The objective during Phase II is to determine if contamination exists in the groundwater and to define the nature and extent of this contamination. In order to accomplish this task, the field activities in Phase II include the installation of 71 groundwater monitoring wells placed hydraulically upgradient and downgradient from the areas of the sumps. Information gathered from other investigative activities conducted in 1993 at sites LHAAP 01 AND LHAAP 29, indicate that groundwater flows in an easterly direction across the areas of the sumps investigation. Monitoring well locations are shown on Maps A, B, and C (ref Appendix A).

Waste process sumps 114, 115 and 116 are located within the Burning Grounds area where extensive investigation activities are currently being conducted. For this reason, no additional monitoring wells will be installed in this area.

Other field activities to be conducted during Phase II are collecting surface soil, sediment and surface water samples for chemical analysis, soil samples for physical tests, developing the wells, collecting groundwater samples for chemical analysis, slug tests, surveying well locations, and geophysical logging of wells. Procedures for these activities are discussed in detail in the CDAP (Appendix B).

Field activities are scheduled to begin in mid-August 1994 and continue through the end of September 1994.

4.0 PHASE II FIELD WORKPLAN.

4.1 General. The soil sample results from the Phase I investigation indicated that contamination exists in the soil adjacent to the sumps and the sump waste racks. The discovery of the presence of organics in the soil samples resulted in the need to investigate the groundwater to determine if these contaminants are present. To accomplish this task, 71 groundwater monitoring wells will be installed in the vicinity of sumps located within the Production Area (Plant 2 and Plant 3), the Igniter Area, the 400 area, the Shops Area, the Y-Area and the Static Test Area. Well locations are shown on Maps A, B, and C. These locations were selected based on the direction of groundwater flow in this area. Wells are placed both hydraulically downgradient or east of the sumps sites and hydraulically upgradient or west of the sump sites for the purpose of monitoring the quality of groundwater in the sumps investigation area.

4.2 Access Permits. Permits for drilling will be obtained under the agreement by the LHAAP Environmental Division. The USACE Technical Manager, Ms. Bernice Perez (918) 669-7172 will contact the LHAAP Safety Office for approval of flame permits and to obtain access into areas restricted due to on-going processing. Point of contact (POC) in the LHAAP Environmental Division is Mr. David Tolbert (903) 679-2728 and POC in the LHAAP Safety Office is Ms. Bonnie Andrews (903) 679-2661.

4.3 Description of Field Work. Section 5.0 of the CDAP discusses the field activities to be performed during this investigation. These activities include, but are not limited to:

- obtaining the appropriate clearances and permits required to commence drilling;
- installing and developing 71 monitoring wells
- decontamination of all equipment between sites
- containerization of investigation derived wastes (IDWs)
- collection of soil samples for physical testing

- collection of surface soil, sediment, surface water, and groundwater samples for chemical analysis
- maintaining documentation of all activities (drilling, sampling, containerization of IDWs and inventories of drums, etc...)
- purging and sampling monitoring wells
- logging the wells
- staging of drums in a secure site
- water level measurements
- slug tests
- surveying of all monitoring wells.

Field activities to be conducted by contract include the collection of water samples upon completion of well installation and surveying of all groundwater monitoring well locations. The USACE Technical Manager will act as a liaison between LHAAP and the contractor during the execution of all field activities.

The USACE Geotechnical Branch will provide oversight of all field activities to be conducted by a contractor. The contractor will designate a field manager who will be responsible for activities performed under contract.

4.3.1 Installation of Monitoring Wells. Installation, construction and completion of monitoring wells is discussed in detail in the CDAP in section 5.0.

4.3.1.1 Drilling. All monitoring wells will be drilled using an 8" hollow stem auger and/or solid stem flight augers. Drilling will advance through the water bearing zone to the first confining clay layer. During Phase I activities, water was encountered at a depth of 4' to 12'. Depending on the topography, groundwater level is anticipated to be encountered at a depth of 4'-12' at most locations. Drilling will be performed by USACE drillers which have obtained 40 hours of personal protection and safety training and yearly refresher courses as specified in Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120. Drilling activities will not commence until drilling, flame, clearance/permits have been obtained from the appropriate LHAAP authorities.

4.3.1.2 Sampling. Before each sample collection, the samplers will don a new pair of plastic gloves to avoid any chance of contaminating or affecting the sample. A surface soil sample (0-6 inches interval) will be collected from each well location. These samples will be analyzed for the parameters listed in Table 2. Additionally, soil samples for physical tests will be collected with a Shelby Tube. The Shelby tube will be used to collected samples for physical tests until groundwater is encountered. At groundwater, samples will be collected with the use of a clean split spoon. The inspector will take a small sample from the bottom of the Shelby tube and make a visual classification of the soil type and record all observed characteristics to include but not limited to color, organic matter, microstructures, moisture content, plasticity and note any odor. The Shelby tubes will then be prepared for shipping to USACE Southwest Division Laboratory for physical testing to include: Classification of Soils, Moisture Content, Atterberg Limits, and Sieve analysis (including hydrometer). The ASTM standard numbers for these tests are listed in Table 1. Soil samples for chemical analysis will be placed into the appropriate plastic jars and prepared for shipment. Sampling procedures, sample preservation and types of sample containers required are discussed in detail in section 5.7 of the CDAP. Sample labelling and shipment preparation is also explained in section 6.0 of the CDAP.

Sediment and surface water samples will also be collected to gather data required for the development of a risk assessment. Location for the collection of these samples will be determined in the field by USACE personnel directly involved with the development of the Sumps Investigation risk assessment. These samples will be collected from:

TABLE 1

ASTM FOR PHYSICAL TESTS
ON SOIL SAMPLES
PHASE II - SUMPS INVESTIGATION

STANDARDS FOR SOIL SAMPLES	NUMBER OF WELLS TO BE SAMPLED
ASTM D2487 - Classification of Soils	71
ASTM D2216 - Moisture Content	71
ASTM D4318 - Atterberg Limits	71
ASTM D422 - Sieve analysis (including hydrometer)	71

Soil samples will be collected from 71 wells (approximately 6 samples from each well) for physical tests plus 17 QA/QC samples.

1 QA/QC soil sample will be collected for every 25 soil samples collected for physical tests.

71 wells x 6 samples/well = 426
+17 QA samples
+17 QC samples

460 Soil samples for physical testing

1) recognizable drainage ditches leading from sumps areas to any receiving waters (creeks, streams, etc....); and

2) creeks and streams with potential for receiving runoff from sumps area(s). Samples "upstream" from the sumps area(s) will also be collected.

Unless otherwise stated, all samples (sediment, surface soil,surface water and groundwater) will be analyzed for: volatile organic compounds (VOCs); high explosives, semivolatile organic compounds (SVOCs), the following metals: aluminum; antimony; arsenic; barium; cadmium; calcium; chromium; cobalt; copper; iron; lead; magnesium; manganese; mercury; potassium; selenium; silver; strontium; thallium and zinc. The addition of thallium to the regulated metals listed under the Safe Drinking Water Act prompts its addition to the list of metals defined in this workplan. Total Petroleum Hydrocarbons (TPH) and cyanide will be analyzed for in the vicinity of buildings where these compounds may have been used. Table 2 lists the parameters and the methods to be used for these analysis. In addition, the pH, specific conductance and temperature will be recorded for all groundwater samples. Sampling procedures discussed in section 5.7 of the CDAP (Appendix B) will be followed.

<u>4.3.2 Geologic Logs.</u> A geologic log will be prepared in the field by a qualified geologist for each monitoring well drilled. Logs will be completed on an ENG 1836 form. Items 1 through 19 on this form must be completed where applicable. Borehole depth information will be from direct measurement to the nearest 0.01 foot. Each and every material type encountered shall be described in column C of this form. Unconsolidated materials will be described using the descriptive Unified Soil Classification System (USCS) which shall include consistence of cohesive materials or apparent density of non-cohesive materials;

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TABLE 2

USEPA APPROVED ANALYTICAL METHODS
FOR GROUNDWATER, SEDIMENT AND SURFACE WATER SAMPLES
PHASE II - SUMPS INVESTIGATION

EPA APPROVED PARAMETERS	NUMBER OF WELLS TO BE SAMPLED
WATER/SOIL	
Method 8240/8240 - Volatile Organic Compounds Method 8270/8270 - Semi-Volatile Organic Compounds Method 8330/8330 - High Explosives Method 6010/6010 - Aluminum, Antimony, Barium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Magnesium, Manganese, Potassium, Silver, Strontium, Thallium, Zinc Method 7470/7471 - Mercury Method 7060/7060 - Arsenic Method 7421/7421 - Lead Method 7740/7740 - Selenium	71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71 71
Additional parameter for Select Wells	
Method 9010/9010 - Cyanide Method 418.1/418.1 -Total Petroleum Hydrocarbons	1 3

Groundwater samples will be collected from 71 wells, plus

71 ÷ 20 = 4 equipment blanks
71 ÷ 10 = 7 QA samples
7 QC samples
Approximately 40 trip blanks

moisture content assessment; color; and any visual or olfactory evidence of contamination. A visual classification will be made of the soil. Description features such as bedding characteristics; organic matter/materials; and macrostructure of fine-grained soils will also be recorded. Other information to be recorded includes, but is not limited to:

- depth at which water was encountered
- absence of water in boring shall be indicated
- changes in lithology and depth where they occur
- any problems encountered
- any other pertinent information.

4.3.3 Geophysical Logs. Downhole geophysical logging will be performed on all well borings greater than 25 feet. Geophysical logs will provide information on lithology, stratigraphy, water saturation, formation density, porosity and allow correlation between borehole. Types of logs to be used are: induction (spontaneous potential), natural gamma ray, and resistivity. Reference should be made to section 5.5 of the CDAP for further discussion of Geophysical logging.

4.3.4 Air Monitoring. Air monitoring with a photoionization detector (PID) combustible gas meter, or flame ionization detector, will be used as discussed in the Site Specific Health and Safety Plan (Appendix C).

4.3.5 Investigation Derived Wastes (IDW). Section 5.11 of the CDAP, includes discussion of handling, labelling, storing and disposal of IDWs. Drill cuttings will be stored in covered Department of Transportation (DOT) approved 55 gallon drums. Each drum will be labelled clearly using a water-proof paint. Information labelled on each drum should include but not limited to: the monitoring well number, date, identify whether contents in drum are soil, purge water, decontamination water, or personal protective equipment. An inventory of all drums will be kept as drilling occurs and will be provided to the LHAAP Environmental Engineers at the end of each week. Upon completion of all field activities, all drums containing IDW will be transported to an approved staging/storing area designated by LHAAP. Disposal of the soil IDW is contingent on the results of the on-going base wide background study being conducted by the USACE Tulsa District. Disposal of all investigation derived wastes will be accomplished in accordance with all applicable state and federal regulations.

4.3.6 Surveys. Surveys will be made of all wells installed during Phase II. Locations will be determined by conventional surveys to determine the elevation of the top of the ground surface, the top of the riser pipe at the notched mark and the horizontal state plane coordinates of each well. Surveys will be performed in accordance with and strictly adhered to the USACE, Tulsa District, Survey Section standards. The USACE, Tulsa District, Survey Section must review and approve of all surveying methodologies/activities prior to commencement of surveying field activities. Reference CDAP section 5.4 for discussion on location surveys.

4.3.7 Other Tests. Slug tests will be conducted on all monitoring wells. This task will be conducted by USACE personnel.

4.3.8 Equipment Decontamination. The LHAAP Fire Department (903) 679-2315 will be contacted for obtaining access to potable water required for the decontamination process for this investigation. All equipment used for drilling, well installation, well development, and sample collection will be decontaminated with a steam cleaner or a high pressure hot water washer and will be decontaminated between each location site. A decontamination station will be set up at a location approved and designated by the LHAAP Environmental Coordinator. At this site, a decontamination pad will be constructed to prevent any decontamination fluids from escaping onto the ground. A pump will be utilized to remove any wastes from the collection basin and into a 55 gallon bung drum. The decontamination water will be properly containerized and labelled accordingly. Reference should be made to the CDAP Section 5.9 for a detailed discussion on decontamination procedures. All wastes will be later tested and disposed of in accordance with the applicable state and federal regulations.

5.0 SAMPLES AND DATA ANALYSIS.

5.1 Handling of Soil Samples. Soil samples will be collected with a clean 3" diameter split spoon and placed into the appropriate sampling containers. Samples for chemical analysis will be immediately placed on ice and all efforts will be made to maintain these samples at a temperature of 4°C. Types of containers and preservation of samples are included as Appendix B of the CDAP. Labelling will be in accordance with Section 6.0 of the CDAP. Samples will then be prepared for shipment to the contract laboratory.

5.2 Handling of Groundwater Samples. The types of sample containers, sample volumes, methods of preservation, and holding times for groundwater samples are listed in Appendix B of the CDAP. The Sample Numbering System for labelling each sample is discussed in section 6.0 of the CDAP.

All sample containers will be clearly labelled and identified with the sampling information, including date, time and name of sampler. Samples will be chilled to 4°C after collection. Each sample will be sealed in plastic "zip lock" bags to protect the labels from water damage and placed in ice chests for shipment. The samples will be placed in high impact plastic ice chests in a manner to minimize tipping, spilling or breakage. Included in each ice chest will be a completed chain of custody form accompanying the samples. This form will also be placed in a "zip lock" bag and taped on the inside cover of the ice chest. Ice or other items to keep samples chilled will be placed in the ice chest prior to sealing. All containers will be sealed appropriately with a chain of custody seal. Samples will be shipped via overnight commercial carrier to the laboratory. The local Greyhound bus station is located in downtown Marshall, Texas. The address is as follows:

201 S. Boliver
Marshall, Texas
Phone: (903) 938-6763

5.3 QA/QC Samples. One QA/QC sample set will be collected for every 10 field samples collected for chemical analysis. Detailed information regarding

QA/QC samples is discussed in section 5.10 of the CDAP. **All QA samples will be sent to the USACE Southwest Division Laboratory (SWD) for analysis.** Field personnel will notify the laboratory prior to shipping samples and <u>MUST</u> notify SWD when the last samples are being shipped. For samples to be shipped on Fridays, Saturdays or on days prior to a holiday, the field personnel <u>MUST</u> notify the laboratory by Wednesday prior to the weekend, so that arrangements can be made to pick up/accept samples over the weekend/holiday. Points of contact at SWD laboratory are Mai Tran and Randy Smith. SWD phone number and address is provided below:

USACE Southwest Division Laboratory
4815 Cass Street
Dallas, Texas 75235-8100
Phone (214) 905-9130

All other samples will be shipped to the contract laboratory. Name and address of contract laboratory will be provided at the beginning of field activities

5.4 Equipment and Travel Blanks. Equipment or rinsate blanks will be taken at a rate of 1 for every 20 samples collected. One travel or trip blank will be prepared for each ice chest containing samples to be analyzed for VOCs. Information on equipment and travel blanks are discussed in section 5.10 of the CDAP.

5.5 Data Evaluation and Management. The data generated during this investigation will be evaluated, and summarized into a Field Data Summary Report. The report will include pertinent information such as, but not limited to:

- a stratigraphic and hydrologic description
- pertinent hydrologic information
- groundwater flow calculations
- maps showing groundwater flow direction
- groundwater chemical analysis results
- field survey results

- slug test results
- physical test results
- any tables, graphs and maps associated with the above data.
- recommendations for further investigation (if applicable)
- recommendations for no further action (if applicable)

5.6 Data Validation. A data validation report, of all the chemical analysis results, will be prepared by Weston, Inc. under contract to the USACE Tulsa District. This report will be submitted to the USACE Tulsa District C & IH Section of the Geotechnical Branch for their evaluation. The validation report will be included as an Appendix to the Phase II Investigation of 125 Waste process Sumps and 20 Waste Rack Sumps Field Summary Report. Reference CDAP section 8.0 for a discussion on data validation and reporting.

6.0 BUDGET AND SCHEDULE.

Phase II remedial activities for the sumps investigation at LHAAP will be funded by the Defense Environmental Restoration Account (DERA) which is managed by the United States Army Environmental Center (AEC). Because of the number of Army installations requiring environmental restoration work and limited funding, not all work is funded immediately.

This workplan will be executed upon receipt of funding and approval of the proper authorities. The Phase II Workplan field activities are currently scheduled to begin in August 1994 and completed by December 1994.

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7.0 REFERENCES.

1. BCM, 1992, BCM Engineers, Planners, Scientists and Laboratory Services, Draft Final Report, Wastewater Collection and Treatment System Evaluation, Project No. 06-7959-01, February 1992.

2. USACE, 1992, Longhorn Army Ammunition Plant RI/FS Work Plan, Vol 1, U.S. Army Corps of Engineers, Tulsa District, June 1992.

3. USACE, 1994, Longhorn Army Ammunition Plant Phase I Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps, Tulsa District, 1994.

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APPENDIX A

OF

FINAL WORKPLAN

MAPS

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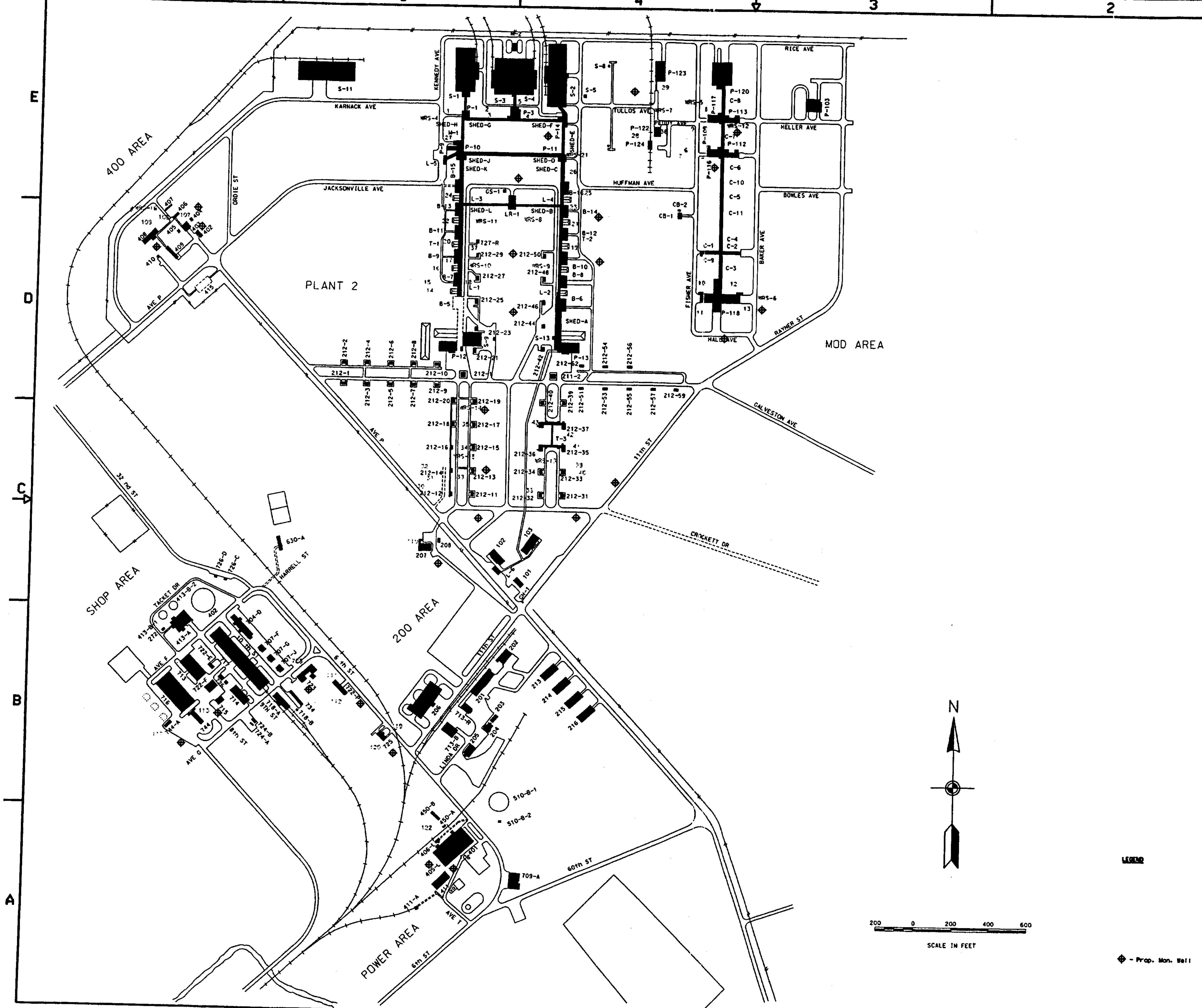

SYM	DESCRIPTION	DATE	APPR
	$ THINK VALUE ENGINEERING - IT SAVES MONEY $		

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

DESIGNED BY:
DRAWN BY: DJ
CHECKED BY: BP
SUBMITTED BY:
CHIEF.

PLANT 2
200, 400 & SHOP
AREAS

SCALE: AS SHOWN
DATE: 2-17-94
DWG CODE:
SHEET REFERENCE NUMBER: A
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CONTRACT NO DACA56- -C-
SHEET OF

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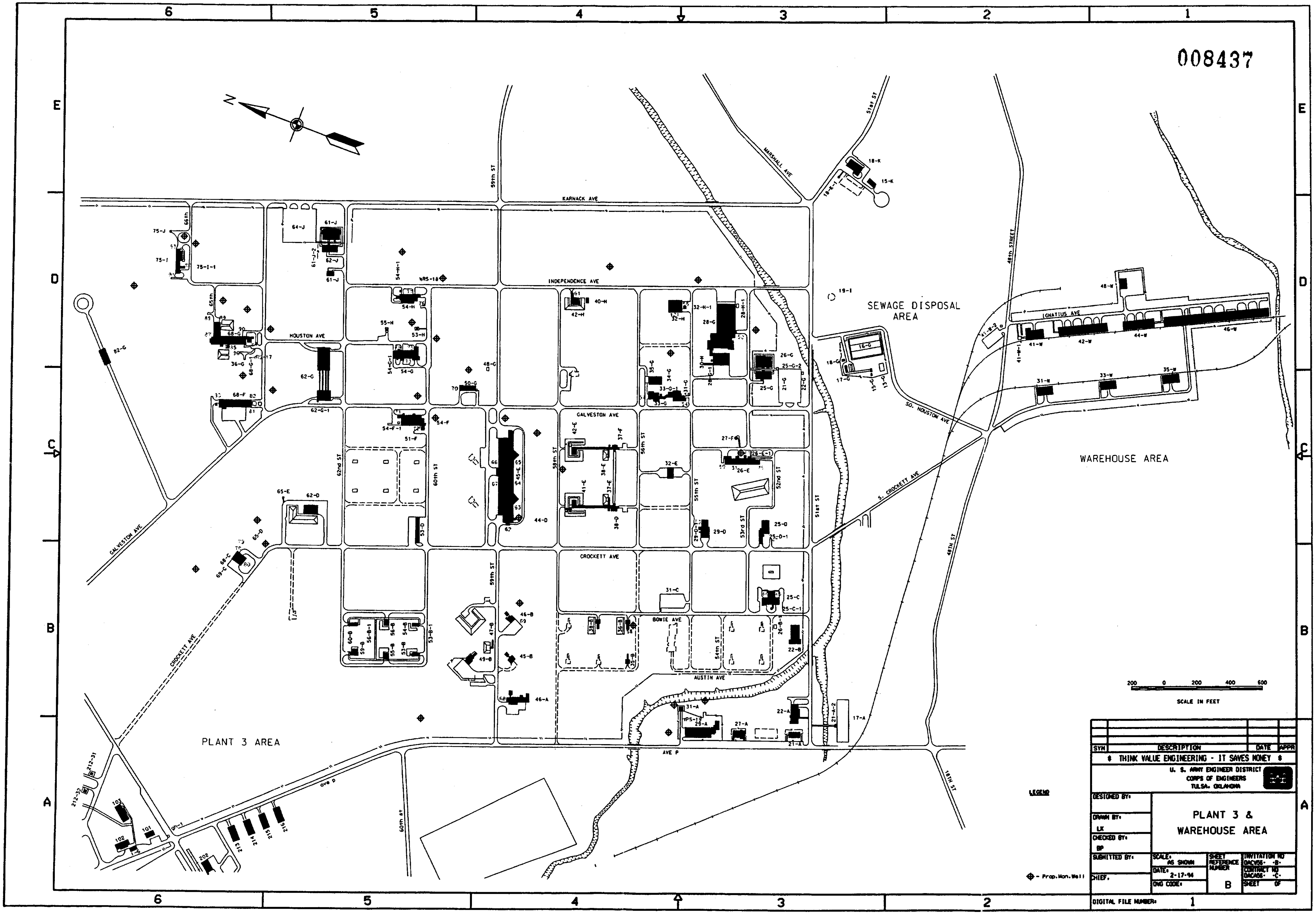
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WAREHOUSE AREA
SEWAGE DISPOSAL AREA
PLANT 3 AREA
KARNACK AVE
INDEPENDENCE AVE
HOUSTON AVE
GALVESTON AVE
CROCKETT AVE
BOWIE AVE
AUSTIN AVE
AVE P
IGNATIUS AVE
MARSHALL AVE
SO. HOUSTON AVE
S. CROCKETT AVE
48th STREET
48TH ST
51st ST
52nd ST
53rd ST
54th ST
55th ST
56th ST
58th ST
59th ST
60th ST
62nd ST
65th
66th
18TH ST
SCALE IN FEET
200 0 200 400 600
LEGEND
- Prop. Mon. Well
SYM
DESCRIPTION
DATE
APPR
$ THINK VALUE ENGINEERING - IT SAVES MONEY $
U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA
DESIGNED BY:
DRAWN BY:
LK
CHECKED BY:
BP
SUBMITTED BY:
CHIEF,
PLANT 3 &
WAREHOUSE AREA
SCALE: AS SHOWN
DATE: 2-17-94
DWG CODE:
SHEET REFERENCE NUMBER
B
INVITATION NO DACW56- -B-
CONTRACT NO DACA56- -C-
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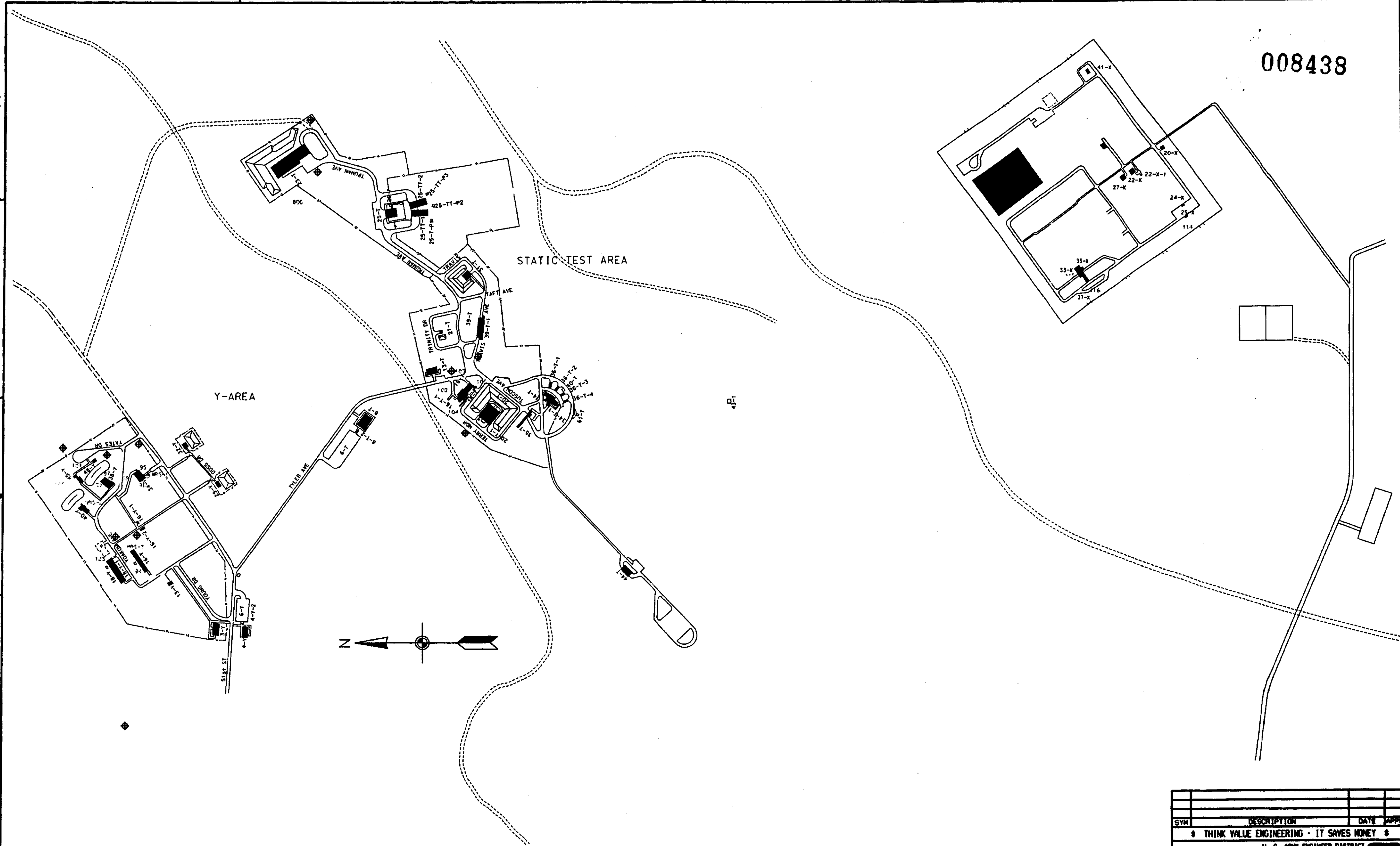

SYM	DESCRIPTION	DATE	APPR

$ THINK VALUE ENGINEERING · IT SAVES MONEY $

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

DESIGNED BY:
DRAWN BY: LK
CHECKED BY: BP
SUBMITTED BY:
CHIEF.

Y-AREA & STATIC TEST AREA

SCALE: AS SHOWN
DATE: 2-17-94
DWG CODE:
SHEET REFERENCE NUMBER: C
INVITATION NO DACW56- -B-
CONTRACT NO DACW56- -C-
SHEET OF

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008439

APPENDIX B

OF

FINAL WORKPLAN

CHEMICAL DATA ACQUISITION PLAN

008440

LONGHORN ARMY AMMUNITION PLANT
PHASE II INVESTIGATIONS OF 125 WASTE PROCESS SUMPS AND 20 WASTE RACK SUMPS

FINAL WORKPLAN

CHEMICAL DATA ACQUISITION PLAN

APPENDIX B

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

PREPARED FOR:

LONGHORN ARMY AMMUNITION PLANT
Karnack, Texas

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LONGHORN ARMY AMMUNITION PLANT
DEPARTMENT OF ENERGY
QUALITY ASSURANCE PROJECT PLAN
RCRA FACILITY INVESTIGATIONS

VOLUME III

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LIST OF ACRONYMS

ASTM	American Society of Testing Materials
CDAP	Chemical Data Acquisition Plan
CFR	Code of Federal Regulations
CIH	Chemistry and Industrial Hygiene Section
COC	Chain of Custody Form
DNAPL	Dense Non-Aqueous Phase Liquid
DOT	Department of Transportation
DQO	Data Quality Objective
EB	Equipment Blank
EM	Engineering Manual
EPA	U. S. Environmental Protection Agency
ER	Engineering Regulation
ERMA	Environmental Restoration Management Analysis
F	Farenheit
Ft	Feet
HE	High Explosive
HTW	Hazardous and Toxic Waste
IDW	Investigation Derived Wastes
LHAAP	Longhorn Army Ammunition Plant
QA	Quality Assurance
QC	Quality Control
mg/L	Milligrams per Liter
mg/kg	Milligrams per Kilogram
MRD Lab	Missouri River Division Laboratory
MS	Matrix Spike

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LIST OF ACRONYMS (Continued)

MSD	Matrix Spike Duplicate
MW	Monitoring well
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RFI	RCRA Facilities Investigation
SSHP	Site Specific Health and Safety Plan
SWD Lab	Southwestern Division Laboratory
TB	Travel Blank
TNRCC	Texas Natural Resource Conservation Commission
$\mu g/L$	micrograms per Liter
$\mu g/kg$	micrograms per Kilogram
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System

1.0 INTRODUCTION.

1.1 General. The purpose of this Chemical Data Acquisition Plan (CDAP) is to document the procedures required to ensure that all data obtained from the investigative activities to be conducted at Longhorn Army Ammunition Plant (LHAAP) are of acceptable quality. The validity and representativeness of this data must be ensured, so that the magnitude and extent of contamination can be accurately defined and remedial decisions can be made which are technically sound. Quality assurance (QA) is the Government activity required to assure desired and verifiable levels of quality in all aspects of an investigation. Quality control (QC) is the functional mechanism to achieve quality data. The QA program, administered by the Government, will ensure that the QC program will result in high quality data. This document will describe the QA/QC procedures for each aspect of the investigations which will meet the data quality objectives of this project. Procedures in this CDAP came from *Chemical Quality Data Management for Hazardous Waste Remedial Activities,* ER-1110-1-263 (ref. 2), a Corps of Engineers regulation, with additional guidance from *RCRA Facility Investigations Guidance,* SW-87-001 (ref. 6), and *Test Methods for Evaluating Solid Waste,* SW-846, (ref. 4).

1.2 Organization. This document discusses the data quality procedures and techniques to be used in the workplan for the sumps investigation at the LHAAP, Karnack, Texas. The study will be accomplished through the sampling and analysis of surface soil, sediments, surface water, and groundwater. A description of the project is given in Section 2. Section 3 describes project organization and personnel; Section 4 discusses the quality assurance objectives for this project; Section 5 discusses the field work to be performed and the procedures to be used in drilling, well installation, and sampling of surface soil, sediment, groundwater, and surface water; and Section 6 discusses sample handling and testing. Sections

7 through 10 discuss sample integrity, data reduction and validation, audits, and corrective action.

2.0 PROJECT BACKGROUND. LHAAP is a government-owned, contractor-operated (Longhorn Division of Thiokol Corporation) facility under jurisdiction of the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM). Current activities at LHAAP include loading, assembling, and packing of pyrotechnic, illuminating and signal ammunition. Located within the production areas and at various locations throughout LHAAP are subsurface waste sumps of varied design and age. These sumps have been used for the purpose of collecting waste waters associated with production processes and related activities. Based on the age and design of these sumps, it is suspected that the contents from these sumps may have been released into the environment over time.

Under the direction of LHAAP, the U.S. Army Corps of Engineers conducted an investigation of the soil adjacent to these sumps. These samples were analyzed for volatile organic compounds, semivolatile organic compounds, 19 metals (aluminum, antimony, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, potassium, selenium, silver, strontium, and zinc). In select areas, soil samples were also analyzed for high explosives, cyanide and total petroleum hydrocarbons. The results of the chemical analysis indicated contamination in the soil. All the results are available from the USACE, Tulsa District and presented in the draft final report "U.S. Army Corps of Engineers, Phase I Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps, February 1994" (ref 8).

The presence of non-naturally occurring constituents in the soils have resulted in the need to investigate the possible contamination of the groundwater.

3.0 PROJECT ORGANIZATION. The Tulsa District, U.S. Army Corps of Engineers (USACE), will use a multi-disciplinary project team from the District to oversee all Phase II sumps investigation project activities.

3.1 Field Personnel. Field operations will be conducted by the Tulsa District, a contractor, or both. Activities will be coordinated by the USACE Technical Manager. The USACE Technical Manager for this project is Ms. Bernice Perez, Engineering Geology and Soil Mechanics Section (918) 669-7172. The USACE Technical Manager will coordinate all field activities with the Tulsa District Office and provide safety and quality control oversight with USACE Geotechnical Branch personnel. Activities conducted under an A-E contract will require each contractor to also designate a Field Manager who will coordinate activities with the USACE Technical Manager.

3.1.1 Tulsa District Field Crews. Tulsa District drilling crews consist of a driller, two helpers and an inspector/geologist. Oversight for drilling activities and all field activities will be performed by USACE Geotechnical Branch personnel. Members of Tulsa District field crews have worked on hazardous waste investigation projects on military installations in Texas, Oklahoma, Arkansas, and New Mexico. Crew members attend formal and informal training sessions, including mandated RCRA & OSHA hazardous and toxic waste (HTW) safety training. Tulsa District sampling and drilling procedures have been critiqued by Region VI, U.S. Environmental Protection Agency, the Oklahoma Water Resources Board, the Oklahoma State Health Department, and the Texas Natural Resource Conservation Commission (TNRCC). The average hazardous waste experience level of the water sampling crew members is approximately 4 years. The average hazardous waste experience level of the drilling crew members is approximately 5 years.

3.1.2 Contract Field Crews. Firms currently under contract to the Tulsa District will perform groundwater sampling activities and surveying of the well locations are the end of all well installation. They were selected based on their qualifications and experience in the environmental investigations field. Each contractor will designate an on-site Field Manager who act as a liaison between the field crew and the USACE Technical Manager. The contractor Field Manager will also be responsible for all field activities executed under contract with the Tulsa District. The contractor will provide an industrial hygienist who oversees the preparation of site specific health and safety plans and oversees all safety aspects of the field activities, when required.

3.2 Quality Control Personnel. All personnel involved in this investigation are responsible for monitoring and reviewing all procedures used in every stage of the work to ensure that data generated in the course of execution of the workplan is accurate, complete, precise and representative of the site studied. The Field Manager or a member of her/his staff shall be designated as the Quality Control Officer and will be responsible for the proper execution of field QC, as discussed in Section 5.10.

3.3 Quality Assurance Personnel. Quality assurance will be performed by the Corps of Engineers, Tulsa District, Geotechnical Branch, Chemistry and Industrial Hygiene Section (CIH) and the Engineering Geology/Soils Mechanics Section. The CIH Section reports to the Chief, Geotechnical Branch and will be responsible for performance and system audits of field and laboratory work, on-going review of QA procedures, and to provide safety training for project personnel. An A-E firm under contract to the USACE will prepare the validation report. The CIH Section will also be responsible for data evaluation and for evaluation of the validation report. The audit function is discussed in Section 9. The USACE Engineering Geology/Soils Mechanics Section will be responsible for providing quality assurance oversight for all field activities to be conducted during the sumps investigation. In addition, they will also be responsible for coordinating security, access, and waste management procedures with LHAAP and their Operating Contractor.

3.4 Laboratories. Analytical, physical and quality control testing will be performed by laboratories directed by the Architect-Engineer firm under contract to the USACE. QA testing is performed by the Corps of Engineers Southwestern Division Laboratory (SWD). SWD is responsible for procuring analytical services, and analyzing QA samples. Details on SWD Lab organization, responsibilities and key personnel are contained in their QA/QC Plan, which is on file in the Tulsa District office. For the sumps investigation, all field and QC samples will be analyzed by Weston, Inc. QA samples will be shipped to SWD.

3.4.1 Samples Collected by Tulsa District Field Crews. During drilling activities, soil samples will be collected for physical testing. These samples will be collected with the use of a Shelby tube and a split spoon. The soil samples will be collected at every 5′ interval or at a change of lithology for physical testing. Physical testing will be conducted to gather information for accurate characterization of soil types at LHAAP. Additionally, surface soil samples for chemical analysis will also be collected at each well location. These samples will be analyzed for the constituents listed in Table 5.3. All QA field samples will be shipped to SWD and all other field samples will be shipped to the contract laboratory.

3.4.2 Sampling by Contract Field Crews. Groundwater sampling will be performed by an A-E contractor. They will ship groundwater samples and QC samples to the designated contract laboratories. The QA samples will be sent to SWD Lab.

3.4.3 Laboratory Validation. SWD and all contract laboratories which analyze samples for metals, anions, herbicides, explosives, volatiles, semivolatiles are validated by the Corps of Engineers Missouri River Division (MRD). The validation process involves review of their laboratory quality management manual, laboratory analysis of performance sample evaluation, and an on-site audit. This validation process is discussed in detail in Appendix B of ER-1110-1-263 (ref. 2), and *Validation of Analytical Chemical Laboratories*, EM 200-1-1, (ref. 7).

4.0 QUALITY ASSURANCE OBJECTIVES. The data quality objectives (DQOs) of this project have been chosen to meet the goals of site characterization, risk assessment, and remedial design. These goals can be achieved with analytical support between Level III and Level IV, as described in ref. 5. As described in ref. 1, the minimum internal data reporting requirements which will be required of all analytical laboratories includes the following:

- Results of field samples, laboratory blanks, surrogate recoveries, matrix spikes, laboratory control samples, laboratory duplicates, matrix spike duplicates, relative percent differences, field duplicates, and field blanks. Sample identification numbers will be cross-referenced with laboratory ID's and QC sample numbers.

- The original copy of the executed Chain of Custody Forms and the Cooler Receipt Forms on which the laboratory has documented the condition of the samples on arrival.

- Each analyte will be reported as an actual unadjusted value or less than a specified quantitation limit (listed in Appendix B, Tables B.4 through B.7). Each questionable result (based on laboratory QC) will be reported as such and appropriately flagged. Soil samples will be reported on a dry weight basis with the moisture content reported as a separate value. Dilution factors, holding times and discusses extraction dates, and analysis dates will also be reported.

- A Data Validation Report which addresses the accuracy, precision, and representativeness of analysis results. This report shall contain a table which indicates the sample field identification number, the date the sample was collected, and the methods of analysis conducted at various laboratories. The comparability section of the report will be added during the review process by the Corps of Engineers, CIH Section.

■ Electronic data in the Environmental Restoration Management Analysis (ERMA) format data files. The file structure is outlined in Appendix C of the CDAP.

The data developed from the investigations described in the workplan should meet the objectives discussed below with respect to precision, representativeness, accuracy, completeness, and comparability. The majority of this data will be developed in the laboratory from the analysis of field samples and the remainder will be measured in the field.

4.1 Accuracy. Accuracy is the degree to which a measurement agrees with the actual value, i.e., the amount of measurement bias. Accuracy is expressed as a percent recovery of a known concentration of reference material. The accuracy of an analytical procedure is determined by the addition of a known amount of material (matrix spike) to a field sample matrix or a standard matrix. A standard matrix is made up of distilled water or sterile, clean soil with approximately the same physical properties (porosity, permeability, plasticity, grain size, etc.) as the field sample. The field sample matrix is described as all components of the sample mixture except the analyte (the compound being analyzed). The analytical laboratories will be required to perform matrix spike/matrix spike duplicates on 5% of the field samples in addition the laboratory's quality control program. Field sample matrix and standard matrix sample spiking show how the sample matrix-analyte chemical interactions affect the analytical results. The matrix behavior of the spiked field sample will be comparable to that of the matrix of the original sample. The matrix spike consists of a known amount of analytes which are added to the matrix before analysis. After analysis for the spike is completed, the accuracy of the procedure is expressed as a percent recovery as shown by the following equation:

$$\% \text{ recovery} = \frac{(C_2 - C_1)}{C_0} \times 100\%,$$

where C_0 = amount of analyte added to the sample matrix,
C_1 = amount of analyte present in the unspiked sample matrix (equal to zero for the standard matrix),
and C_2 = amount of spiked material recovered in the analysis.

Typically, the amount of a reference analyte spiked into a field sample matrix is specified by the laboratory quality control program, or 3 to 5 times the background concentration of the analyte in the sample matrix. Samples cannot be spiked for all organic compounds which could possibly exist in the field sample matrix, however, a set of surrogate compounds, each of whose physical and chemical properties is similar, is used as surrogate matrix spikes, or surrogates. Acceptable recovery ranges for each class of organic compounds are discussed in the analytical methods for each parameter.

4.2 Precision. Precision is a measure of the degree of reproducibility of an analytical value and is used as a check on the quality of the sampling and analytical procedures. Precision is determined by analyzing replicate samples. The significance of a precision measurement depends on whether the sample is a field replicate, lab replicate, or a matrix spike replicate. Field replicates are taken at the rate of 10% or one per batch (each daily shipment of samples from a site), whichever is greater. Matrix spike/matrix spike duplicates are performed on 5% of the field samples in addition to the laboratory's quality control program. Precision of the analytical method, at each stage, is determined by calculation of a relative percent difference (RPD) between duplicate analytical recoveries of a sample component, relative to the average of those recoveries, or a factor of difference, the ratio of the concentrations. The RPD is calculated as follows:

$$RPD = \frac{|C_2 - C_1|}{(C_2 + C_1) \div 2} \times 100\%$$

where C_1 = analyte concentration in the sample,
C_2 = analyte concentration in the sample replicate,

and $|\ |$ = an absolute value (It is customary to express RPD as a positive number).

These calculations are usually performed on matrix spikes and matrix spike duplicates.

Because of the substantial variations encountered with field duplicates, a separate calculation for precision is performed for field quality control duplicates. A factor of difference will be calculated as:

$$\text{Factor} = \frac{C_1}{C_2} \quad \text{if } C_1 \text{ is higher than } C_2$$

or

$$= \frac{C_2}{C_1} \quad \text{if } C_2 \text{ is higher than } C_1$$

where C_1 = analyte concentration in the field sample,
C_2 = analyte concentration in the field quality control sample replicate,

The acceptance limit for the factors will be a maximum of 2 for water samples and a maximum of 5 for soil samples.

4.3 Completeness. Field completeness will be assessed by comparing the number of samples collected to the number of samples planned. Analytical completeness will be assessed by comparing the total number of samples with valid analytical results to the number of samples collected. The overall project completeness is, therefore, a comparison between the total number of valid samples to the number of samples planned. The results will be calculated following data validation and reduction. Completeness (C) is determined by:

$$C = \frac{P_1}{P_0} \times 100\%$$

where P_0 = total number of samples planned,
and P_1 = number of valid data points.

A value of 90% or higher is the goal. For values less than 90%, problems in the sampling or analytical procedures should be examined and possible solutions explored.

4.4 Representativeness. Representativeness expresses the degree to which sample data accurately and precisely represent actual site conditions. The determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures to those outlined in the workplan.
- Comparing analytical results of field duplicates with samples to determine the spread in the data.
- Examining blanks for cross contamination.

Representativeness is a qualitative determination. The representativeness objective of this workplan is to eliminate all non-representative data.

4.5 Comparability. Comparability is a qualitative measure of the confidence with which one data set can be compared to another. These data sets include data generated by different laboratories performed under this workplan, data generated by laboratories in previous investigative phases, data generated by the same laboratory over a period of several years, or data obtained using differing sampling techniques or analytical protocols. The comparability objectives of this work plan are (1) to generate consistent data using standard test methods; and (2) to salvage as much previously generated data as possible. Comparability will be evaluated by comparing the QA sample analyzed by SWD to its field replicate.

Because of the substantial variations encountered with field duplicates, a separate calculation for precision is performed for field quality assurance duplicates.
A factor of difference will be calculated as:

$$\text{Factor} = \frac{C_1}{C_2} \quad \text{if } C_1 \text{ is higher than } C_2$$

$$\text{or} \quad = \frac{C_2}{C_1} \quad \text{if } C_2 \text{ is higher than } C_1$$

where C_1 = analyte concentration in the field sample,
C_2 = analyte concentration in the field quality assurance sample replicate,

The acceptance limit for the factors will be a maximum of 2 for water samples and a maximum of 5 for soil samples.

4.6 Sensitivity. Sensitivity is a general term which refers to the calibration sensitivity and the analytical sensitivity of a piece of equipment. The calibration sensitivity is the slope of the calibration curve evaluated in the concentration range of interest. The analytical sensitivity is the ratio of the calibration sensitivity to the standard deviation of the analytical signal at a given analyte concentration. The detection limit, which is based on the sensitivity of the analysis, is the smallest reported concentration in a sample within a specified level of confidence. Quantitation limits represent the sum of all of the uncertainties in the analytical procedure plus a safety factor. The detection limit is a part of the quantitation limit. Quantitation limits are given in Tables B-4 to B-5.

5.0 FIELD OPERATIONS. This section discusses drilling, well installation, sampling, decontamination, waste disposal, other field procedures, and field QA/QC.

5.1 Oversight.

5.1.1 Field Manager. Field activities will be overseen by the Field Manager and/or Technical Manager, who will meet with the sampling and drilling crews prior to the commencing of the Phase II field activities. The purpose of the meeting is to review the objectives of the investigation and resolve any unclear details. The Field Manager will discuss drilling locations and clearances, sampling parameters and equipment, decontamination, and any special considerations of this site. The Field Manager is responsible for ensuring that sampling procedures as discussed in the workplan and the CDAP are followed, that the paperwork is completed correctly, and that the quality control procedures are correctly implemented. The Field Manager will serve as a liaison between the sampling crew and the laboratory and between the field crews and the USACE Technical Manager.

5.1.2 Drill Rig Inspector. A geologist will serve as an inspector for all drilling activities. The geologist will have a degree in geology and drill rig operations experience. The inspector will prepare and describe samples, cuttings, and core, monitor drilling operations and any problems encountered, oversee monitoring well installation, record groundwater data, and prepare monitoring well diagrams and geologic logs.

5.2 Drilling. Dry drilling techniques will be used. Drill pipe, bits, barrels, casing, and other equipment used below ground will be steam cleaned as discussed in Section 5.9. Drilling techniques to be used in drilling boreholes for monitor well installation are discussed below. Due to the soil conditions at LHAAP, it is recommended that the hollow stem auger technique be used to produce the best results. This drilling method will allow the borehole to remain open until the monitoring well can be installed.

5.2.1 Hollow Stem Auger. This drilling technique utilizes hollow stem flight augers with a cutting head attached to penetrate the formation. A sampling device, such as a split spoon, is lowered through the auger string to take a drive sample. Variations of the method include use of a pilot bit or wireline core sampler in the center of the auger assembly. Use of a hollow stem auger has the following advantages:

- Maintains hole stability in unconsolidated or poorly consolidated materials.
- Allows drilling without added fluids.
- Permits good formation sampling with split spoon, Shelby tube, or wireline core sampler.
- Allows for recognition of saturated zones.
- Produces large diameter holes if formation is sufficiently stable to stand open when the augers are retracted.
- Large internal diameter augers (6 inches or greater) can be utilized as temporary surface casing for other drilling techniques.
- Waste is limited to the auger cuttings which are collected at the top of the hole. These are generally placed into a collection container as discussed Section 5.11. Dust is minimal. Liquid waste is not present unless a saturated zone is encountered.

Limitations include:

- Need for air monitoring for volatiles in potentially contaminated areas.

5.2.2 Solid Stem Auger. The drilling technique utilizes solid flight augers with a cutting head attached to penetrate the formation. Solid stem augers have the following advantages:

- Quick and efficient method in overburden type materials
- Allows drilling without added fluids.
- Permits disturbed formation sampling.
- Allows for recognition of saturated zones.
- Waste is limited to the auger cuttings which are collected at the top of the hole. Dust is minimal. Liquid waste is not present unless a saturated zone is encountered.

Limitations includes:

- Difficulty of penetration in hard materials.
- Risk of losing auger flights (and hole) at excessive depths.
- Inability to use the technique for deep well installation because of depth limitations.

5.2.3 Drilling fluids. No drilling fluids usage are anticipated during this investigation at LHAAP.

5.2.4 Sampling. Personnel collecting samples will don a new pair of latex plastic gloves prior to each sample taken. A pre-cleaned split spoon will be used to collect a surface (0-6 inches interval) soil sample prior to drilling at each monitoring well location. Enough sample will be collected to fill two 1/2 liter glass jars to full capacity and immediately chilled to 4°C. Surface soil samples will be analyzed for those parameters listed in Table 5.3.

TABLE 5.1

ASTM FOR PHYSICAL TESTS ON SOIL SAMPLES PHASE II - SUMPS INVESTIGATION

STANDARDS FOR SOIL SAMPLES	NUMBER OF WELLS TO BE SAMPLED
ASTM D2487 - Classification of Soils	71
ASTM D2216 - Moisture Content	71
ASTM D4318 - Atterberg Limits	71
ASTM D422 - Sieve analysis (including hydrometer)	71

Soil samples will be collected from 71 wells (approximately 6 samples from each well) for physical tests plus 17 QA/QC samples.

1 QA/QC soil sample will be collected for every 25 soil samples collected for physical tests.

71 wells x 6 samples/well = 426
+17 QC samples
+17 QA samples

460 soil samples for physical testing

Soil samples for physical testing will also be collected from every 5' interval or at each change in lithology. This will be accomplished with the use of a pre-cleaned split spoon. The soil sample will then be placed into two 1/2 liter plastic jar. Each plastic jar will be fill to full capacity with no headspace. Sample for physical testing are not required to be chilled to 4°C. Table 5.1 lists the ASTM standard numbers for these physical tests. The technique to be used to collect soil samples for this investigation is discussed below.

5.2.4.1 Split Spoon. A split spoon is a 3-inch diameter sampling device which is driven into the soil with a drive hammer. It is frequently used inside hollow stem augers or other types of casing. The sample is representative of the materials encountered, but is not undisturbed. It is recommended for use when collecting the surface soil sample in order to minimize disturbance to the soil which will be analyzed for volatile organics.

5.2.4.2 Shelby Tube. A Shelby tube is a thin-walled sampler which is pushed into the soil. It takes samples primarily in unconsolidated, cohesive materials. A Shelby tube might be useful in sampling near surface materials or sediments. It does not produce an undisturbed sample for purposes of laboratory testing. All efforts will be made to minimize disturbance to the sample.

5.2.5 Geological Logs. The strata encountered during drilling will be described in detail, using the U.S. Corps of Engineers geological log form (ENG Form 1836). A geologic log will be prepared in the field by a qualified geologist/inspector for each monitor well boring drilled. Borehole depth information will be obtained from direct measurement to the nearest 0.01 foot. Each and every material type encountered shall be described in column C of this form. Unconsolidated materials will be described using the descriptive Unified Soil

Classification System (USCS) which will include consistence of cohesive materials or apparent density of non-cohesive materials; moisture content assessment; color; and any visual or olfactory evidence of contamination. A visual classification will be made of the soil. Description features such as bedding characteristics; organic matter/materials; and macrostructure of fine-grained soils will also be recorded. Other information to be recorded include, but is not limited to:

- depth at which water was encountered
- absence of water in boring will be indicated
- changes in lithology and depth where they occur
- any problems encountered
- any other pertinent information.

Boring descriptions will be determined from geophysical logs or from characterization of cuttings and drill action, where samples or core are not taken. A geologic log form is given in Appendix A of the CDAP.

5.2.6 Borehole abandonment. All borings not converted into monitoring wells will be abandoned by filling with a cement grout. The grout will have the composition as described in Section 5.3.2.2. After the grout has dried, the settlement depression will be filled to the surface with additional grout.

5.3 Well Installation.

5.3.1 Types of Well Installations. Wells will be drilled using the method listed in Section 5.2. Groundwater monitoring wells will be installed to a depth of approximately 30 feet. Drilling will advance through the water table until the first confining layer is encountered. This will define the confining layer for correlation purposes is this area. Wells will be installed just into the first clay confining layer for the purpose of investigating the presence of dense non-aqueous phase liquids (DNAPL) which were present in the results of the soil samples collected during Phase I. Groundwater is anticipated at a depth of 4-12 feet.

5.3.1.1 Well Casing. The monitoring wells will be constructed of pre-cleaned 4-inch nominal diameter, flush-threaded 40 polyvinyl chloride (PVC) casing and stainless steel screens. Well casing will be installed from the screen to approximately three feet above the surface. Centralizers will be used to keep the casing centered in the borehole. Once well installation has been completed, a notch will be made on the riser pipe to designate a reference point of which all water level measurements will be taken from. This will provide consistency for data collection for all future sampling events.

5.3.1.2 Riser and Cap. Surface construction of well pads, covers, etc., will comply with TNRCC requirements. Approximately 3 feet of well casing will be left above ground and enclosed in a protective steel casing. The protective casing will extend two feet below the ground surface and will have a locking cover to prevent entry of unauthorized personnel and rainwater. A four by four-foot 3000 psi concrete pad, six inches thick, will be poured around the protective casing at the ground surface, sloped away from the center to promote drainage. A surveyor's bolt will be placed in the concrete pad adjacent the protective covering to serve as a ground level reference. Four metal posts will be placed outside each corner of the concrete pad to protect the well.

5.3.1.3 Screen. Wells will be screened with four-inch diameter 316 stainless steel wire-wrap screen. The bottom of the screen will be placed approximately 1 foot into the clay confining layer with the intent to intercept any

DNAPLs, if present. The top of the screen will extend ten feet above into the saturated zone. Screen opening size will be 0.01 inches unless formation grain size indicates this is inappropriate. The Field Manager may elect to have an assortment of screen sizes available early in the drilling program.

5.3.1.4 Sump. No sumps will be placed at the bottom of the well.

5.3.1.5 Filter Pack. A sand filter will be placed in the annulus between the well screen and the borehole from the bottom of the hole to approximately two feet above the top of the screen via a tremie pipe (dropped dry). A commercially available bagged 15-30 clean silica sand is anticipated for most applications. However, a variety of sand gradations will be available during early stages of the investigations to insure the filter pack is appropriate for the formation characteristics. The sand will be stockpiled in an uncontaminated area and transported in the bags to the well site.

5.3.1.6 Seal. A minimum two-foot thick bentonite seal will be placed above the filter sand in the well annulus. This will be accomplished by using pellets and installing via a tremie pipe by dropping or pumping. If well conditions and drilling method permit, the seal may be dropped down the annulus between the drill pipe and the well casing. The seal must be hydrated with potable water for at least 4 hours prior to grouting.

5.3.2 Materials Used in Well Construction.

5.3.2.1 Bentonite. Well seals will be composed of bentonite pellets, flakes, or gel as appropriate to insure successful installation. The manufacturer, brand, and amount of bentonite used will be recorded on the field data sheet and in the field journal.

5.3.2.2 Grout. Grout will be used for monitoring well construction and borehole abandonment. The grout will consist of a pumpable mixture of water, cement, and approximately 5% bentonite. Grout will be pumped or poured through a tremie or into an open hole or pipe. Grout density measurements will be taken and recorded on the geologic log. The quantities of grout used will be recorded on the well log and in the field journal. Grouting will be accomplished in an appropriate manner for the specific application. Generally, grout will be pumped through a tremie pipe placed in the annulus just above the previously installed seal which was hydrated for a minimum of four hours prior to grout placement.

5.3.2.3 Screens. Screens will be 316 stainless steel in order to provide a strong but inert material which will be in contact with the groundwater.

5.3.3 Development. After the monitoring well installation is completed, and the grout has been allowed to set for a minimum of 24 hours, wells will be developed to remove drill cuttings as well as fines from the sand filter which might clog up the well screen. Each well will be bailed and/or pumped until the water runs clear and a stable pH and conductivity are achieved. Water and cuttings will be disposed of in as described in section 5.11 of this CDAP.

5.3.4 Well schematics. A well diagram will be prepared for each well which will contain all pertinent information concerning the well, such as drilling method, installation technique, diameter, casing materials, depth, locations of the bentonite seal, screen length and opening size, filter pack length and gradation, grout, and the riser pipe height. A typical well schematic is shown in Appendix A. A geologic log will also be prepared for each well. Log and well schematic forms are shown in Appendix A.

5.4 Location Surveys. All borings and monitoring wells will be physically located by survey. The survey contractor will be required to meet or exceed a Third Order Class 1 survey, with an accuracy of 1 in 10,000. This accuracy equates to approximately 0.01 foot horizontally and vertically. The contractor will use the control furnished by the Tulsa District Corps of Engineers for all surveys. Horizontal control will be in accordance with Texas State Plane Coordinate System, North Zone, using NAD 83, and vertical control will be in accordance with sea level datum of the National Geodetic Survey 1929. The contractor will be prohibited from exceeding 300 feet in each leg of his vertical traverse and from closing on the same bench mark. The USACE, Tulsa District, Survey Section must review and approve of all surveying activities prior to commencement of surveying field activities.

5.5 Geophysical Surveys.

5.5.1 Downhole Geophysical Logs. The use of geophysical logs will be decided in the field based upon boring depth and conditions. Geophysical logs will be used to yield information on lithology, stratigraphy, water saturation, formation information and allow correlation of stratigraphy between boreholes. Specific types of logs which may be employed during Phase II are discussed below.

5.5.1.1 Natural Gamma Ray. This log can be run in dry holes or liquid filled holes, and can be run through PVC or metal casing. A detector in the borehole measures natural radiation in the formations intercepted by the borehole. The natural radiation is a function of the concentration of gamma emitters present (potassium, thorium, uranium). Generally, the concentration of these elements is higher in clays than other lithologies. The log is used for correlation, defining bed thickness, and in lithologic determination.

5.5.1.2 Spontaneous Potential. This log is applicable in water or mud filled open holes. Natural electrical potentials resulting from the interaction of borehole fluids, formation matrix, and formation fluids are measured such that the log records vertical variation of this voltage. Typically this log is used for correlation and to define bed thickness.

5.5.1.3 Resistivity Logs. This type of log is applicable in fluid-filled open holes. An electrical current is either applied directly to the borehole environment or induced. A variety of this type of electrical source logs are available commercially, e.g. induction logs, multiple point and spacing resistivity logs, laterlogs, microresistivity logs, and micro-laterlogs. Typical uses include thin bed recognition, correlation, and estimation and/or calculation of water saturation.

5.5.1.4 Compensated Neutron Logs. Neutron logs are used primarily for the determination of porous formations and their associated porosity. Neutron logs respond to the amount of hydrogen (i.e amount of water) in the formation and are indicative of the amount of liquid-filled porosity. The neutrons are electrically neutral particles which, when they collide with a hydrogen nucleus, lose energy and thus slow down. The slowing of the neutron is proportional to the amount of hydrogen in the surrounding formation. The compensated Neutron logging tool generally uses an americium-beryllium (AmBe) source to provide neutrons. The compensated Neutron Tool is a dual spacing, thermal neutron-detection instrument. The ratio of counting rates from the two detectors is processed at the surface to produce a linear scaled recording. The compensated neutron tool has greater penetration than the single point neutron.

5.5.1.5 Bulk Density (Gamma) Log. This log is primarily useful in uncased holes, but may be modified to yield useful results in cased holes. Spacing of the source and detector are varied to allow various depths of investigation (i.e., diameter around the borehole). The sonde contains a medium-energy gamma ray source which is placed against the borehole wall. The detector measures back scattered gamma rays which are proportional to electron density of the formation. Electron density is related to the true bulk density which in turn depends on the density of the rock matrix material, the formation porosity, and the density of the fluids filling the pores. The log is typically used to determine porosity and lithology.

5.6 Physical Groundwater Testing.

5.6.1 Water Level Measurements. The water level will be measured to the nearest 0.01 foot with respect to the established measuring point on the well. This point will be a notch in the riser pipe. Static water levels will be measured in the monitoring wells using an electronic water level measuring device. The measurement will be checked against previous water level data, and where an anomalous reading is indicated, remeasurement will occur until the reading is within 0.01 feet. All measurements will be recorded in the field journal and will include the well number, date, time, and measuring device (with serial number). The depth of the well will be measured and compared to the installation depth to determine if the well is accumulating fine grained material in the well. Any well condition problems noted will also be recorded in the field journal. The probe will be rinsed in Type II reagent grade water immediately before being lowered into the well and immediately after removing it from the well. If the well appears heavily contaminated during the first sampling round, additional cleaning of the probe will be required. (Reference Section 5.9)

5.6.2 Slug Tests. Slug tests are performed in order to determine the hydraulic parameters of the aquifer. The purpose of this test is to determine permeability of a stratum, taking into account bedding planes, fractures, and other discontinuities. Slug tests can give a more reliable indication of permeability than a laboratory test, which is performed on a very small test specimen. A known volume (slug) of water is removed from a well, and the rate of recharge is recorded.

5.7 Sampling Procedures. Samples are portions of a solid or liquid material which are analyzed to determine the physical properties or presence of selected constituents. These may be physical tests or chemical tests. Table 5.2 lists the analyses to be performed at LHAAP. A complete list of analytes under each grouping are given in Appendix B. Samples from Phase II activities may or may not be analyzed for everything listed in Table 5.2. Based upon findings from Phase II activities, future phases may require either a broader or narrower range of analyses.

TABLE 5.2 ANALYSES TO BE PERFORMED AT LHAAP

Analysis	Water		Soil	
	Groundwater	Surface	Surface	Sediment
Volatiles	X	X	X	X
High explosives	X	X	X	X
Metals	X	X	X	X
*Total Petroleum Hydrocarbons	*X	*X	*X	*X
*Cyanide	*X	*X	*X	*X
Field Measurements	X	X		

*To be analyzed for in areas where these constituents may have been used.

5.7.1 Groundwater sampling.

5.7.1.1 Well Evacuation Procedures. Prior to sampling, the stagnant water within the well (five casing volumes) will be removed so that fresh formation water can enter. If after five volumes, pH and conductivity have not stabilized, then additional volumes will be removed. Handling and disposal of purge water is discussed in section 5.11. The well should be sampled as soon as possible after purging. For slowly recharging wells, sampling should take place as soon as sufficient recharge has occurred to fill sampling containers. The sampling crew will record the recharge rate, if not immediate, the date, time, and rate of purging, and any unusual conditions noted with this operation. Non-dedicated purging equipment will be thoroughly scrubbed and rinsed with Type II reagent grade water each time it is used. Under heavily contaminated or unknown conditions, additional rinses will be performed.

5.7.1.2 Sampling. Wells will be sampled with a disposable teflon bailer. Bailers will be **SLOWLY** lowered into the wells. A generator, if used, will be placed downwind of the well to prevent fumes from contaminating the sample.

Each pre-cleaned sample container will be filled directly from the bottom of bailer or discharge tube of the pump. A common container will not be used to fill sample bottles. Sampling equipment and containers will be kept from ground contact, and may be laid on plastic sheets on the ground. Upgradient wells will be sampled before downgradient wells. Sampling will proceed from the least contaminated to the most contaminated, if that information is available. Parameters for groundwater sample analysis are listed in Table 5.3.

TABLE 5.3

USEPA APPROVED ANALYTICAL METHODS FOR GROUNDWATER, SEDIMENT AND SURFACE WATER SAMPLES PHASE II - SUMPS INVESTIGATION

EPA APPROVED PARAMETERS		NUMBER OF WELLS TO BE SAMPLED
WATER/SOIL		
Method 8240/8240 -	Volatile Organic Compounds	71
Method 8270/8270 -	Semi-Volatile Organics	71
Method 8330/8330 -	High Explosives	71
Method 6010/6010 -	Aluminum	71
	Antimony	71
	Barium	71
	Cadmium	71
	Calcium	71
	Chromium	71
	Cobalt	71
	Copper	71
	Iron	71
	Magnesium	71
	Manganese	71
	Potassium	71
	Silver	71
	Strontium	71
	Thallium	71
	Zinc	71
Method 7470/7471 -	Mercury	71
Method 7060/7060 -	Arsenic	71
Method 7421/7421 -	Lead	71
Method 7740/7740 -	Selenium	71
Additional parameter for Select Wells		
Method 9010/9010 -	Cyanide	1
Method 418.1/418.1 -	Total Petroleum Hydrocarbons	3

Groundwater samples will be collected from 71 wells, plus
71 ÷ 20 = 4 equipment blanks
71 ÷ 10 = 7 QA samples
7 QC samples
Approx. 40 trip blanks

Samples from Phase II activities may or may not be analyzed for everything listed below. Based upon findings from Phase II activities, future phases may require a broader or narrower suite of analyses. Samples of groundwater for chemical analysis are taken in the following order:

- Field parameters
- Volatile organics
- High explosives
- Metals
- Cyanide
- Total Petroleum Hydrocarbons

Field analyses (pH and conductivity) will be performed according to SOP 2.2, which is on file in the Tulsa District office. Table B.1 lists container, preservation, and handling requirements for each parameter and Table B.2 lists holding times. The sequence of operations for groundwater sampling is as follows:

- Purge slow-recharging wells at the outset of the sampling day.
- Purge and sample other wells.
- Preserve the samples.
- Sample slow rechargers, if possible.
- Package and ship the samples to the laboratory.

5.7.1.3 Immiscible Layers. Phase I investigation of the soil adjacent to sump 117, located near building 744-A, showed the presence of TPH in the soil. Immiscible liquid layers may be encountered near Bldg 744-A, therefore procedures for dealing with immiscible layers in groundwater are included in this plan and listed below:

- the level of the immiscible layer surface and water interface will be determined with an electronic probe. The apparent thickness of the immiscible layer is defined as the difference between the liquid level and the interface level.

- A sample will be collected, using a transparent Teflon bailer. Presence of the immiscible layer will be confirmed visually.

5.7.2 Surface and Sediment Sampling. Surface soil and sediment samples will be collected to generate data to support the development of the risk assessment. Surface soil and sediment samples will be collected using stainless steel coring tubes (Split spoon) or other appropriate collection devices. Samples will be placed in two 1/2 liter glass jars and shipped to the contract laboratory. Refer to section 5.2.3 for sampling procedures. Ditches located within the vicinity of the sumps investigation areas of concern, will be sampled by obtaining both grab and composite samples at discrete depths and depth ranges. Locations of sediment samples will be determined in the field by USACE directly involved with the development of the risk assessment. Sample location, depth, sampling method and any other pertinent information will be recorded in the field log book.

5.7.2.1 Chemical Testing. Analyses listed in Table 5.3 will be performed on the surface soil, sediment and groundwater samples. Samples will be placed in pre-cleaned 1/2 liter glass jars with teflon-lined caps. The samples will be packed in ice-filled ice chests, and shipped to the laboratory by overnight carrier to the analytical laboratory. QA/QC samples for soil and sediment samples consist of equipment blanks and replicates as discussed in Section 5.10.

5.7.3 Surface Water Sampling. Water samples will be collected directly into the sampling bottle or by such sampling devices as a Kemmerer sampler or a plexiglass Van Dorn sampler. Surface water samples are to be collected from areas in the vicinity of the sumps and will be determined in the field by USACE personnel directly involved with the development of the risk assessment. Analyses to be performed are the same as those to be conducted for groundwater analysis. These parameters are listed in Table 5.3.

5.8 Field Screening. Field screening techniques give an indication of the degree of contamination. These techniques are used to locate areas for more extensive exploration and sampling, to define the lower limits of sampling and testing in a borehole, and to determine safety hazards for worker protection and transport.

5.8.1 Organics.

5.8.1.1 Air Monitoring for Worker Protection. Air monitoring with a photoionization detector, combustible gas meter, or flame ionization detector, will be used as discussed in the Site Specific Health and Safety Plan (SSHP).

5.9 Decontamination.

5.9.1 Drilling Equipment. All drilling rigs will be brought onto LHAAP in a clean condition with no mud on the undercarriage or vehicle. A decontamination station will be established at a site designated and approved by the LHAAP Environmental Engineer. A decontamination station will be constructed in such a way to prevent any decontamination fluids from escaping onto the ground. The pooled decontamination water will be pumped out of the decontamination station and into DOT approved 55 gallon bung drums and labelled as "DECON WATER". This station will be equipped with a mobile high pressure hot water cleaner or steam cleaner and steel wash racks. All drilling equipment (augers, bits, core barrels, rods and tools) and the drill rig shall be decontaminated between boreholes.

Each member of the drilling crew will don a new pair of gloves before beginning each soil boring. The person taking the samples will wear disposable plastic gloves and will change them between each sampling interval. Used gloves will be bagged and disposed of in a manner which meets RCRA guidelines, as discussed in Section 5.11.

5.9.2 Well casing. All casing and screens used in monitoring well construction will remain in the factory-sealed containers until use. These materials will be placed on a clean, dry tarp or on blocks during assembly. If contact with the ground does occur, the affected sections will be cleaned with low sudsing soap and multiple rinsing with potable water.

5.9.3 Sampling Equipment. Sampling equipment will be cleaned at the end of the work day and in between site. The sampling equipment will be transported in sealed, clean containers, and care will be taken to avoid contamination. Sampling equipment will be clean in the following manner: (1) washed with a non-phosphate detergent or Alconox, (2) rinsed with potable water, (3) undergo a final rinse with distilled water and (4) allowed to air dry. Purging equipment will be cleaned with distilled water and a brush and triple rinsed with distilled water before purging the next well. If the purging equipment is heavily contaminated, as determined by sight, smell, and air monitoring, it will be cleaned as described above. Each member of the sampling crew will don a new pair of gloves at each sampling location. The person who actually takes the samples will wear disposable plastic gloves and will change them between each sampling interval for each sampling site. Used gloves will be bagged and disposed of as discussed in the Section 5.11.

5.10 Field Quality Assurance and Quality Control Samples.

5.10.1 Chemical Samples. Quality Assurance (QA) and Quality Control (QC) samples for surface water, surface soil, sediment and soil for physical testing will be used to verify that the sampling, analytical and physical testing are being performed properly. QC samples are taken in the field and analyzed with the field samples by the same laboratory. QA samples will be analyzed by SWD laboratory check the performance of the contract laboratory. QC samples are required for all samples including travel blanks, equipment blanks, and replicates. QA and QC samples are entered into the field journal along with their associated samples and are described below.

5.10.1.1 <u>Travel Blanks</u>. Travel blanks consist of American Society of Testing Materials (ASTM D 1193-91) Type II reagent water, or equivalent water sealed into three sample 40 ml vials in the field laboratory. The specifications which the water must meet are listed below:

Electrical conductivity, max., at 25°	1.0 μS/cm
Electrical resistivity, min., at 25°	1.0 MΩ cm
Total Organic Carbon, max.,	50 μg/L
Sodium, max.,	5 μg/L
Chlorides, max.,	5 μg/L
Total silica, max.,	3 μg/L
Microbiological contamination, max. (as heterotrophic plate count)	10/100mL.

The travel blank is not opened again until it has been received in the laboratory. One travel blank will be prepared for each shipment of water samples to be analyzed for volatile organic compounds, all of which are shipped in the same ice chest to the lab each day. Travel blanks measure cross contamination of water samples during shipment and contamination sources contacted during shipment. Travel blanks are not required to be collected for equipment blanks (rinsate blanks) associated with soil/sediment samples.

5.10.1.2 <u>Equipment Blanks</u>. Equipment blanks for field samples will consist of ASTM Type II water which is being poured over or through non-dedicated sampling equipment such as augers, knives, spoons, or bailers as the final rinse. The final rinse over the equipment drains off and into the appropriate sampling containers. Containers will then be labelled accordingly and chilled to 4°C and prepared for shipment in the ice chest with the associated samples from the site. Equipment blanks will be prepared and preserved in the same manner as water samples. Equipment blanks measure the effectiveness of equipment decontamination. Equipment blanks are taken at a rate of 1 for every 20 or fewer field samples and are analyzed for the same constituents as the associated soil or water samples.

5.10.1.3 Replicate Samples. Replicate samples or splits are duplicate samples which may consist of a composite, or as a series of grab samples from the same source. Every tenth sample is taken in triplicate. One of each set of these replicates will be sent to SWD Lab as an audit sample (QA sample) for the contract laboratory, and the other two samples will be sent to the analytical lab as a field sample and a QC sample, each with a unique sample number. In cases where only sufficient sample exists for a duplicate set, every fifth sample is a duplicate. This duplicate alternates as a QC and QA sample. Field tests will be done in duplicate.

5.11 Waste Management.. Waste will be generated at LHAAP from activities such as drilling, monitoring well installation and groundwater sampling. The sampling results of previous investigations will be utilized to assist in determining the type of waste that may be generated. The RFI generated waste from drilling and well installation will be managed as a solid waste that has the potential to be considered hazardous waste. It will be contained in such a manner to insure that the waste from each sampling location for each medium is kept separate from the other waste until the results of the sampling are received and an accurate determination of the status of the waste can be made. The Tulsa District will be responsible for managing the waste generated during the investigation activities until it is turned over to the management and operating contractor for storage and disposal and manifesting, if needed. The waste will be managed such that all Federal and State regulations governing the disposal of hazardous waste (as defined in 40 CFR, Parts 260-265 and 268) and non-hazardous solid waste will be followed. If any of the waste is transported off site for disposal, the management and operating contractor and/or LHAAP will be responsible for signing the manifest.

5.11.1 Non-Regulated Wastes. All non-regulated wastes (boxes, paper towels, etc...) generated will be placed in plastic trash bags for disposal in a dumpster.

5.11.2 Personal Protection Equipment. All used personal protective equipment and related wastes will be disposed of separately into a 55-gallon drum and labeled "PPE-Pending Analysis". At the end of each day, all PPE will be placed in a large plastic trash bag and sealed. An adhesive tape, with the date, will be secured on the outside of the bag and then placed in a 55-gallon drum. To make efficient use of storage, several bags with different dates may be placed into one drum provided each bag is labeled accordingly.

5.11.3 Drums. All soil investigation derived wastes (IDW) will be placed in Department of Transportation (DOT) approved 55-gallon open top drums. All liquid IDW will be placed in DOT 55-gallon bung drums. IDW includes, but is not limited to: soil cuttings, development water, purge water, decontamination water and muds and personal protection equipment.

5.11.4 Documentation. On the exterior of each drum, there will be an individual chronological number for inventory purposes. In addition, the following information will be labeled on each drum:

- monitor well number,
- drilling date (date cuttings were generated),
- type of media (soil or water) contained in drum,
- volume in drum (Example: 1/2 full, 1/3 full, 1/4 full).

An inventory of all drums with the above information will be kept by the Field Manager and maintained on a daily basis. A copy of the list shall be provided to the USACE Technical Manager, Ms. Bernice Perez and to the LHAAP Environmental Coordinator, Mr. David Tolbert upon request at any time. Upon completion of this project, the original inventory will be provided to the USACE Technical Manager.

IDWs from each monitoring well location will be containerized separately. For example, all soil cuttings generated during drilling activities for Monitoring Well #15 will be containerized in a 55-gallon **open top** drum. At the completion of installing MW-#15, the water generated from developing this well will be containerized in a 55-gallon **bung** drum. IDWs from MW-#15 will not be combined with any other IDWs from any other site.

5.11.5 Suppliers. Procuring DOT approved 55-gallon drums will be the responsibility of USACE Tulsa District. DOT 55-gallon **open top** drums will be procured for solid wastes and DOT 55-gallon **bung** drums will be procured for all liquid wastes.

5.11.6 Labels. Labels stating **"PENDING ANALYSIS"** to be affixed on each drum containing IDWs, will be the responsibility of the USACE Tulsa District.

5.11.7 Handling and Storage. Handling and transporting all drums, from the sites to a storage area as designated by LHAAP, will be the responsibility of the USACE Tulsa District or designated contractor.

5.11.8 Disposal. Disposal of the drummed wastes will be contingent on the results of the base wide background investigation currently being conducted by the USACE Tulsa District. Disposal of these wastes, and future characterization of contents (if necessary), will be the responsibility of the USACE Tulsa District.

6.0 SAMPLE HANDLING AND TESTING.

6.1 Sample Numbering System. Sample numbers are assigned as follows:

LHS-@@##-x(ddd)-qq

LHS refers to the project Longhorn Sumps being investigated,
@@ refers to the site location where:
MW = monitoring well
is the monitoring well number,
x describes the sample medium, where
1 = groundwater
2 = surface soil sample
3 = surface sediment
4 = surface water,
5 = soil for physical testing
6 = ditch sediment
ddd represents either the soil/sediment depth in feet at the top of the sample or the sequential number of the water sampling episode.

qq is either a QA/QC modifier, when needed, or an abbreviation of composite where
QA = a QA sample (split for SWD Lab)
QC = a QC sample (split for contract lab)
TB = travel blank
EB = equipment blank.

6.2 Preparing Samples. A field laboratory will be established at LHAAP. This lab will either be a mobile lab or a trailer in a fixed location or a LHAAP designated building. The field laboratory will be used for reagent preparation, sample preservation, equipment decontamination and cleaning, labelling bottles, and completing paperwork. Decontamination procedures outlined in section 5.9 will be followed. When samples are brought in from the field, they are preserved according to Table B.1. They are then placed in the ice chest in packing material designed to prevent breakage. All efforts will be made to maintain the samples at 4°C. The ice chest is filled with double-bagged ice and the chain of custody form and field data form are placed inside in a zip-lock plastic bag placed on top of the ice. The ice chest is secured and a seal is placed on opposing sides of the chest opening. The aqueous volatile organics samples collected each day are placed in one ice chest, with a travel blanks and a completed COC. The samples are then delivered to the transporter. Samples are generally shipped on the day they are sampled, but in no event held longer on site than 48 hours so as not to exceed any holding periods. Samples are kept refrigerated until shipment. In Marshall, Texas the Greyhound bus station is located in the downtown area at: 201

S. Boliver
Marshall, Texas
(903) 938-6763

6.3 Receiving Samples. After the ice chests are delivered to the laboratory, the samples are logged in, the COC is signed, and the samples are checked for breakage or leakage. The temperature of the ice bath is checked. If the temperature exceeds 4°C or if any other problems are noted, this information is recorded on the Cooler Receipt Form and the field manager is notified of the problem. Samples are repackaged and shipped to subcontract laboratories, if necessary, using procedures as described in Section 6.2.

6.4 Laboratory Procedures. Laboratory analytical procedures come from the following sources: U. S. Environmental Protection Agency (SW 846 and EPA-600, refs. 4 and 3). Analytical methods from these sources are given in Table B.2. Quantitation limits are given in Tables B.4 through B.5. Quantitation limits, however, are dependent on the concentration of the components in the matrix to be analyzed. Calibration of laboratory instruments will be performed according to manufacturer's recommendations.

7.0 SAMPLE INTEGRITY. The quality of analytical data is suspect if the integrity of the sample cannot be ensured. Integrity includes the procedures and written records which, when taken together, verify that the sample is as represented.

7.1 Security. Security involves procedures which ensure sample integrity. Security is required until final disposal of the sample after laboratory analysis is complete. Aspects of sample security are discussed below.

7.1.1 Security of the Well. Each well will have a locking cap and keys will be given out only to those who need them. Because LHAAP is not an open facility, access to the monitoring wells will be limited.

7.1.2 Security of the Sample in the Field. Samples, once taken, will be in the possession of the sampling crew or locked in the field laboratory. QA and QC samples will be taken, which, when analyzed, will also document the integrity of the sample.

7.1.3 Security of the Sample in the Lab. Samples will be stored in a secure area in the laboratory with limited access to authorized laboratory personnel. Upon receipt of the ice chests, laboratory personnel will check the temperature of the ice bath, the condition of the samples, and the accuracy of the accompanying paperwork.

7.2 Custody. Custody consists of formal records which document integrity. These records are described below.

7.2.1 Chain of Custody Form. The chain of custody form (COC) is a record which describes the sample, the date and method number to be used for sampling analysis, and the name of the analyses required. It has spaces for signatures of those receiving and relinquishing the samples. The form is normally signed by the sampler, the individual preparing the samples for shipment, and the receiving individual at the laboratory. A copy of this form is retained at the field, and the original fully executed copy is returned to the Tulsa District in the hard copy laboratory report, where it is placed on file. An example of this form is given in Appendix A.

7.2.2 Laboratory Traffic Report. Samples which are sent from the primary field laboratory to a contract lab are sent with this form. It is a laboratory chain of custody form which gives the sampling date, the analyses to be performed and the date the results are needed. Because various fractions of the sample might be sent to several contract labs, the original COC cannot be used. The traffic reports are also returned to the District in the hard copy laboratory reports.

7.2.3 Bill of Lading. A bill of lading (bus bill or airbill) documents receipt of the samples by the carrier. It is not possible for the carrier's representative to sign the COC since it is sealed in the ice chest. Bills of lading are kept on file in the District Office, and copies are included in the laboratory report.

7.3 Sample Tracking and Identification. Other than the items listed in 7.2, there is additional documentation which demonstrate sample integrity. These are listed as follows:

7.3.1 Field Log Book. The field log book is a bound record, kept by the water sampling crew, in which groundwater sampling information is recorded. It is taken to the wells to record purging and sampling data, water levels, and other items of interest. It is used in the field lab to record preservation and preparation procedures for shipment. It is also used to record equipment calibration and decontamination of sampling equipment. In case of concurrent operations, sampling information will be transferred to the field log book in the field lab. The information for the COC and field data form comes from the field log book. The field log book is not the same as the field journal, which is kept by the Field Manager. The field log book will be turned over the Tulsa District Corps of

Engineers for filing.

7.3.2 <u>Field Data Form</u>. The field data form transmits necessary information about the well to the lab. Field measurements such as Ph, conductivity, and water levels as well as problems with the well or the sample are noted on this form. An example is shown in Appendix A.

7.3.3 <u>Sample Labels</u>. Labels on each jar contain the well or boring number, the sample number, preservation (if any), the analysis to be performed, and the sampler's initials. Examples are provided in Appendix A.

7.3.4 <u>Cooler Receipt Forms</u>. A Cooler Receipt Form is a form filled out by the laboratory upon receipt of a ice chest containing samples. The condition of the samples is noted on the form; such as temperature, presence or absence of bubbles in aqueous volatiles samples, and any sample container breakage. An example is provided in Appendix A.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING.

8.1 Analytical Data.

8.1.1 Field Data. Field data reduction will be performed in the Tulsa District Office. Data validation in the field is determined primarily by making several readings (QC checks for reproducibility). Periodic QA oversight is also a part of the validation process. The field data is sent to the lab on the field data form and is returned to the Tulsa District in the hard copy lab reports. The field log book will be submitted to the USACE Technical Manager for retention.

8.1.2 Laboratory Data. Laboratory data are reduced at the contract lab, which generates a laboratory report containing the analytical data for both field, field quality control and laboratory quality control samples. The contractor will then produce a data validation report which is a reflection of meeting or not meeting the DQOs specified in section 4.0 of this document. The government will then produce a quality assurance report for inclusion in the data validation report which discusses the "comparability" DQO. In the comparability discussion, the results reported by the government's laboratory will be compared to the field and quality control replicate samples results reported by the contractor. Table B-8 outlines the items which will be evaluated when the data is evaluated. Laboratory deliverables include the following:

- Results of field samples, laboratory blanks, surrogate recoveries, matrix spikes, laboratory control samples, laboratory duplicates, matrix spike duplicates, relative percent differences, field duplicates, and field blanks. Sample identification numbers will be cross-referenced with laboratory ID's and QC sample numbers;

- The fully executed Chain of Custody Forms and the Cooler Receipt Forms on which the laboratory has documented the condition of the samples on arrival.

- Laboratory results regarding Practical Quantitative Limits, Sample Quantitation Limits, and the determined analytical results are to be provided for each analyte. Listed in Appendix B, (Tables B.4 through B.5) are the Practical Quantitative Limits for some analytes. Each questionable result (based on laboratory QC) will be reported as such and appropriately flagged. Soil samples will be reported on a dry weight basis with the moisture content reported as a separate value. Dilution factors, extraction dates, and analysis dates will also be reported.

- A Data Validation report which addresses the accuracy, precision, and representativeness of each analysis. This report shall contain a table which indicates the sample field identification number, the date the sample was taken, and will indicate what methods of analysis were conducted at various laboratories. The comparability section of the report will be added during the review process by the USACE CIH Section.

- Electronic data in the Environmental Restoration Management Analysis (ERMA) format data files. The file structure is outlined in Appendix C.

Calibration and internal standard information, raw data, (which includes equipment/analyst worksheets/logbooks, equipment tuning calibrations, sample extraction volumes, etc.) and all instrumentation graphs and traces will be available from the laboratory, if needed.

8.2 Technical Data. Technical data refers to data of several types, such as groundwater flow calculations, stratigraphic maps generated from geologic and geophysical field data, isopleth profiles of contaminants, and statistical models. Technical data will be reduced, validated, and reported by the project staff, and is subject to review by the CIH Section. Data reduction involves the digitizing of plot data not already provided in graphical form, and creation of computer disk files containing all information related to the data forms listed above.

9.0 AUDITS. Audits, which are QA procedures designed to meet the data quality assurance objectives discussed in Section 4, are of two basic types as discussed below.

9.1 System Audits. A systems audit is a qualitative evaluation of all components of a project to determine if each component is properly performed. Systems audits are generally performed at the outset of investigations and periodically during the life of a project. Systems audits for office and fieldwork will be performed by the CIH Section, and system audits for laboratory work will be performed by the MRD Lab. These audits consist primarily of site inspections and apply only to chemical analytical laboratories. Laboratory site inspection by MRD is discussed in Section 3.4.3, ER 1110-1-263 (ref. 2), and EM 200-1-1 (ref 7).

9.2 Performance Audits. Performance audits are quantitative evaluations of the components of a project. These consist of audit samples to be checked by MRD as a part of the laboratory validation process, QA replicates taken as a part of the sampling process and analyzed by SWD, and laboratory QA procedures as specified by the analytical method.

TABLE 9.1 AUDIT ELEMENTS FOR LHAAP INVESTIGATIONS		
Element	Performed by	Frequency
Laboratory Site Inspection	MRD	When laboratory is selected and as often as 18 months thereafter
Field Inspection	USACE Inspector and/or CIH Section	Monthly or more frequently at first; less frequently thereafter
Technical Data Inspections	CIH Section	As Needed
Laboratory Check Samples	MRD	When laboratory is selected and as often as 18 months thereafter
Analysis of Field Replicates	SWD	Every 10 samples
Government QA Report	CIH Section	One for each laboratory report

10.0 CORRECTIVE ACTION.

10.1 Field Activities. Field activities which are improper will be corrected as quickly as possible. The Field Manager will be responsible to see that corrective action is initiated and documented whenever the error has the potential to compromise the quality of the data being generated or whenever there is a possibility that the error might be repeated. Corrective action can also be initiated by USACE personnel designated as inspectors/oversight and/or personnel CIH Section during site visits. QA personnel will complete a trip report, which will be sent to the technical manager through Chief, Geotechnical Branch. This report will document problems and proposed corrective action. It will be a part of the permanent project files. QA personnel will also make recommendations to the field crews through the Field Manager who can give approval for immediate implementation.

10.2 Field Data. Corrective action for poor field data quality (as determined by replicate measurements or prior expectation) consists of remeasurement until successive readings agree within reasonable limits. Examples of frequently made measurements and limits to which they should agree include:

- temperature
- pH - Measurements should agree within 0.02 pH unit.
- conductivity - Measurements should agree within 2 numbers of the last significant digit.
- depth and water level measurements - Readings should agree within 0.01 foot.

If remeasurement is not successful, then instrument calibration and operation and the user's technique will be evaluated.

11.0 REFERENCES

1. U. S. Army Corps of Engineers, August, 1989, "Minimum Chemistry Data Reporting Requirements for DERP and Superfund HTW Projects", CEMRD-ED-GC Memorandum.

2. U. S. Army Corps of Engineers, January, 1990, "Chemical Data Quality Management for Hazardous Waste Remedial Activities", ER-1110-1-263.

3. U. S. Environmental Protection Agency, March, 1983, "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020.

4. U. S. Environmental Protection Agency, November, 1986, "Test Methods for Evaluating Solid Waste", SW 846, 3rd Ed.

5. U. S. Environmental Protection Agency, May, 1987, "Data Quality Objectives for Remedial Response Activities: Development Process", EPA 540/G-87/003.

6. U. S. Environmental Protection Agency, 1987, "Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations", SW-87-001.

7. U. S. Army Corps of Engineers, March 1994, "Validation of Analytical Chemistry Laboratories", EM-200-1-1.

8. U.S. Army Corps of Engineers, February 1994, "Phase I Investigations of 125 Waste Process Sumps and 20 Waste Rack Sumps".

008498

APPENDIX A

OF

CHEMICAL DATA ACQUISITION PLAN

EXAMPLES OF FORMS, WELL SCHEMATICS, ...

Hole No. 008499

DRILLING LOG	DIVISION	INSTALLATION	SHEET OF SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

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

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

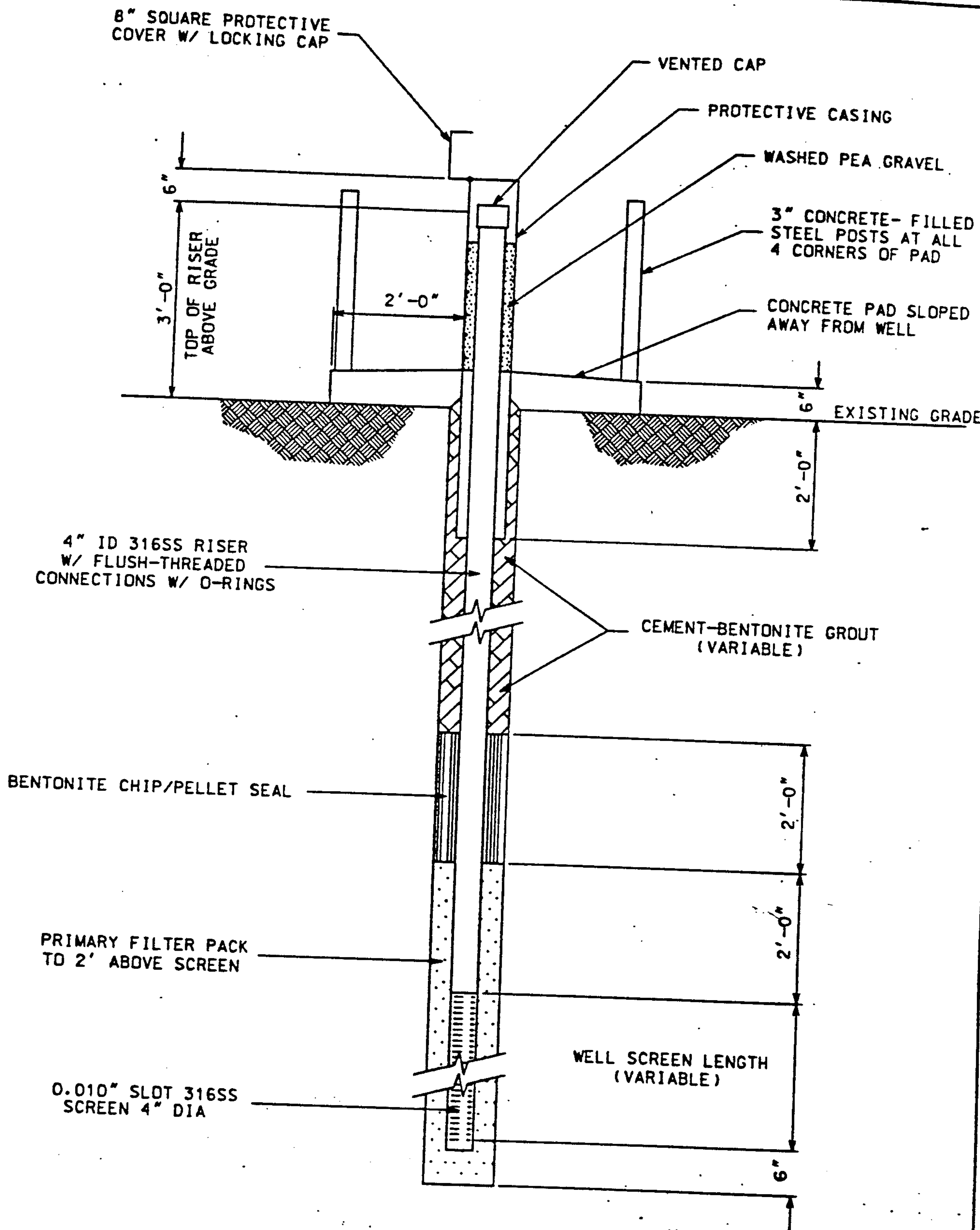

FIGURE 6
MONITORING WELL DETAIL
NOT TO SCALE

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT, TULSA,OKLAHOMA
LONGHORN ARMY AMMUNITION PLANT
SUMPS INVESTIGATION

SAMPLE NO.______________________

DATE:_____________ TIME:_____________

[redacted]

VOLATILE ORGANICS

pH<2 W/HCL? [Y] [N]

Signature:_______________________________

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT, TULSA, OKLAHOMA
LONGHORN ARMY AMMUNITION PLANT
SUMPS INVESTIGATION

SAMPLE NO.________________________

DATE:______________TIME:___________

EQUIPMENT BLANK

TPH

pH<2 W/H2SO4? [Y] [N]

SIGNATURE:__________________________________

008502

FIELD DATA FORM
SOIL/SEDIMENT MONITORING

Project: LONGHORN - SUMPS - PHASE II Date: ____________

Site: ____________

Ice Chest # samples will be shipped in ____________

Total Samples per this form: ____________

Soil Sample Information

Depth	Sample ID#	(# of jars)	Description
____ to ____	____	____	____
____ to ____	____	____	____
____ to ____	____	____	____
____ to ____	____	____	____
____ to ____	____	____	____
____ to ____	____	____	____

Bus Bill#: ____________

Bus Bill#: ____________

Notes concerning condition of well, odor, color or problems:

____

____

____

____

____

Sample Collector(s): ____________

____

008503

FIELD DATA FORM
GROUNDWATER MONITORING WELLS

Project: **LONGHORN -SUMPS-PHASE II** Date: ______________________

Site: ______________________ Sample ID#: ______________________

Csg/Diameter: **4"** ______ Csg/Type: **PVC** ____ Riser Elev: __________

Stick-Up Height: ______________ Flush Depth: ______________

Depth of Water from Top of Casing: __________ Time: ________

Total Well Depth: __________ Rate of Recharge: __________

Depth to Water at Time of Sampling: __________ Time: ________

Purging Device: __________________ No. Well Volumes ________

Gallons to Purge: __________ Actual Gallons Purged ________

Purging Rate: ____

pH: ________ ________ Time: ________ Type: ____________

________ ________

Conductivity, umhos/cm Time: ________ Type: ____________

________ ________ Temperature: ____________

________ ________ Turbidity: ____________

Chest#: ______ Bus Bill#: ________________________________

Chest#: ______ Bus Bill#: ________________________________

Notes concerning condition of well, odor, color or problems:

____

____

____

____

____

Sample Collector(s): ______________________________________

APPENDIX B

OF

CHEMICAL DATA ACQUISITION PLAN

TABLES FOR ANALYTICAL METHODS, CONTAINERS, ETC...

008505

APPENDIX B

OF

CHEMICAL DATA ACQUISITION PLAN

TABLES FOR ANALYTICAL METHODS, CONTAINERS, ETC...

APPENDIX B

TABLE OF CONTENTS

Table B.1 SAMPLE CONTAINERS, PRESERVATION, AND PREPARATION FOR WATER SAMPLES

Parameter	Size and Type of Container	# of Containers	ICE to 4 C	Method of Preservation
volatile organics	40 ml glass vial	3	yes	no head space, pH<2 w/ HCl
pH, conductivity, turbidity, & temperature	1/2 pint glass jar	1	no	field test
cyanide	1 L plastic bottle	1	yes	pH>12 w/ NaOH
High Explosives	*1 L glass bottle	1	yes	none
metals	1 L plastic bottle	1	yes	pH<2 w/ HNO_3
TRPH	*1 L amber glass bottle	2	yes	pH<2 w/ H_2SO_4

* **If sufficient volume of water is available, provide 2 sample bottle for this parameter.**

Table B.2 MAXIMUM HOLDING TIMES AND ANALYTICAL METHODS FOR SOIL

Parameter	Analytical Reference	SOIL METHOD	Extraction Time	Analysis Time
ORGANICS				
volatile	SW-846 3rd	8240	NA	28 days
high explosives	SW-846 3rd	8330	14 days	40 days
TRPH	EPA-600	418.1	NA	28 days
METALS				
arsenic (As)	SW-846 3rd	7060	NA	6 months
mercury (Hg)	SW-846 3rd	7470	NA	28 days
selenium (Se)	SW-846 3rd	7740	NA	6 months
lead (Pb)	SW-846 3rd	7421	NA	6 months
all other metals (Al,Sb,Ba,Ca,Cd,Cr,Co, Cu,Fe,Mg,Mn,K,Ag,Tl,Zn & Sr)	SW-846 3rd	6010	NA	6 months

Note: NA - not applicable

Table B.3 MAXIMUM HOLDING TIMES AND ANALYTICAL METHODS FOR WATER

Parameter	Analytical Reference	WATER METHOD	Extraction Time	Analysis Time
ORGANICS				
volatile	SW-846 3rd	8240	NA	14 days
high explosives	SW-846 3rd	8330	7 days	40 days
TRPH	EPA-600	418.1	NA	28 days
METALS				
arsenic (As)	SW-846 3rd	7060	NA	6 months
mercury (Hg)	SW-846 3rd	7470	NA	28 days
selenium (Se)	SW-846 3rd	7740	NA	6 months
lead (Pb)	SW-846 3rd	7421	NA	6 months
all other metals (Al,Sb,Ba,Ca,Cd,Cr,Co, Cu,Fe,K,Mg,Mn,Ag,Sr,Tl, & Zn)	SW-846 3rd	6010	NA	6 months

Note: NA - not applicable

Table B.4 ESTIMATED QUANTITATION LIMITS (EQLs) FOR VOLATILE ANALYSES IN SOIL AND WATER SW-846, Method 8240

Analyte	Water EQL (μg/L)	Soil EQL (μg/kg)
Acetone	100	100
Acetonitrile	100	100
Allyl Chloride	5	5
Benzene	5	5
Benzyl Chloride	100	100
Bromodichlormethane	5	5
Bromoform	5	5
Bromomethane	10	10
2-Butanone	100	100
Carbon Disulfide	100	100
Carbon Tetrachloride	5	5
Chlorobenzene	5	5
Chlorodibromomethane	5	5
Chloroethane	10	10
2-Chloroethyl Vinyl Ether	10	10
Chloroform	5	5
Chloromethane	10	10
Chloroprene	5	5
1,2-Dibromo-3-Chloropropane	100	100
1,2-Dibromoethane	5	5
Dibromomethane	5	5
1,4-Dichloro-2-Butene	100	100
Dichlorodifluoromethane	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethane	5	5
1,1-Dichloroethene	5	5

Table B.4 ESTIMATED QUANTITATION LIMITS (EQLs) FOR VOLATILE ANALYSES IN SOIL AND WATER
SW-846, Method 8240

Analyte	Water EQL (μg/L)	Soil EQL (μg/kg)
Trans-1,2-Dichloroethene	5	5
1,2-Dichloropropane	5	5
Cis 1,3-Dichloropropene	5	5
Trans-1,3-Dichloropropene	5	5
Ethylbenzene	5	5
Ethyl Methacrylate	5	5
2-Hexanone	50	50
Isobutyl Alcohol	100	100
Methacrylonitrile	100	100
Methylene Chloride	5	5
Methyl Iodide	5	5
Methyl Methacrylate	5	50
4-Methyl-2-Pentanone	50	50
Pentachloroethane	10	10
Propionitrile	100	100
Styrene	5	5
1,1,1,2-Tetrachloroethane	5	5
1,1,2,2-Tetrachloroethane	5	5
Tetrachloroethene	5	5
Toluene	5	5
1,1,1-Trichloroethane	5	5
1,1,2-Trichloroethane	5	5
Trichloroethene	5	5
1,2,3-Trichloropropane	5	5
Vinyl Acetate	50	50
Vinyl Chloride	10	10

Table B.4 ESTIMATED QUANTITATION LIMITS (EQLs) FOR VOLATILE ANALYSES IN SOIL AND WATER SW-846, Method 8240		
Analyte	Water EQL (μg/L)	Soil EQL (μg/kg)
Xylene (Total)	5	5

Estimated Quantitation Limits (EQLs) for Water-Miscible Liquid Waste equal Water EQL X 50; EQLs for High concentration soil and sludge equal Soil EQL X 125; EQLs for Non Water-Miscible Waste equal Water EQL x 500.

Table B.5 PRACTICAL QUANTITATION LIMITS (PQLs) FOR HIGH EXPLOSIVES IN SOIL AND WATER SW-846, Method 8330			
Analyte	PQL LC (μg/L)	PQL HC (μg/L)	PQL (μg/kg)
HMX	-	13	2200
RDX	0.836	14	1000
1,3,5-TNB	0.258	7.3	250
1,3-DNB	0.108	4	250
Tetryl	-	4	650
NB	-	6.4	260
2,4,6-TNT	0.113	6.9	250
4-AM-DNT	0.0598	-	-
2-AM-DNT	0.0349	-	-
2,6-DNT	0.314	9.4	260
2,4-DNT	0.0205	5.7	250
2-NT	-	12	250
4-NT	-	8.5	250
3-NT	-	7.9	250

PQL LC = Practical Quantitation Limit for Low Concentration Technique
PQL HC = Practical Quantitation Limit for High Concentration Technique

Table B.6 ESTIMATED DETECTION LIMITS FOR METALS IN SOIL AND WATER

Method	Analyte	Water (μg/L)	Soil (μg/kg)
6010	Antimony	20	8700
	Aluminum	900	9000
	Barium	40	8700
	Cadmium	5	800
	Calcium	1000	8700
	Chromium	10	1400
	Cobalt	ND	1400
	Copper	20	1700
	Iron	50	4300
	Magnesium	1000	87000
	Manganese	10	870
	Potassium	30	2600000
	Silver	10	1400
	Strontium	50	10000
	Thallium	3	8700
	Zinc	20	1700
7060	Arsenic	5	740
7421	Lead	5	1000
7471 7470	Mercury	0.2	100
7740	Selenium	5	450

Table B.7 ESTIMATED DETECTION LIMITS FOR MISCELLANEOUS ANALYSES IN SOIL AND WATER

Analyte	Water (mg/L)	Soil (mg/kg)
Cyanide, total and amenable	0.02	1.0
Total Recoverable Petroleum Hydrocarbons (TRPH)	1.0	10.0

ND = Not Determined
NA = Not Applicable

Table B.8 DATA VALIDATION CHECK SHEET

Item	Data Quality Objective	Applicable Analyses	Frequency	Acceptable Results
-FIELD SAMPLES-				
Analytical Method	Comparability	All	Each analysis	as specified on COC or Tables B.2 and B.3
Holding Time	Precision Accuracy Representativeness	All chemical analyses	Each analysis	As in Tables B.4 and B.5
Quantitation Limit	Precision Accuracy Representativeness	All chemical analyses	Each analysis	As in Tables B.5-B.7
Matrix Spike Recovery	Accuracy	All chemical analyses	1/batch or 5%	As required in SW-846
Matrix Spike Duplicate Recovery	Precision	All chemical analyses	1/batch or 5%	As required in SW-846
Relative % Difference	Precision	All chemical analyses	1/batch or 5%	As required in SW-846
Method Blank	Representativeness	All chemical analyses	Representative	No compounds above quantitation or detection limits
Surrogate recovery	Accuracy	All organic analyses	each analysis	As required in SW-846
-QUALITY CONTROL DUPLICATE-				
Analytical Results	Precision	all	10% or 1/batch	Factor of 2 for water Factor of 5 for soil
-QUALITY ASSURANCE DUPLICATE-				
Analytical Results	Comparability	all	10% or 1/batch	Factor of 2 for water Factor of 5 for soil
-TRIP BLANK-				

Table B.8 DATA VALIDATION CHECK SHEET				
Item	Data Quality Objective	Applicable Analyses	Frequency	Acceptable Results
Analytical Results	Representativeness	volatiles	1 per shipping container with volatiles	No volatile compounds above the EQLs
-EQUIPMENT BLANK-				
Analytical Results	Representativeness	all chemical analyses from non-dedicated equipments	5% or 1/batch	No compounds above the detection or quantitation limits
-CHAIN OF CUSTODY FORM-				
Filled out correctly and properly signed	Representativeness	all chemical analyses	1 per container	No missing or incorrect information; no lapses in Custody
-FIELD DATA FORM-				
Filled out correctly and proper times between purge and sampling	Representativeness	all groundwater samples	1 per well	No missing or incorrect information; <24 hours lapse

008518

008519

APPENDIX C

OF

CHEMICAL DATA ACQUISITION PLAN

GUIDANCE FOR SUBMITTAL OF DATA ON

ELECTRONIC MEDIA

(ENVIRONMENTAL RESTORATION MANAGEMENT ANALYSIS FILE STRUCTURE)

008520

Blank

008521

APPENDIX C

OF

CHEMICAL DATA ACQUISITION PLAN

GUIDANCE FOR SUBMITTAL OF DATA ON

ELECTRONIC MEDIA

(ENVIRONMENTAL RESTORATION MANAGEMENT ANALYSIS FILE STRUCTURE)

008522

GUIDANCE FOR SUBMITTAL OF DATA ON ELECTRONIC MEDIA FOR THE TULSA DISTRICT HTRW PROJECT DATABASE

1. Required files, file formats, and data element descriptions are attached.

2. ASCII data may be submitted on 3.5" dos formatted diskettes or on 8mm tape using the UNIX TAR or CPIO utilities. Tape labels should include blocking factors and the UNIX command used to create the tape. If a compression utility is used, an executable of the utility should be provided.

2. All dates should be in the format YYMMDD. (920623 rather than 06/23/92).

3. The sample numbering system detailed in the work plan should be followed. As a minimum, all samples id's should contain at least three four character strings, with an additional two characters for qa and qc samples.

4. Data elements in each record may be separated by a ¦ or other special character. Padding data fields with blanks is neither required nor desired. Optionally, data may be submitted positionally. Positional data files must be acommpanied by a key indicating the beginning column for each data element.

6. All depth measurements should be expressed as positive numbers.

7. A diskette containing the following information is enclosed.

TULSADB.FIL	This document in WordPerfect 5.1 format
VALIDS.LST	A WP51 file containing a listing of the values contained in the List_Domain table of the Oracle database. The numbers in the left column equate to the numbers in the DOMAIN column of the wordperfect tables in this document.
ANALYTES	A WP51 file containing the CAS number and other accepted abbreviations. This is the information contained in the ANALYTE table of the Oracle database.

8. Point of Contact for electronic data submissions is Karla Fleming (918)-669-7157.

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
RESULTS TABLE	Analytical results for one or more analytes obtained from a single extraction and testing event. Each record provides the analytical results for a single analyte.		
analysis_method	Code identifying the analysis method used. This code, along with the lab_sample_id and run_number will link back to the appropriate test table record.	char 10	121200
result_flag	A coded value qualifying the analytical results field. Indicates whether the result was undetected, detected above or below the detection limit.	char 5	121700
detection_limit	Minimum detectable quantity of a parameter based on laboratory conditions, analytical method, or field conditions. This should account for any dilutions done on sample other than the normal dilutions called for in the analytical method.	numeric	
lab_sample_id	The sample id assigned by the performing laboratory, used with analysis method to link to cl_sample_id in the tests table.	char 20	
measured_value	Value for a given parameter (analytical result) reported in units consistent with the units of measurement code.	numeric	
review_qualifier	Coded values that are assigned during chemistry data validation (for example EPA qualifiers).	char 5	

008523

val. _cas	The Chemical Abstra[illegible]vices identifier for the analyte being reported. A code from the Analyte Domain Table is used for physical properties and compounds that do not have assigned CAS numbers.	char 12	
value_uom	Units of measure used to report the measured value.	char 10	121600
qc_expected_result	The target value for a QC sample. Typically equal to the amount of standard spiked into the sample.	numeric	
run_number	Run number of the analysis if more than one run was made.	integer	
value_confidence	Confidence value associated with the reported measured value (eg: measured value plus or minus confidence interval).	integer	

008524

T. /COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
SAMPLE TABLE	Information regarding a water, soil or environmental sampling event. Each record provides data about the sampling of one environmental medium at one sampling location.		
sample_id	PTXss-hhhh-xaaa-bb The sample numbering system detailed in the work plan should be followed. As a minimum, all samples id's should contain at least three four character strings, with an additional two characters for qa and qc samples.	char 20	
loc_code	Unique identification assigned to each sampling location. Usually this is the same as the hhhh portion of the sample id. Links the sample table to the Location table.	char 10	
sample_date	Date that a sample was collected, field test performed, or a quality control sample created. Format is YYMMDD.	YYMMDD	
top-depth	Distance in feet from the surface elevation to the top of the sample.	numeric	
bottom_depth	Lower depth in feet at which a soil sample is collected for analysis, relative to ground surface.	numeric	
field_lot_number	The lot number is used to group together all field samples associated with or judged against a particular set of QC samples. This field is combined with the sample date for lot correlation.	char 19	
matrix	A code indicating the media sampled.	char 3	120900

008525

008526

met[illegible]	A code identifying t[illegible]hod used to collect a sample.	char 4	120800
qc_code	Identifies a QC sample type.	char 8	121000
sample_time	Time of day that a sample is collected, a field measurement is made or a quality control sample is created. Use 24 hour clock. Format is HHMMSS. Option field during testing of GIS. Will be a required field on future investigations.	HHMMSS	
collector	Name of the person who obtained the sample or created the quality control sample. Optional	char 24	
witness	Name of the person who witnessed the sampling or creation of the control sample. Optional.	char 24	
contractor	Identifier of the contractor performing the sampling event.	char 5	
remarks	Any remarks about the sample. Optional field	char 40	

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
TESTS TABLE	Information relating a single sampling event to one or more sample extraction and analysis events. Each record describes a single extraction and analysis event for one environmental sample at one location.		
analysis_date	Date than analysis was performed. Format is YYMMDD.	YYMMDD	
analysis_time	Time that analysis was performed. Use a 24 hour clock, no colons. HHMMSS . For initial submissions this field is not being required, however we expect to make it mandatory in the future.	HHMMSS	
analysis_method	A code representing the method used to analyze for a given analyte.	char 6	121200
basis	A code indicating whether test results are reported on a wet or dry basis.	char 1	121400
cl_sample_id	The sample id assigned by the laboratory performing the test. This field links to the lab_sample_id in the results table.	char 20	
dilution_factor	A number representing the adjustment of the sample concentration. A dilution factor of 1 indicates no adjustment.	numeric	
extract_date	Date extraction was performed. Format is YYMMDD.	YYMMDD	
extract_method	A code representing the method used to extract or prepare a sample for a particular analysis.	char 6	121300
extract_time	Time extraction was performed expressed as HHMMSS using a 24 hour clock.	HHMMSS	

008527

lot_ [illegible]trol	The batch designator [illegible] autonomous group of environmental samples and associated quality control samples analyzed by a test. This is equivalent to the EPA SW-846 concept of "analytical batch".	char 10	
pl_sample_id	This field will be the same as the sample_id in the sample table if the laboratory received the sample from the field. If the sample was received from another laboratory, this field will contain the sample identification assigned by the sending laboratory. This field links the test table to the sample table.	char 20	
lab_code	A code identifying the analytical laboratory performing the analysis of a sample.	char 4	
run_number	Run number of the analysis. Not required if only one run is reported.	integer	

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TULSA DISTRICT DA[illegible]TIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
LOG_RUN	General information about a logging run which is a collection of data by a logging tool.		
inspector	Name of the inspector on the job.	char 5	
loc_code	The location code identifying the well	char 10	Location Table
log_equip	A code indicating the type of log.	char 7	122300
lrsequency	Number of the logging run in the sequence of runs.	integer	
reference	Name of the place where the geophysical log is stored.	char 24	
remarks	Any remarks regarding the logging run.	char 240	
run_date	Date on which the logging run was performed.	integer	YYMMDD
svc_company	Code for the company performing the logging operation.	char 5	Contractor Table
tool_type	The type of geophysical tool used.	char 7	122400
witness	Name of witness to the logging run.	char 24	

008529

TULSA DISTRICT DATA[illegible]IONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
BOREHOLE	Information about a borehole. The borehole table acts as an adjunct to the location table and a prerequisite to any well information tables.		
const_method	A code identifying the method used to construct the borehole.	char 2	121800
depth	Total depth of the borehole.	numeric	
deviation_code	A code identifying the direction of the deviation.	char 4	123500
diameter	Diameter of the borehole expressed in inches.	numeric	
drill_company	A code identifying the contractor drilling the borehole.	char 5	Contractor Table
start_date	Drilling start date	YYMMDD	
end_date	Date drilling was completed.	YYMMDD	
Loc_code	A code identifying the surveyed location at which the borehole was drilled.	char 10	Location Table

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TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
LOCATION	Information defining the general area where samples are to be taken.		
class	A code describing the location such as CH for channel, SW for surface water, WL for well, BH for borehole etc.	char 2	123200
loc_code	The unique identifier assigned to a location where samples are taken.	char 10	Location Table
coord_uncertainty	Resolution of the coordinate	char 1	123400
descript	Any additional information to describe a sampling or measuring location in text format. Example: "Monitoring well 10 feet NE of building 624.	char 240	
establish_company	Code for the organization which establishes a sampling or measuring location. Typically the primary contractor.	char 5	Contractor Table
establish_date	The date construction of a sampling or measuring location was completed.	YYMMDD	
latitude	Latitude coordinate. Optional	numeric	
longitude	Longitude coordinate. Optional	numeric	
easting	Easting coordinate. SPCS 1983 Texas Central	numeric	
northing	Northing coordinate. SPCS 1983 Texas Central	numeric	
proximity	A code indicating whether the sampling location is on or off a military base. Not required for Pantex.	char 1	123300
scode	SWMU code associated with this location.	char 12	SWMU Table

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surf[illegible]_elevation	Elevation of ground [illegible]e for groundwater, soil or sediment sampling. Elevation of water surface for water sampling. Report in mean feet above sea level.	numeric	
survey_id	Survey license number.	Char 12	
survey method	A code indicating the method of survey used. Examples : survey, GPS, digitized, grid estimate.	char 4	124900

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TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_ANNULUS			
descript	Any comments or a description of the annulus interval.	char 10	
diameter	The diameter of the annulus expressed in inches.	numeric	
fill_volume	The volume of material used to fill the annulus interval expressed in cubic inches.	numeric	
loc_code	The code used to identify the location of the annulus interval. This code also serves as a key to the well_construction table.	char 10	Location Table
material	A code identifying the material used as fill in the annulus interval.	char 3	122000
top_depth	The depth in feet from the surface elevation.	numeric	

008533

TULSA DISTI[illegible] [illegible]ATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CASING	Information about the casing.		
inner_diameter	Inside diameter of the casing in inches.	numeric	
loc_code	The location identifier of the well being described. This value serves as a key to both the location and well_construction tables.	char 10	Location Table
material	A code indicating the type of casing material used.	char 15	123600
outer_diameter	Outside diameter of the casing in inches.	numeric	
segment_count	Number of casing segments. All segments must be of equal length.	integer	
segment_len	The length of the segments in feet.	numeric	
top_depth	The depth in feet from the surface elevation to the top of the casing.	numeric	

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TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CENTRALIZERS			
depth	Depth in feet from the surface elevation to the well centralizers.	numeric	
loc_code	A code identifying the well location. Links this table to the Location table and the well construction table.	char 10	Location Table

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
TEST_PIT	Information about a test pit.		
loc_code	Identifies a surveyed location which can be associated to the test pit.	char 10	Location Table
tarea	Total calculated area of this test pit.	numeric	
tvol	Total estimated volume of test pit expressed in cubic yards.	integer	

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CONSTRUCTION	General information about the construction of a well.		
completion_method	A code describing the method used to complete the well or the nature of the openings that allow water to enter the well.	char 2	120300
cover_type	A code for the type of cover placed on top of the well.	char 1	125500
geo_complete_zone	A code for the general hydrologic description of the well completion zone.	char 2	120400
loc_code	A code identifying the surveyed location of this well.	char 10	Location Table
number_posts	The number of protective posts placed on the pad at the top of the well.	integer	
pad_size	A description (eg. 5 X 4 feet) of the pad placed at the top of the well.	char 10	
pump_equip	A code identifying the type of pump used.	char 3	125600
remarks	Comments on the purpose of the well, construction of the well, or information identifying the geologic formation of the completion.	char 240	
riser_height	The height of the riser in feet above the top of the well.	numeric	
ss_aquifer	A code identifying the sole source aquifer in which the well was completed.	char 4	120500
sump_length	Length of the sump in feet.	numeric	
sump_material	A code for the sump material.	char 3	122200
well_type	A code describing the type of well (water supply, monitoring, etc.)	char 3	120200

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TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_CONSTRUCTION	General information about the construction of a well.		
completion_method	A code describing the method used to complete the well or the nature of the openings that allow water to enter the well.	char 2	120300
cover_type	A code for the type of cover placed on top of the well.	char 1	125500
geo_complete_zone	A code for the general hydrologic description of the well completion zone.	char 2	120400
loc_code	A code identifying the surveyed location of this well.	char 10	Location Table
number_posts	The number of protective posts placed on the pad at the top of the well.	integer	
pad_size	A description (eg. 5 X 4 feet) of the pad placed at the top of the well.	char 10	
pump_equip	A code identifying the type of pump used.	char 3	125600
remarks	Comments on the purpose of the well, construction of the well, or information identifying the geologic formation of the completion.	char 240	
riser_height	The height of the riser in feet above the top of the well.	numeric	
ss_aquifer	A code identifying the sole source aquifer in which the well was completed.	char 4	120500
sump_length	Length of the sump in feet.	numeric	
sump_material	A code for the sump material.	char 3	122200
well_type	A code describing the type of well (water supply, monitoring, etc.)	char 3	120200

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TULSA DISTRICT DATA D[illegible]NARY
ERMA DATABASE

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_SCREEN	Information about the well screen.		
diameter	Diameter of the screen in inches.	numeric	
loc_code	A code identifying the location of the well in which the screen is placed. This key serves as a key to the well_construction table.	char 10	Location Table
material	A code for the material used to make the screen.	char 6	121500
percent_open_area	Percent of screen that is open for flow.	numeric	
slot_size	Vertical size of the screen slot opening in inches	numeric	
stype	A code identifying the type of screen being used.	char 3	121900
top_depth	Depth in feet from the ground surface to the top of the screened interval.	numeric	
wslength	Length in feet of the screened interval.	numeric	

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
WELL_STATUS	This table is used to track the changes in the status of the well. Each record represents a change in the status of a well. The end date of a status is assumed to be the same as the start date of the subsequent status.		
comments	Historical information relating to the well changes.	char 240	
loc_code	The unique code assigned to identify the well.	char 10	Location Table
start_date	Date on which the specific changes to the well began.	YYMMDD	
wsstatus	Well status code	char 4	120200

TABLE/COLUMN NAME	DESCRIPTION	DATA TYPE	DOMAIN
CORE	Field and/or laboratory information associated with a core or sidewall sample.		
bottom_depth	The depth in feet from the location surface elevation to the bottom of the core.	numeric	
ctype	A code describing the type of core retried based on the standard core barrel sizes.	char 2	125200
diameter	Core diameter in units of inches.	numeric	
loc_code	The location code of the well.	char 10	Location Table
percent_recovered	Total length of core recovered in a core run divided by the total distance of the core run.	numeric	
rock_quality	The rock quality designation is obtained by counting the total number of core pieces greater than 4 inches in length divided by the total length of the core, in NX and larger sized cores.	numeric	
run_number	The number for the core run from which the sample was taken.	integer	
top_depth	The depth in feet from the location surface elevation to the top of the core.	numeric	

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APPENDIX C

OF

FINAL WORKPLAN

SITE SAFETY AND HEALTH PLAN

008543

LONGHORN ARMY AMMUNITION PLANT

WASTE PROCESS SUMP INVESTIGATIONS (PHASE II)

JULY 1994

SITE SAFETY AND HEALTH PLAN

U.S. ARMY CORPS OF ENGINEERS
TULSA DISTRICT

008544

1.0 PLAN APPROVAL

This Site Safety and Health Plan for waste process sump investigative activities at Longhorn Army Ammunition Plant has been prepared and approved by the following:

GREG SNIDER
Project Industrial Hygienist

Date: 7/11/94

RAMONA E. WAGNER
Chief, Chemistry and Industrial Hygiene Section

Date: 11 July 1994

BOB W. VANDEGRIFF
Chief, Safety and Occupational Health Office

Date: 11 July 1994

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2.0 PURPOSE AND SCOPE

This Site Safety and Health Plan (SSHP) establishes procedures and work practices to protect Tulsa District Corps of Engineers (COE) employees and authorized visitors from potential safety and health hazards resulting from investigative activities in support of Phase II Waste Process Sump Investigations at Longhorn Army Ammunition Plant (LHAAP).

This SSHP has been prepared in accordance with Occupational Safety and Health Administration guidelines outlined in 29 CFR 1910.120 along with US Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1.

3.0 APPLICABILITY

This SSHP applies to all COE personnel and authorized on-site visitors working in the identified areas. Supervisors are to ensure that employees understand and follow the guidelines contained within this plan.

4.0 RESPONSIBILITIES

The following personnel are responsible for site safety and health and ensuring compliance with the requirements and procedures contained within this SSHP.

(a) Bob Vandegriff, Tulsa District Safety Officer
(b) Greg Snider, Project Industrial Hygienist
(c) TBD, Drill Rig Inspector, SSHO
(d) TBD, Drill Rig Operator
(e) TBD, Water Sampling Crew Chief

4.1 Safety Officer

* Overall responsibility for safety and health on Corps of Engineers projects.
* Oversite and approval of safety and health plan requirements.
* Direction of industrial hygiene sampling and air monitoring strategies.
* Medical surveillance program implementation.
* Hazardous waste worker training program implementation.
* Ensure that the project is performed in accordance with SSHP and EM 385-1-1 requirements.

4.2 Project Industrial Hygienist

* Development and preparation of safety and health plan.
* Direct site safety and health officer on health and safety matters and field implementation of the safety and health plan.

* Upgrade or downgrade levels of protection as outlined in the SSHP.
* Perform and direct industrial hygiene air sampling activities.
* Direct site specific training activities as outlined in the SSHP.
* Coordinate with the Safety Officer on health and safety matters.
* Ensure that the project is performed in accordance with the SSHP and EM 385-1-1 requirements.

4.3 Site Safety and Health Officer

* Direct safety and health activities on-site.
* Implement the SSHP and ensure the project is performed in accordance with SSHP and EM 385-1-1 requirements.
* Perform health and safety activities on-site as specified in the SSHP, and report all results to the project industrial hygienist.
* Upgrade or downgrade levels of protection as directed by the project industrial hygienist.
* Suspend field activities if action levels are exceeded or conditions at the site change.
* Perform air monitoring as specified in the SSHP and maintain documentation of air monitoring results.
* Establish and enforce site zonation requirements as outlined in the SSHP.
* Report all infractions of the SSHP to the project industrial hygienist.

4.4 Drill Rig Operator

* Inspect drilling equipment daily and ensure equipment is in safe operating condition.
* Suspend drilling activities and report unsafe drilling conditions to the SSHO and Core Drill Chief.
* Ensure that all drilling operations are performed in accordance with the SSHP and EM 385-1-1 requirements along with the drilling activity hazard analysis.

4.5 Water Sampling Crew Chief

* Inspect all sampling and purging equipment daily and ensure equipment is in safe operating condition.
* Serve as the SSHO during sampling operations and ensure all activities are conducted in accordance with the SSHP and EM 385-1 along with the water sampling activity hazard analysis.
* Suspend sampling activities and report unsafe conditions to the project industrial hygienist and Geology Section Chief.

5.0 SITE LOCATION AND HISTORY

Longhorn Army Ammunition Plant (LHAAP) is located in central east Texas in the northeast corner of Harrison County, approximately 14 miles northeast of Marshall, Texas and approximately 40 miles west of Shreveport, Louisiana. The installation occupies 8,493 acres between State Highway 43 and the western shore of Caddo Lake (Figure 5-1).

LHAAP is a government-owned contractor-operated (GOCO) industrial facility under the jurisdiction of the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM). The Longhorn Division of Thiokol Corporation is the operating contractor. The primary mission of LHAAP is to load, assemble, and pack pyrotechnic and illuminating/signal ammunition and solid propellant rocket motors. Other missions at LAAP consist of compounding pyrotechnic and propellant mixtures, accommodating receipt and shipment of containerized cargo, and the maintenance and layaway of standby facilities and equipment as they apply to mobilization planning. Static firing and elimination activities of Pershing I and II rocket motors by the United States and the former U.S.S.R. are also conducted at Longhorn as required by the Intermediate-Range Nuclear Force Treaty.

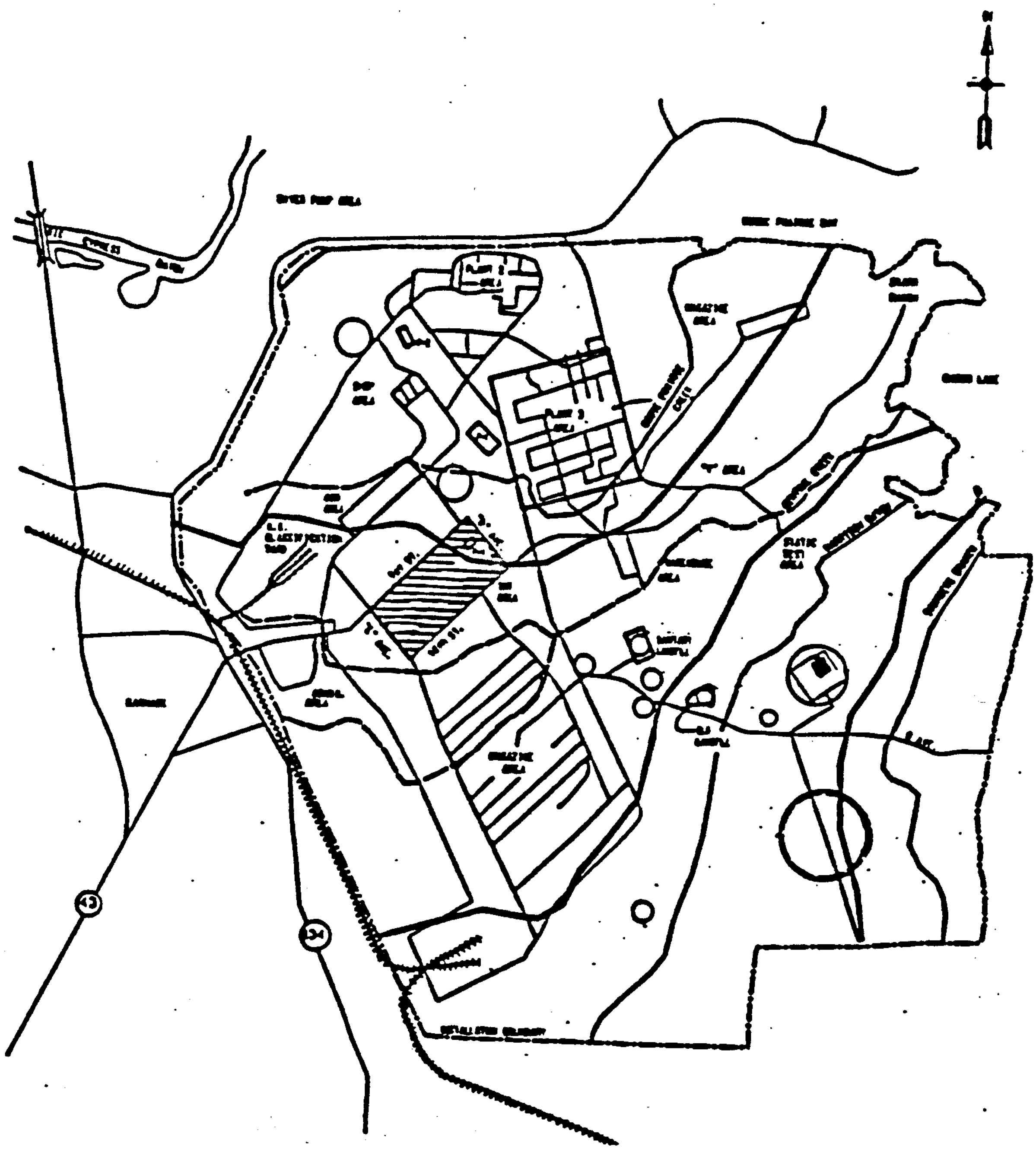
Previous activities at LHAAP during the World War II era up to 1965 consisted of the production of 2,4,6-trinitrotoluene flake, photoflash ammunition and bombs, simulators, hand signals, and 40 mm tracer rounds.

6.0 PROJECT SCOPE

Investigative activities planned in support of this project consist of drilling and sample collection near 145 waste process/ waste rack sumps. Approximately 71 shallow monitoring wells will also be installed. Soil and groundwater samples will be taken and tested for field parameters, volatile organics, explosives, and heavy metals. Selected soil samples will be additionally tested for Total Petroleum Hydrocarbons and cyanide.

The process waste sumps, waste rack sumps, and drain lines are used to collect process waste runoff and rainwater runoff at active and inactive facilities throughout LHAAP. The scope of this project is to determine if the sumps have leaked contaminants into the environment.

FIGURE 5-1
SITE LOCATION MAP



7.0 TRAINING

All personnel entering the site during field investigative activities must meet training requirements outlined in 29 CFR 1910.120. Additional site specific training will be conducted by a competent person under the direction of the Project Industrial Hygienist and the Occupational Safety and Health Office in the following areas:

- History of the site.
- Field activities planned.
- Safety, health and other hazards present at the site.
- Use of personal protective equipment.
- Work practices which will minimize potential hazards.
- Safe use of equipment at the site.
- Air monitoring activities.
- Industrial hygiene sampling activities.
- Recognition of signs and symptoms indicating possible overexposure to chemical hazards.
- Decontamination procedures.
- Emergency response and evacuation procedures.

Site specific training will be documented on forms included in Appendix C.

8.0 SITE WORK ZONES

8.1 Drilling and Soil Sampling Operations

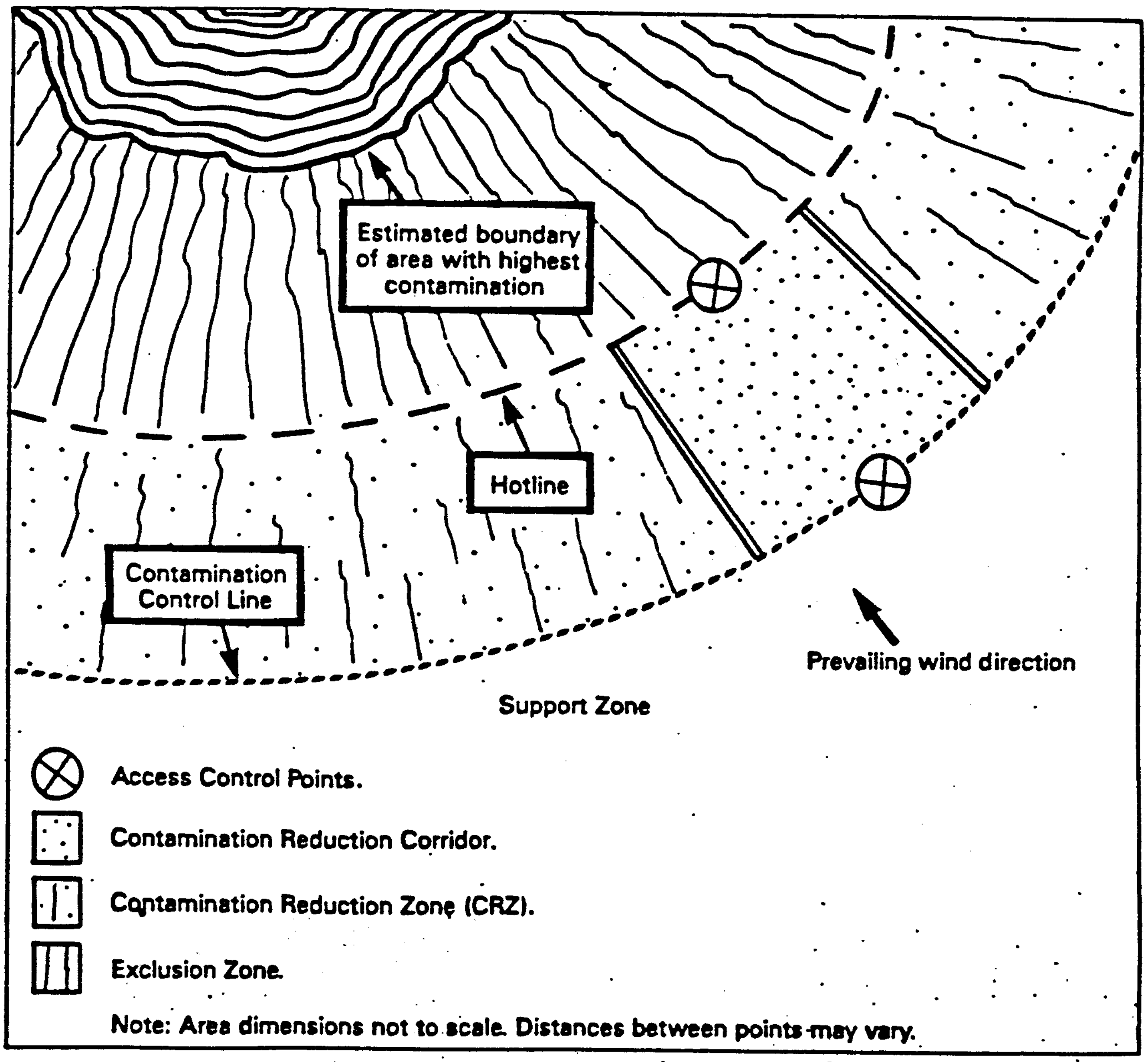
During drilling, soil sampling and associated decontamination activities the site will be formally segregated into an Exclusion Zone, Contamination Reduction Zone and a Support Zone. An illustration of site work zones is shown in Figure 8-1.

(a) Exclusion Zone. The exclusion zone shall be a 30-foot radius around the drilling rig, if space allows, formally marked with printed hazard tape. If necessary, the boundaries of the exclusion zone may be extended to prevent the spread of contaminants outside of the zone and prevent unauthorized personnel from entering the site. The exclusion zone is considered a contaminated zone, therefore, appropriate personal protective equipment is required for entry. All personnel and equipment exiting the exclusion zone must be properly decontaminated. Unauthorized personnel are not allowed within this zone.

(b) Contamination Reduction Zone. The contamination reduction zone will consist of a site specific area outside the exclusion zone serving as a buffer between the potentially contaminated exclusion zone and the non-contaminated support zone. Decontamination activities will take place in the contamination reduction zone. All authorized personnel must enter and exit the exclusion zone through the contamination reduction zone.

(c) Support Zone. The support zone is a staging area for equipment and personnel. A log will be kept in the support zone of all personnel entering and exiting the site. Access of personnel into the exclusion zone will be controlled in the support zone. The support zone is considered a non-contaminated zone.

FIGURE 8-1
SITE WORK ZONES



8.1 Water Sampling Operations

In most cases, the possibility for the spread of contaminants off the site has been diminished or eliminated when the well casing is installed. Therefore, formal segregation of the site into work zones is not necessary during water sampling operations. Chemical and equipment hazards are still present at the site, therefore, unauthorized personnel or personnel not meeting hazardous waste training requirements are not allowed at the site. If it is not possible to prevent unauthorized personnel from entering the site, then printed hazard tape shall be used to form a limited access exclusion zone. All water sampling operations will be conducted in accordance with guidelines set forth in the Tulsa District Groundwater Monitoring Program Site Safety and Health Plan.

9.0 HAZARD ANALYSIS

9.1 Chemical Hazard Evaluation

A variety of chemical hazards potentially exist at the site with primary routes of exposure through inhalation, ingestion, contact and absorption. A process waste sump inventory conducted in 1993 indicate that the most likely chemical contaminants at the site include a variety of metals (Al, Sb, Ba, B, Cr, Co, Cu, Pb, Ag, W, Zn, Zr), organic solvents (acetone, methyl ethyl ketone, methylene chloride, 1,1,1-trichlorethylene), and isophorone diisocyante. Exposure will be minimized through good work practices, proper decontamination, and the proper use of personal protective equipment. Chemical hazards will be continuously monitored at the site with appropriate air sampling techniques. A summary of potential site contaminant exposure data is summarized below.

<u>Acetone</u>

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 750 ppm
TLV: 750 ppm
Ionization Potential: 9.69 eV
Hazard: Flammable, Toxic

May produce dermatitis after repeated exposure. High vapor concentrations may irritate eyes, nose and throat and cause headaches, dizziness and unconsciousness.

<u>Aluminum</u>

Route of Entry: Inhalation, Ingestion
PEL: 15 mg/m3
TLV: 10 mg/m3
Ionization Potential: N/A

Hazard: Flammable, Toxic

Inhalation of finely divided particles can cause pulmonary fibrosis. A reactive metal with greatest hazards associated with chemical reactions. Moderately flammable/explosive by heat, flame, or chemical reaction.

Antimony

Route of Entry: Inhalation, Skin or eye contact
PEL: 0.5 mg/m3
TLV: 0.5 mg/m3
Ionization Potential: N/A
Hazard: Flammable, Toxic

Poisonous by ingestion, inhalation, and intraperitoneal routes. Upon contact can cause irritation of the skin and mucous membranes.

Barium

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 0.5 mg/m3
TLV: 0.5 mg/m3
Ionization Potential: N/A
Hazard: Flammable, Toxic

May cause local irritation to the eyes, nose, throat, and skin. Ingestion may cause heart rate to slow and stop. Vascular constriction and increased voluntary muscle tension.

Benzene

Route of Entry:
PEL: 1 ppm
TLV: 0.1 ppm
Ionization Potential: 9.25 eV
Hazard: Confirmed Human Carcinogen, Flammable

A human poison by inhalation and experimentally by skin contact. Confirmed human carcinogen producing leukemia, Hodgkins disease, and lymphomas. A severe eye and moderate skin irritant.

Boron

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 10 mg/m3
TLV: 10 mg/m3
Ionization Potential: N/A
Hazard: Flammable, Toxic

Poisonous by ingestion. Flammable in the form of dust when exposed to air or by chemical reaction. Very unstable and reactive in the form of dust.

Chromium

Route of Entry: Inhalation, Ingestion
PEL: 1.0 mg/m3
TLV: 0.5 mg/m3
Ionization Potential: N/A
Hazard: Toxic

Exposure can cause dermatitis to exposed skin and pulmonary sensitization. Acute exposure may cause coughing, headache, dyspnea, fever, weight loss.

Cobalt

Route of Entry: Inhalation, Contact, Skin or eye contact
PEL: 0.05 mg/m3
TLV: 0.05 mg/m3
Ionization Potential: N/A
Hazard: Toxic

Poison by intravenous, intratracheal, and intraperitoneal routes. Moderately toxic by ingestion. Inhalation of dust may cause pulmonary damage. Dermatitis may be caused by contact.

Copper

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 1.0 mg/m3
TLV: 1.0 mg/m3
Ionization Potential: N/A
Hazard: Toxic

Copper may act as an irritant to skin causing itching, erythema, and dermatitis. Contact with the eye may cause conjunctivitis and ulceration and turbidity of the cornea. Contact with skin may cause keratinization. Irritation of the upper respiratory tract results from inhalation. Extreme nausea and gastric pain may result from ingestion.

Isophorone Diisocyanate

Route of Exposure: Inhalation, Ingestion, Absorption, Skin or eye contact
PEL: 0.005 ppm
TLV: 0.005 ppm (skin)
Ionization Potential: Unknown
Hazard: Toxic

Poisonous if inhaled, ingested or absorbed through skin. A severe irritant to the eyes, skin and mucous membranes causing burns.

Lead

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: .05 mg/m3
TLV: .15 mg/m3
Ionization Potential: N/A
Hazard: Toxic

Inhalation or ingestion may cause headache, weakness, irritability, aching muscles, constipation, anorexia, abdominal pains, anemia, high blood pressure, fine tremors.

Methylene Chloride (Dichloromethane)

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 25 ppm
TLV: 50 ppm
Ionization Potential: 11.32 eV
Hazard: Suspected Human Carcinogen, Toxic

Methyl Ethyl Ketone

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 200 ppm
TLV: 200 ppm
Ionization Potential: 9.53
Hazard: Toxic

Moderately toxic by ingestion, skin contact, and intraperitoneal routes. Inhalation may cause systemic effects, conjunctiva, nose and throat irritation.

Silver

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 0.01 mg/m3
TLV: 0.01 mg/m3
Ionization Potential: N/A
Hazard: Toxic

Local contact with metallic silver can cause skin discoloration. Solutions of silver may be highly corrosive to the skin, eyes, and intestinal tract. All forms of silver are cumulative in body tissue.

1,1,1-Trichloroethylene

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 50 ppm

TLV: 50 ppm
Ionization Potential: 9.45 eV
Hazard: Toxic

Poisonous by intravenous and subcutaneous routes. Moderately toxic by ingestion, inhalation and intraperitoneal routes. A severe eye and skin irritant. Severe headaches and drowsiness after prolonged inhalation to moderate concentrations.

Tungsten

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 5 mg/m3
TLV: 5 mg/m3
Ionization Potential: N/A
Hazard: Flammable, Toxic

A skin and eye irritant. Flammable in the form of dust when exposed to flame. May ignite in air or by chemical reaction with oxidants. Mildly toxic.

Zinc

Route of Entry: Inhalation, Ingestion, Skin or eye contact
PEL: 1.0 mg/m3
TLV: 1.0 mg/m3
Ionization Potential: N/A
Hazard: Toxic

Zinc may be corrosive to the skin and mucous membranes. Contact with eyes may cause inflammation, swelling, and corneal ulceration. May produce skin sensitization and dermatitis. Ingestion may produce corrosive effects to the esophagus and stomach. Inhalation may produce metal fume fever resulting in a metallic taste in the mouth, cough, shortness of breath, fatigue and muscle pain.

9.2 Physical Hazard Evaluation

Work activities associated with environmental investigations create inherent physical and safety hazards. These hazards will be reduced by conforming to applicable OSHA and COE safety requirements along with worker experience and good judgement. Activity hazard analysis for drilling and water sampling operations are presented in Appendix.D. Standard Operating Procedures for temperature stress, confined space entry, and severe weather are included in Appendix B.

9.2.1 Noise

Noise level surveys have shown to be in excess of 85 dB(A) when drilling at increased RPM levels. Auguring operations have not shown to produce noise levels in excess of 85 dB(A). Random noise level measurements will be taken during drilling operations to determine if hearing protection is required. Hearing protection is not required during auguring operations, however, it is recommended in order to reduce long term cumulative hearing loss.

Purging operations using portable generators and QED driver units have shown to produce noise levels well in excess of 85 dB(A), therefore, hearing protection is mandatory during purging and sampling operations with these systems. Hearing protection will not be necessary when purging and sampling with disposable bailers.

10.0 PERSONAL PROTECTIVE EQUIPMENT

In order to minimize bodily contact with hazardous substances identified at the site, during drilling, soil sampling and water sampling activities, the following personal protective equipment requirements shall be used by all site personnel entering the exclusion zone. If site conditions change or action levels are exceeded, levels of protection will be upgraded to ensure worker protection. Levels of protection will be upgraded or downgraded based upon site specific conditions as determined by the Safety Officer.

Drilling and Soil Sampling

- Tyvek disposable or cotton coveralls
- Disposable cotton work gloves (drilling)
- Disposable chemical resistant gloves (sampling)
- Steel toe safety work boots
- Chemical resistant neoprene work boots or boot covers (as necessary)
- Hard hat
- Hearing protection (as necessary)
- Safety glasses

Water Sampling

- Disposable chemical resistant gloves
- Steel toe safety work boots
- Safety glasses
- Hearing protection
- Full face shield of protective goggles (preservation activities)

10.1 Respiratory Protection

All personnel involved in HTRW investigative activities will have access to a NIOSH approved air purifying respirator (half face minimum). Appropriate cartridges will be made available to field personnel as necessary by the Project Industrial Hygienist. Respirators will be added to personal protective equipment requirements as determined by site conditions and the Project Industrial Hygienist. Respiratory use will be in accordance with requirements outlined in the Tulsa District Respiratory Protection Program. All personnel required to wear a respirator must first receive an indepth respiratory physical, a physicians interpretation of the employees ability to wear a respirator, and receive a qualitative fit test with the selected respirator.

Respiratory use is not authorized without prior consent of the Project Industrial Hygienist or the Safety and Occupational Health Office.

11.0 AIR MONITORING

11.1 Drilling and Soil Sampling Operations

(a) A photoionization detector (PID) will be used to monitor employee exposure (breathing zone) to ionizable compounds at intervals not to exceed 30 minutes. Soil cuttings will also be screened to access the amount of contamination present.

(b) A combustible gas/oxygen meter will be used to monitor concentrations of combustible gases and oxygen continuously during drilling operations.

(c) 3M 3500 organic vapor monitors will be used randomly throughout the project, as determined by the project industrial hygienist, to quantify worker exposure to organic compounds. Analysis will be specifically performed for methylene chloride.

(d) Integrated air pump sampling will be performed randomly throughout the project, as determined by the project industrial hygienist, to determine exposure to isocyante compounds. Analysis will be performed for isophorone diisocyante.

11.2 Water Sampling Operations

Air monitoring requirements for water sampling operations will be determined by the project industrial hygienist based upon air monitoring results generated during drilling operations.

12.0 ACTION LEVELS

A summary of breathing zone action levels for potential site contaminants is listed in Table 12-1.

(a) A value of 10 PID units above background in the workers breathing zone will require the site to be evacuated and termination of work operations. After 15-30 minutes the SSHO will take additional readings. If a value of 5-10 PID units

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above background is still present in the workers breathing zone the SSHO shall contact the Project Industrial Hygienist for recommended actions and necessary personal protective equipment upgrades.

(b) Combustible gas/oxygen. Alarms on the combustible gas/oxygen meter will be set at 10% of the lower explosive limit (LEL) and <19.5% and >23% oxygen. Should the alarms activate, work operations will be terminated and the SSHO shall notify the Project Industrial Hygienist for recommended actions.

(c) Action levels for specific chemicals will be set at one half of the OSHA PEL or ACGIH TLV, whichever is lower. Workers will be notified of industrial hygiene sampling results as available.

TABLE 12-1
ACTION LEVELS BASED ON BREATHING ZONE MEASUREMENTS

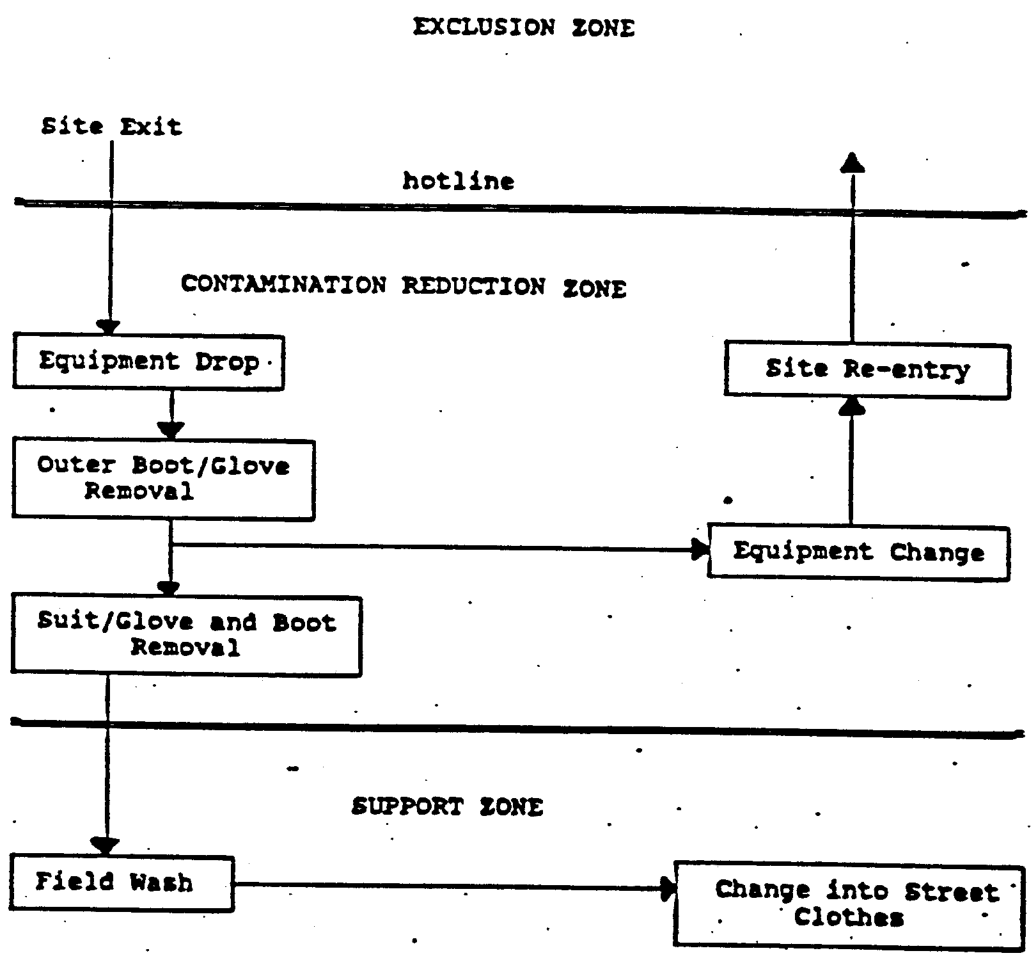
CONTAMINANT	INSTRUMENT	ACTION LEVEL	ACTION
Organic Vapors	HNU PI-101	0-5 PID	Continue work.
		5-10 PID	Monitor worker breathing zone with detector tubes.
		>10 PID	Evacuate exclusion zone, terminate work operations, notify Project Industrial Hygienist.
Combustible Gases	Industrial Scientific HMX-271	<10% LEL	Continue work.
		10% LEL (alarm)	Shut down electrical and fuel powered motors. Evacuate exclusion zone, notify Project Industrial Hygienist.
Oxygen Content	Industrial Scientific HMX-271	<19.5% (alarm)	Stop work. Evacuate exclusion zone. Oxygen deficiency exists, notify Project Industrial Hygienist.
		19.5-23%	Continue work.
		>23% (alarm)	Stop work. Evacuate exclusion zone. Oxygen enriched atmosphere, notify Project Industrial Hygienist.

13.0 DECONTAMINATION

(a) Personnel. Decontamination activities for personnel will consist of disposal of Tyvek coveralls and gloves into trash bags, and placing cotton coveralls in laundry bags, upon exit of the exclusion zone. If contaminated liquids are present at the site requiring the use of chemical resistant boots or boot covers, each individual exiting the exclusion zone must go through formal decontamination station boot wash procedures as outlined in Figure 13-1.

(b) Equipment. All equipment contacting contaminated soils or groundwater will be thoroughly steam cleaned at the decontamination containment pad. Decontamination fluids will be managed in accordance with LHAAP and project requirements.

FIGURE 13-1
LEVEL D DECONTAMINATION PROCEDURES



008561

14.0 MEDICAL SURVEILLANCE

All Corps of Engineers employees working on hazardous waste sites are required to participate in the Tulsa District Medical Surveillance Program. Employees receive an annual physical examination including blood chemistry with complete blood count and differential; urinalysis; medical history; required chest x-rays; audiogram; pulmonary function testing; and a physicians interpretation as to the employees ability to wear a respirator. As required the examination may include testing for heavy metals. The Tulsa District Medical Surveillance Program is managed by the Safety and Occupational Health Office.

15.0 EMERGENCY RESPONSE

Phone numbers for emergency response are listed below. An emergency response plan is included in Appendix A. An emergency medical evacuation route map to Marshall, TX Memorial Hospital is provided as Figure 15-1.

- Marshall Memorial Hospital	(903) 935-8745
- Ambulance Service	(903) 938-6711
- Marshall Police	(903) 935-7831
- Marshall Fire Department	(903) 938-6711
- LHAAP Fire Department	(903) 679-2315
- LHAAP Ambulance	(903) 679-2315
- LHAAP Security	(903) 679-2327
- Poison Control Center	1-800-822-9761

COE SAFETY AND OCCUPATIONAL HEALTH OFFICE

Bob Vandegriff (918) 669-7360

COE QUALITY ASSURANCE AND INDUSTRIAL HYGIENE

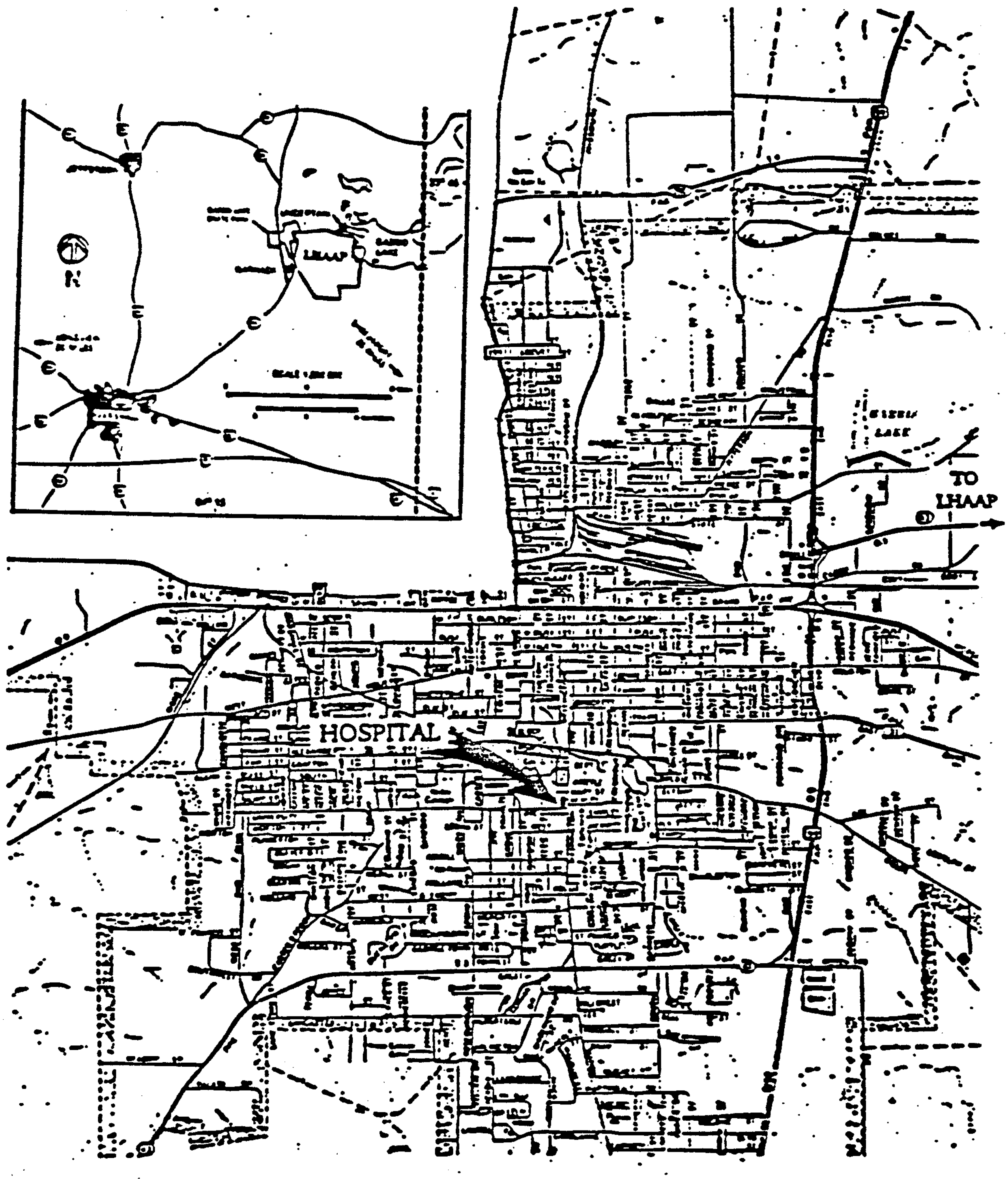
Greg Snider (918) 669-7073

COE INVESTIGATIONS SECTION

Buddy Collins (918) 832-4120

008562

FIGURE 15-1
EMERGENCY MEDICAL EVACUATION ROUTE MAP



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16.0 REFERENCES

(a) EM 385-1-1, Engineers Safety and Health Requirements Manual, October 1992.

(b) 29 CFR 1926, Occupational Safety and Health Administration (OSHA), Construction Industry Standards.

(c) 29 CFR 1910, Occupational Safety and Health Administration (OSHA), General Industry Standards.

(d) COE, Tulsa District Respiratory Protection Program, October 1992.

(e) NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

(f) American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices, 1993-94.

(g) NIOSH, Pocket Guide to Chemical Hazards, June 1990.

008564

APPENDIX A

EMERGENCY PLAN

008563

EMERGENCY PLAN

1.0 General. Careful consideration has been given to the relative possibility to fire, explosion, or release of vapors, dusts, or gases which may impinge on nearby facilities. The most likely off-site impact from this investigation involves the potential for increased airborne contaminants as a result of intrusive activities. Control measures will be employed as necessary to preclude any possibility of off-site migration of contaminants. As a result of the hazards on site and the conditions under which investigations will be conducted, the possibility of an emergency situation exists. An emergency plan is required by 29 CFR 1910.120 to be available for use and is included below.

1.1 Site Safety and Health Officer. The Site Safety and Health Officer (SSHO) shall implement this emergency plan whenever conditions at the site warrant such action. The SSHO will be responsible for assuring the evacuation, emergency treatment, emergency transport of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

1.2 Evacuation. In the event of an emergency situation, such as fire, explosion, significant release of contaminants, etc., the SSHO will notify all site personnel indicating the initiation of evacuation procedures. All personnel in both the restricted and nonrestricted areas will evacuate and assemble in the support zone or other safe area as identified by the SSHO. The SSHO will have authority to initiate proper action if outside services are required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency has been identified. The SSHO shall see that access for emergency equipment is provided and that all equipment has been shut down once the emergency has been identified. Once the safety of all personnel is established, the emergency response groups will be notified of the emergency. Other personnel listed in paragraph 2.1 shall then be notified.

1.3 Personnel Exposure. In the event of personnel exposure, skin contact, inhalation, or ingestion the following procedures shall be followed:

1.3.1 Skin Contact. Wash/rinse affected area thoroughly with copious amounts of soap and water, then provide appropriate medical attention if required. Eyes should be rinsed for at least 15 minutes following chemical contamination.

1.3.2 Inhalation. Move to fresh air and if necessary decontaminate and transport to nearest hospital.

1.3.3 Ingestion. Decontaminate and transport to nearest hospital.

EMERGENCY PLAN

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1.3.2 Inhalation. Move to fresh air and if necessary decontaminate and transport to nearest hospital.

1.3.3 Ingestion. Decontaminate and transport to nearest hospital.

1.3.4 Puncture Wound or Laceration. Decontaminate and transport to nearest hospital for professional medical attention. The SEC will provide medical data sheets to appropriate medical personnel as required.

2.0 Fire or Explosion. Immediately evacuate the site and notify the local fire and police departments, and other appropriate emergency response groups.

2.1 Environmental Incident. Secure spread of contamination if possible. Notify fire, sheriff, and police departments to inform them of the possible need for assistance to evacuate nearby areas. If a significant release has occurred, the National Response Center should be contacted. Emergency phone numbers are located in Appendix B. Those groups will alert the National or Regional Response Teams as necessary. Following these emergency calls, the following personnel listed below shall be notified:

Bob Vandegriff	Safety Office	(918) 669-7360
Greg Snider Tracey Jordan	Industrial Hygienist	(918) 581-6101

2.2 Adverse Weather. In the event of adverse weather, the Site Safety and Health Officer will determine if work can continue without sacrificing the health and safety of site personnel. Some of the items to be considered prior to determining if work should continue are:

- Heavy Rainfall
- Potential for heat stress
- Tornadoes
- Limited visibility
- Electrical storms
- Potential for accidents
- Malfunctioning of monitoring equipment

2.3 Incident Investigation. Upon receiving a report of an incident on the site, the Site Safety and Health Officer will investigate the circumstances surrounding the incident. The COE Occupational Safety and Health Office may be requested to participate in the investigation of serious incidents.

2.4 Incident Reporting. All serious incidents resulting in a fatality, emergency response, lost work time, or medical treatment will be reported immediately by the Site Safety and Health Officer. A written report will be forwarded to the COE Occupational Safety and Health Office, at the address listed below, within 48 hours of the incident. An incident follow-up report will be distributed within one week of the incident.

U.S. Army Corps of Engineers
Safety and Occupational Health Office
P.O. Box 61
Tulsa, Oklahoma 74121

008568

APPENDIX B

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE 1 - CONFINED SPACE ENTRY PROGRAM

1.0 Purpose. To establish specific requirements for practices and procedures to protect employees from the hazards of entry into and work within confined spaces.

2.0 Applicability. The policy and procedures prescribed herein are applicable to all employees of the Tulsa District and apply to all missions of the District, both military and civil. Contract personnel working for the Tulsa District will be required to develop and implement a confined space entry program which at a minimum meets the requirements described within this program.

3.0 References.

(a) EM 385-1-1, Engineers Safety and Health Requirements Manual, April 1981, Revised October 1987.

(b) 29 CFR 1926.21, Occupational Safety and Health Administration, Safety Training and Education.

(c) 29 CFR 1910.146, Occupational Safety and Health Administration, Proposed Rule (5 June 1989), Permit Required Confined Spaces.

(d) 29 CFR 1910.1200, Occupational Safety and Health Administration, Hazard Communication.

(e) ANSI Z117.1-1989, American National Standard, Safety Requirements for Confined Spaces.

4.0 Definitions.

(a) Attendant/Competent Person - An individual stationed outside the confined space who is trained to monitor and observe the authorized entrants working inside the confined space.

(b) Authorized Entrant - An employee who is authorized by the employer to enter a confined space.

(c) Blanking or Blinding - The absolute closure of a pipe, line or duct, by fastening across its bore a solid plate or cap which completely covers the bore; which extends at least to the outer edge of the flange at which it is attached; and which is capable of withstanding the maximum upstream pressure.

(d) **Permit Required Confined Space** - Any space which is large enough and so configured that an employee can bodily enter and perform work. Confined spaces usually have limited or restricted means for entry or exit, and are not designed nor intended to be occupied by employees. A confined space has one or more of the following characteristics:

(1) Contains or has known potential to contain a hazardous atmosphere;

(2) Contains materials/chemicals with the potential for suffocation or engulfment of the entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes downward and tapers to a smaller cross-section;

(4) Or contains any other recognized serious safety hazard.

(e) Double Block and Bleed - The closure of a line, duct or pipe by locking and tagging a drain or vent which is open to the atmosphere in the line between two locked-closed valves.

(f) Emergency - Any occurrence (including any failure of hazard control or monitoring equipment) or event(s) internal or external to the confined space which could endanger entrants.

(g) Engulfment - The surrounding and effective capture of a person by a liquid or finely divided solid substance.

(h) Entry - The act by which a person intentionally passes through an opening into a confined space, and includes ensuing work activities in that space. The entrant is considered to have entered as soon as any part of the entrant's face breaks the plane of an opening into the space.

(i) Entry Permit - The written or printed document established by the employer, the content of which is based on the employer's hazard identification and evaluation for that confined space and is the instrument by which the employer authorizes his or her employees to enter that confined space. The permit defines the conditions under which the space may be entered; states the reason(s) for entering the space; the anticipated hazards of the entry; lists eligible attendants, entrants, and the individuals who may be in charge of the entry; and establishes the length of time for which the permit may remain valid.

(j) Hazardous Atmosphere - An atmosphere which exposes employees to a risk of death, incapacitation, injury or acute illness from one of the following causes:

(1) An explosive gas, vapor, or mist in excess of 10 percent of its lower explosive limit (LEL);

(2) An airborne combustible dust at a concentration that obscures vision at a distance of five feet or less;

(3) An atmospheric oxygen concentration below 19.5 percent or above 22 percent;

(4) An atmospheric concentration of any substance in excess of its established permissible exposure limit (PEL).

(5) Any atmospheric condition recognized as immediately dangerous to life or health.

(k) Hot Work Permit - An employer's written authorization to perform operations, within the confined space, which could provide a source of ignition, such as riveting, welding, cutting, burning or heating.

(l) Immediately Dangerous to Life or Health (IDLH) - Any condition which poses an immediate threat of loss of life; may result in irreversible or immediate severe health effects; may result in eye damage; irritation or other conditions which could impair escape from the space.

(m) Inerting - Rendering the atmosphere of a confined space nonflammable, non-explosive or otherwise chemically non-reactive by such means as displacing or diluting the original atmosphere with steam or gas which is non-reactive with respect to that space.

(n) Isolation - The separation of a confined space from unwanted forms of energy which could be a serious hazard to authorized entrants.

(o) **Low Hazard Permit Required Confined Space** - A permit required confined space where there is an extremely low likelihood that an IDLH or engulfment hazard could be present, and where all other serious hazards have been controlled.

(p) Oxygen Deficient Atmosphere - An atmosphere containing less than 19.5 percent oxygen by volume.

(q) Oxygen Enriched Atmosphere - An atmosphere containing more than 22 percent oxygen by volume.

(r) Confined Spaces - Examples of typical confined spaces include tanks, pits, diked areas, vats, tunnels, boilers, silos, ducts, digestors, manholes, sewers, stacks, storage bins, pipelines, barges, tank cars, shafts, septic tanks, pumping or lift stations, hoppers, steam condensers, trenches, bunkers, vaults, grease pits, equipment housing and cisterns. Site specific conditions must be evaluated to determine whether the examples listed above are considered to be permit required confined spaces or low hazard permit required confined spaces.

(s) General Confined Space Entry Hazards - Examples of typical confined space entry hazards include atmospheric, engulfment, mechanical, electrical, chemical and physical hazards.

5.0 General Requirements For All Permit Required Confined Spaces and Low Hazard Permit Required Confined Spaces.

(a) Training. No person shall be required or permitted to enter a confined space until they have been trained in the hazards associated with confined space entry. Training will be conducted by a competent person under the direction of the Safety and Occupational Health Office. The following items shall be addressed in the confined space entry training program.

- Hazard recognition
- Signs and symptoms of exposure
- Entry/exit procedures
- Personal protective equipment
- Rescue/emergency procedures
- First aid/CPR overview
- Lockout/tagout and energy control
- Communication
- Monitoring
- Heat stress recognition and prevention
- Respiratory protection
- Safety and health hazard recognition

(b) Confined Space Placarding. Signs shall be posted on the outside of all identified confined spaces, within Tulsa District facilities and on construction sites managed by the Tulsa District, which require routine or periodic entry. The signs shall notify employees of the hazards which are present within the space and that entry is not authorized without meeting entry permit requirements and without prior supervisor approval. A sample confined space placard is included in attachment 2.

(c) Prevention of Unauthorized Entry. If possible, all confined spaces identified on Tulsa District property and on construction sites managed by the Tulsa District, shall be locked or secured to prevent unauthorized entry.

6.0 SPECIFIC PERMIT REQUIRED CONFINED SPACE ENTRY PROCEDURES.

(a) General. A permit required confined space is one that is difficult to enter and exit; is not intended for occupancy except for repair or maintenance; presents potential serious hazards such as toxic, oxygen deficient or flammable atmosphere; and involves engulfment or mechanical hazards. Such a confined space would require an attendant/competent person on duty while employees are within the space.

(b) Entry Permit. Before employees are required to enter a permit required confined space, an entry permit (attachment 1) authorizing entry into the space must be completed by the crew supervisor or individual responsible for the entry. A new permit shall be completed at the start of each work shift, after extended breaks and at any time a new material (such as a cleaning compound or paint) or work process (such as welding or grinding) is introduced into the space. The permit shall be clearly posted at the point of entry into the confined space.

(c) Atmospheric Testing and Monitoring. Atmospheric testing and monitoring of the confined space shall be conducted prior to entry and continuously while the space is occupied. Monitoring and testing of the space will be conducted for oxygen content of the space, combustible gasses, vapors and mists, and other toxic compounds which could potentially be present within the space. Individuals required to monitor confined spaces will be trained in the operation of monitoring equipment and interpretation of confined space conditions. Atmospheric testing and monitoring of confined spaces must be performed by a competent person under the direction of the Safety and Occupational Health Office.

(d) Atmospheric Testing and Monitoring Equipment. Equipment used for initial and continuous monitoring of confined spaces consists of the following minimums:

(1) Combination oxygen/combustible gas meter. Optional capabilities for toxic substances detection such as carbon monoxide, hydrogen sulfide, etc.

(2) Detector tubes appropriate for the suspected contaminants within the confined space.

(3) Optional equipment may include photoionization detectors (PID), flame ionization detectors (FID), organic vapor analyzers (OVA), and infra-red detectors (IRD).

Equipment must be maintained, operated and calibrated in accordance with manufacturers recommended procedures. All monitoring equipment must be factory approved for use in hazardous and flammable atmospheres.

(e) Attendant/Competent Person. A person certified in CPR/First Aid and trained in emergency rescue, including respiratory usage, shall be assigned to remain on the outside of the confined space at all times the space is occupied. The authorized attendant shall maintain continuous communication with those working inside the space. The attendant shall have the primary responsibility of monitoring the confined space and performing emergency rescue. Rescue procedures shall be specifically designed for each confined space and recorded on the entry permit. The attendant/competent person shall not enter the confined space.

(f) Emergency Rescue Equipment. Minimum equipment required on the site while the space is occupied shall consist of the following minimums:

(1) A full body harness with attached lifeline;

(2) A tripod if the confined space is more than six feet deep.

(3) A supplied air respirator or self contained breathing apparatus.

(g) Personal Protective Equipment. Personal protective equipment necessary for confined space entry will be selected based upon site specific conditions. The personal protective equipment necessary for confined space entry will be listed on the entry permit. All use of personal protective equipment, including respirators, will be under the direction of the Safety and Occupational Health Office.

7.0 SPECIFIC LOW HAZARD PERMIT REQUIRED CONFINED SPACE ENTRY PROCEDURES.

(a) General. A low hazard permit space is a confined space with a very low likelihood of a flammable or explosive atmosphere, atmospheric toxins or engulfment hazards. No attendant/competent person is necessary while the space is occupied.

(b) Entry Permit. When supervisors, in consultation with the Safety and Occupational Health Office, determine based on documentation which appears on the entry permit (attachment 1), that the confined space is a low hazard permit space, entry may be authorized without providing an attendant for a period of up to one year. The permit shall be clearly posted at the point of entry into the confined space.

(c) Supervisors who plan to have employees enter low hazard permit spaces to perform minor maintenance work and inspections which will not generate any serious hazard, shall ensure the authorized entrants receive the necessary training and that the following conditions are met:

(1) Appropriate entry practices and procedures are in effect before authorizing entry and followed throughout the entry.

(2) If the space has a potential for a hazardous atmosphere, the low hazard permit space shall be shown to be, and to remain, acceptable for entry using one of the following means, as appropriate to make the determination:

(A) Ventilation of the low hazard permit space prior to entry, using a mechanically powered ventilator for at least the time specified by the manufacturer and continuously throughout the entry.

(B) A combination of mechanically powered ventilation and atmospheric testing using appropriate direct reading atmospheric testing and monitoring equipment.

(C) Continuous atmospheric monitoring using appropriate direct reading atmospheric testing and monitoring equipment.

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TULSA DISTRICT CONFINED SPACE ENTRY PERMIT

NOTE: COPY OF PERMIT WILL REMAIN AT THE ENTRY POINT OF THE CONFINED SPACE WHILE THE SPACE IS OCCUPIED

[1] |____| Confined Space Entry Permit -- Valid Until |______________________|

|____| Low-Hazard Confined Space Entry Permit -- Valid Until |______________________|

[2] LOCATION AND DESCRIPTION OF CONFINED SPACE

____

____

[3] PURPOSE OF ENTRY

____

____

[4] DEPARTMENT ______________________________

[5] AUTHORIZED ENTRANTS ____________________ ____________________

____________________ ____________________

[6] SPECIAL REQUIREMENTS

	YES	NO	N/A		YES	NO	N/A
Lock Out / De-Energize				Escape Harness			
Lines Broken - Capped/Blanked				Tripod			
Purge - Flush and Vent				Lifelines			
Ventilation				Fire Extinguishers			
Secure Area				Lighting			
Breathing Apparatus				Protective Clothing			
Resuscitator - Inhaler				Respiratory Protection			
Attendant/Competent Person				____________			

[7]

TEST(S) TO BE TAKEN	PERMISSIBLE ENTRY LEVEL	INITIAL TESTING REQUIRED YES	NO	N/A	CONTINUOUS TESTING REQUIRED YES	NO	N/A
% Oxygen	19.5% - 22.0%						
% Explosive Gas	< 10% LEL						
Carbon Monoxide	< 35 ppm						
Hydrogen Sulfide	< 10 ppm						
____________	____________						

[8]

MONITORING INSTRUMENTS USED	SERIAL NUMBER	CALIBRATED YES	NO	N/A
____________	____________			
____________	____________			

[9] AUTHORIZED ATTENDANT/COMPETENT PERSON ______________________

[10] EMERGENCY PHONE NUMBERS

FIRE DEPARTMENT ____________________ AMBULANCE ____________________

[11] SUPERVISOR AUTHORIZING ALL ABOVE CONDITIONS SATISFIED ______________________
signature

ATCH 1

008576

DANGER
CONFINED SPACE

NO UNAUTHORIZED ENTRANTS

ENTER BY PERMIT ONLY

CHEMICAL HAZARDS: ______________	CONTROL: ______________
PHYSICAL HAZARDS: ______________	CONTROL: ______________
MECHANICAL HAZARDS: ______________	CONTROL: ______________
ENGULFMENT HAZARDS: ______________	CONTROL: ______________
ELECTRICAL HAZARDS: ______________	CONTROL: ______________
ATMOSPHERIC HAZARDS: ______________	CONTROL: ______________

SUPERVISOR IN CHARGE: ______________________________

SAFETY AND OCCUPATIONAL HEALTH OFFICE: (918) 669-7360

:DURE 2 - SNAKE BITE

:rson approaching a snake
:he snake off. However,
:xploring areas where snakes
:s, under bushes, or in holes,

snake are:

it will exacerbate the effect

wound as it is minimally

ince venom is most dangerous

un for help as this will

:ention.

: bile.

affected extremity lower than
assistance.

STANDARD OPERATING PROCEDURE 3 - TEMPERATURE STRESS

1.0 Heat Stress. Heat produced by the body and the environmental heat together determine the total heat load. Therefore, if work is to be performed under hot environmental conditions, the workload of each job shall be established and the heat exposure limit pertinent to the workload evaluated against the applicable standard in order to protect the employee from exposure beyond the permissible limit. For the purpose of this SOP, the American Conference of Governmental Industrial Hygienist published Threshold Limit Values and Biological Exposure Indices, latest edition shall be considered the standard for work operations conducted in permeable protective clothing. NIOSH/OSHA/USCG/EPA heat stress monitoring recommendations shall be considered the standard for work operations conducted in impermeable protective clothing.

1.1 Heat Stress Monitoring.

1.1.1 Permeable Work Ensembles. Since measurement of deep body temperature is impractical for monitoring the employees' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological response to heat. At the present time Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT values are calculated by the following equations:

Outdoor with solar load: WBGT = 0.7 NWB + 0.2 GT + 0.1 DB
Indoors or outdoors with no solar load: WBGT = 0.7 NWB + 0.3 GT

Where:
WBGT = Wet Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer, such as the Reuter-Stokes, Thermo-environmental Monitor, (WIBGET).

TABLE 1 - PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES
Values are given in degrees Fahrenheit WBGT

	WORK LOAD		
Work-Rest Regimen	Light	Moderate	Heavy
Continuous Work	86	80	77
75% Work 25% Rest each hour	87	82	78
50% Work 50% Rest each hour	89	85	82
25% Work 75% Rest each hour	90	88	86

1.1.2 Impermeable Work Ensembles. For workers wearing semipermeable or impermeable encapsulating ensembles, the ACGIH work/rest standard cannot be used. For these situations workers should be monitored as described below when the temperature in the work area exceeds 70 degrees fahrenheit.

Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

1.2 Heat Stress Prevention. Proper training and preventive measures will avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, the following steps should be taken:

- Adjust work schedules
- Provide shelters
- Maintain body fluids
- Encourage physical fitness
- Utilize cooling devises
- Recognize heat stress warning symptoms

TABLE 2 - SIGNS AND SYMPTOMS OF HEAT STRESS

Heat rash may result from continuous exposure to heat or humid air.

Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. To reduce occurrence of heat cramps increase amount of water consumption. Sign and symptoms include:

- muscle spasms
- pain in the hands, feet and abdomen

Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardio-vascular insufficiency or dehydration. In the event of heat exhaustion measures need to be taken to cool the body and replace body electrolytes. Signs and symptoms include:

- pale, cool, moist skin
- heavy sweating
- dizziness
- nausea
- fainting

Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical attention must be obtained. Signs and symptoms are:

- red, hot, usually dry skin
- lack of or reduced perspiration
- nausea
- dizziness and confusion
- strong, rapid pulse
- coma

2.0 Cold Stress. Fatal exposure to cold among workers have almost always resulted from accidental exposures involving failure to escape from low air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the fall in deep core temperature of the body. Employees should be protected from exposure to cold so that the deep core temperatures does not fall below 36 degrees Celsius (96.8 F); lower body temperature will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

2.1 Evaluation and Control. For exposed skin, continuous exposure should not be permitted when the air speed and temperature results in an equivalent chill temperature of -32 degrees Celsius. At temperatures of 2 degrees Celsius or less it is imperative that employees who become immersed in water or

ie. ately provided with a change
othermia. Special protection of
. manual dexterity for the

onal total body protection is
or below 4 degrees Celsius as

old protective clothing
and physical activity.

site is increased by wind or
ng effect of the wind shall be
a, or by wearing a removable

does not give adequate
or frostbite, work shall be
ate clothing is made available
ve.

tive liquids at temperatures
e special precautions to avoid
ause of the added danger of cold
i .

or below -12 degrees Celsius

constant protective observation

periods must be taken in heated
ing into dry clothing shall be

required to work full-time in
hey have become accustomed to
d protective clothing.

in such a way that sitting
is minimized.

cted in safety and health
shall include as a minimum

es and appropriate first aid

.
g abits.
f stbite.

e. Recognition signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.

f. Safe work practices.

2.2 Special Workplace Recommendations. Special caution shall be exercised when working with toxic substances and when workers are exposed to vibration. Cold exposure may require reduced exposure limits. Eye protection shall be provided to workers employed out-of-doors in snow and/or ice terrain. Trauma sustained in freezing or subzero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment.

STANDARD OPERATING PROCEDURE 4 - THUNDERSTORMS AND TORNADOES

Meteorological conditions shall be closely watched, especially in the spring, when severe thunderstorms and tornadoes are most likely to occur. Thunderstorms and tornadoes often occur late in the afternoon on hot spring days, but can occur at any time of the day in any season of the year. Tornadoes are usually preceded by severe thunderstorms with frequent lightning, heavy rainfall, and strong winds.

A **severe thunderstorm watch** or a **tornado watch** announcement on radio or television indicates that a severe thunderstorm or tornado is possible. Work may continue at the work site during severe thunderstorm watches or tornado watches if conditions allow. A **severe thunderstorm warning** or a **tornado warning** signifies that a severe thunderstorm or a tornado has been sighted or detected by radar and may be approaching. All work on site shall cease during a thunderstorm, severe thunderstorm warning, or a tornado warning.

Personnel of site during a tornado shall take the following steps:

- evacuate office trailers or vehicles.
- If outdoors, lie flat in a nearby ditch.
- Stay away from power poles, electrical appliances, and metal objects.
- Do not try to outrun a tornado.

APPENDIX C

SITE SPECIFIC TRAINING FORMS

SITE SPECIFIC TRAINING RECORD FORM

Project: Longhorn AAP Waste Process Sump Investigations

Location: Marshall, Texas

Meeting Date: ______________________________ Time: ______________________

Meeting Conducted By: ____________________________________

____

Topics:

_____ History of the site

_____ Field activities planned

_____ Safety, health and other hazards present at the site

_____ Use of personal protective equipment

_____ Work practices which will minimize potential hazards

_____ Safety use of equipment at the site

_____ Air monitoring activities

_____ Industrial hygiene sampling activities

_____ Recognition of signs and symptoms indicating possible overexposure to chemical hazards

_____ Decontamination procedures

_____ Emergency response and evacuation procedures

_____ Public relations

_____ Right and responsibilities under OSHA

Meeting Participants:

______________________________	______________________________
______________________________	______________________________
______________________________	______________________________
______________________________	______________________________
______________________________	______________________________

SITE SAFETY AND HEALTH PLAN ACKNOWLEDGEMENT FORM

I have read, understand, and agree to follow the guidelines described in this Site Safety and Health Plan.

PROJECT: Longhorn AAP Waste Process Sump Investigations

NAME	ORGANIZATION	SIGNATURE	DATE

008587

X

D ANALYSIS

APPENDIX D

ACTIVITY HAZARD ANALYSIS

DRILLING ACTIVITY HAZARD ANALYSIS

Prior to the start of work, the Drill Rig Operator will inspect all drilling equipment and ensure equipment is in proper working condition and that all safety features and kill switches are functioning as designed and clearly labeled. The Drill Rig Operator is responsible for safety in all aspects involving the drilling rig and other drilling equipment.

(a) Protective Equipment. All personnel in the vicinity of the drilling rig shall, as a minimum, wear the protective equipment listed below. Additional protective equipment as described in the SSHP will be required when exposure to chemical hazards is possible.

- Hard hat
- Steel toe safety boots
- Safety glasses
- Back support belts (when lifting 15 lbs or more)
- * Hearing protection (foam inserts)

* Sound level surveys have not shown noise levels in excess of 85 dB(A) during general drilling and auguring operations. If it is necessary to shout in order to communicate, then sound levels are in excess of 85 dB(A) and hearing protection shall be used.

Activity	Hazard	Control
Rig Transport/ Setup	(1) Struck By	- All augers and pipe sections shall be secured in racks during transport. - Never move the rig with the mast upright. - Set hydraulic leveling jacks before raising the mast.
	(2) Backing	- A ground guide is required in addition to a functioning audible backup alarm during all equipment backing.
	(3) Electrical/ Utility	- Inspect for buried and overhead utilities in the vicinity of the rig. - A drilling clearance shall be obtained from base authorities or OKIE-1 before initiating drilling activities.
Pipe Handling	(1) Struck By	- Pipe stored in racks, on trailers or on flatbed trucks should be blocked to prevent shifting.

Activity	Hazard	Control
		- Pipe should be loaded and unloaded, layer by layer, with the bottom layer blocked securely at all four corners. - Be prepared for sudden movement when tailing pipe sections.
	(2) Back Strain	- Use proper lifting techniques and a back support device when manually handling pipe sections.
Hoisting Operations	(1) Struck By	- Never engage the rotary clutch until all personnel and equipment are clear. - Never leave the brake unattended when engaged. - Drill pipe or auger sections should not be picked up or dropped suddenly. - Test the brakes daily.
Catline Operations	(1) Struck By	- Do not use more wraps than necessary to pick up the load. More than one layer of wrapping is not allowed. - Personnel should not stand near, step over, or go under a cable under tension. - The cathead must be kept clear of obstructions and entanglements.
Derrick Operations	(1) Fall	- The mast should be lowered, if possible, to make repairs or to free up entangled wire rope or obstructions. - If the mast must be ascended, a proper ladder safety climbing device must be used.
	(2) Weather	- The Drill Rig Operator must be aware of weather conditions (wind, rain, lightning, etc.) and terminate drilling operations in the event of unsafe conditions.
Maintenance	(1) Equipment	- The drilling rig must be maintained in a proper functioning manner.

Activity	Hazard	Control
		- All motors must be shut off and electrical and mechanical components locked out of service when making repairs.
	(2) Fire	- All motors must be shut off during re-fueling. - Smoking in the vicinity of the drilling rig is not permitted. - A fire extinguisher must be maintained on the drilling rig at all times. - Fuel containers will not be stored within 10' of operating equipment. - Approved safety cans will be used for all fuel storage. - A welding permit must be obtained from proper base authorities when making repairs.

WATER SAMPLING ACTIVITY HAZARD ANALYSIS

Prior to the start of work, the water sampling Team Leader will inspect all purging and sampling equipment and ensure the equipment is in a proper operating condition. The Team Leader is responsible for safety in all aspects of water sampling.

(a) Protective Equipment. All personnel engaged in water sampling activities shall, as a minimum, wear the following protective equipment.

- Steel toe safety boots
- Chemical splash goggles or face shield during sample preservation
- Chemical resistant gloves during sample preservation and sampling
- Back support belt (when lifting 15 lbs or more)

* **Hearing protection**

* Sound level surveys conducted during purging operations using portable generators, compressors, and QED driver units have shown noise levels to be in excess of 85 dB(A), therefore hearing protection is required.

Activity	Hazard	Control
Mobilization/ Site Setup	(1) Struck By	- All equipment will be properly secured in trucks and on trailers during transport. - Nitrogen cylinders will be properly stored and secured in an upright position with protective caps in place.
	(2) Backing	- Ground guides will be used when backing trucks and trailers up to the well casing.
	(3) Back Strain	- Portable generators, compressors, air cylinders and the Bennett System will be loaded, and unloaded, by a minimum of two crew members. - Proper lifting techniques and back support devices will be used when lifting equipment.
Sample Preservation	(1) Fire	- Sample preservation chemicals will not be stored within 10' of operating equipment. - Sample preservation chemicals will be stored in

Activity	Hazard	Control
		containers designed and approved for this purpose.
	(2) Burns	- Proper gloves, eye and face protection will be worn during sample preservation. - Sample preservation will only be performed in a well ventilated area.
Maintenance	(1) Equipment	- All purging and sampling equipment must be maintained in a proper functioning condition. - All motors must be shut off or unplugged when making repairs.
	(2) Fire	- All motors must be shut off during re-fueling. - Smoking at the site is not permitted. - A fire extinguisher must be maintained at the site at all times. - Fuel containers will not be stored within 10' of operating equipment. - Approved safety cans will be used for all fuel storage.

008594

FINAL

WORK PLAN ADDENDUM

for the

PHASE II
REMEDIAL INVESTIGATION
SITES 11, 1, XX, 27

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted to:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

AUGUST 1994

Prepared by:

SVERDRUP ENVIRONMENTAL, INC.
ST. LOUIS, MISSOURI

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008596

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AMCCOM	U.S. Army Armament, Munitions, and Chemical Command
CDAP	Chemical Data Acquisition Plan
COE	U.S. Army Corps of Engineers
EPA	U.S. Environmental Protection Agency
EPS	Environmental Protection Systems, Inc.
FFA	Federal Facility Agreement
INF	Intermediate-Range Nuclear Forces
LHAAP	Longhorn Army Ammunition Plant
MSC	Media-Specific Concentration
NPL	National Priorities List
RCRA	Resource Conservation and Recovery Act

SECTION 1.0

INTRODUCTION

1.1 Introduction

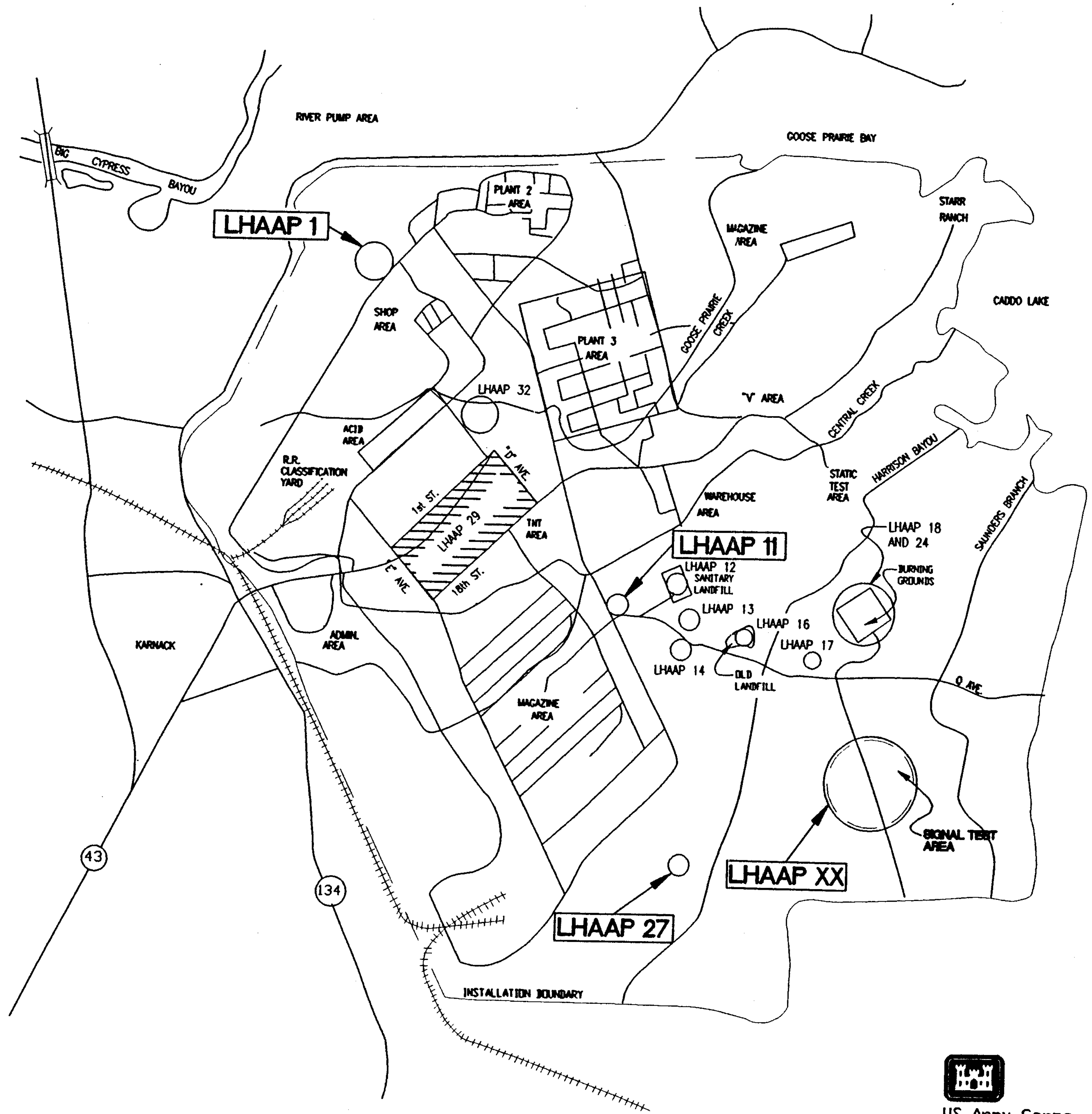
This Work Plan Addendum describes the remedial activities necessary to conduct a Phase II Remedial Investigation (RI) for Longhorn Army Ammunition Plant (LHAAP), Karnack, Texas. It provides modifications to the RI/FS Work Plan Volume I - General, U.S. Army Corps of Engineers, June 1992. These modifications address the activities required to perform a Phase II RI at four (4) LHAAP sites, as listed in Table 1-1. The site locations within LHAAP are shown on Figure 1-1.

TABLE 1-1

Areas for Phase II Remedial Investigation Activities at LHAAP

LHAAP No.	Area Name
* 11	Suspected TNT Burial Site at Avenues P and Q
1	Inert Burning Grounds
XX	Ground Signal Test Area
27	South Test Area

Note: An "*" denotes a SWMU listed in Part B of the RCRA Permit.



SITES IN THIS INVESTIGATION
LHAAP 11
LHAAP 1
LHAAP XX
LHAAP 27

N

3000 0 3000 6000
SCALE IN FEET

US Army Corps of Engineers Tulsa District

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

SITE LOCATION MAP

Sverdrup Environmental

FIGURE 1-1

000086-3\CADD\LH3-01

1.2 Purpose and Scope

The purpose of this addendum is to ensure that environmental impacts associated with past and present activities at the LHAAP are thoroughly investigated in the Phase II RI, and that an appropriate remedial action is selected to protect the public health, welfare, and the environment. The proposed investigations presented herein are intended to satisfy the data requirements to complete the RI and the risk assessment.

The scope of this addendum is to present the rationale and step-by-step plan of action for each field activity included in the Phase II RI.

1.3 Regulatory Background

LHAAP was placed 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 Natural Resources Conservation Commission (TRNCC), formerly the Texas Water Commission (TWC), entered into a CERCLA Section 120 Agreement for remedial activities at LHAAP. The CERCLA Section 120 Agreement, referred to as the Federal Facility 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.

LHAAP was issued a Resource Conservation and Recovery Act (RCRA) Part B permit, Permit No. HW-

50195, by the TNRCC in February 1992. Areas listed as SWMUs in the Part B permit have an asterisk in front of the LHAAP number in Table 1-1.

1.4 Addendum Organization

The Work Plan Addendum describes general information about the facility, previous investigations, and the proposed plan for the Phase II RI. This addendum is designed to complement the Corps of Engineers LHAAP RI/FS Work Plan (June, 1992). Companion documents include the Chemical Data Acquisition Plan (CDAP) Addendum and the Site Safety and Health Plan (SSHP) Addendum. The CDAP Addendum incorporates minor additions to the Corps of Engineers CDAP dated June 1992. The original RI/FS SSHP has been implemented without change for completion of the Phase II RI.

The Work Plan Addendum has been divided into four sections. Section 1.0 is the introduction. It describes the sites to be investigated, the remedial activities tasks, and the organization of the Work Plan Addendum.

Section 2.0 provides general information about the facility. It describes the location, background, and other features of the facility.

Section 3.0 gives site specific information about each of the four areas included in the Phase II RI. A detailed description is provided for each site. A discussion of previous investigations and a summary of the results are provided. The potential contaminants, migration pathways, and receptors of contaminants are also provided in the section.

Section 4.0 presents the data requirements needed for site characterization and the plan of investigations for each of the four sites. The number of samples, type of samples (soil, groundwater, sediment, or surface water), and parameters to be tested are presented. The field procedures for obtaining the samples and lab procedures for analysis are described in the CDAP Addendum.

1.5 Project Management

Remedial activities at LHAAP will be performed by the U.S. Army with review and direction from the EPA Region VI and the TNRCC. The Army will use the Corps of Engineers (COE) and the COE's contractors to perform the remedial activities at LHAAP. The COE will conduct operations under the direction of the Army's Project Manager for LHAAP, Mr. Dave Tolbert, Longhorn Army Ammunition Plant, ATTN: SMCLO-EV; Marshall, Texas 75671-1059.

Work performed by contractors for the COE will be reviewed and revised before submittal to the EPA and the TNRCC. Tulsa District COE will be responsible for execution of all work by the COE. All submittals, revisions and review times will be in accordance with the guidelines in the FFA.

SECTION 2.0

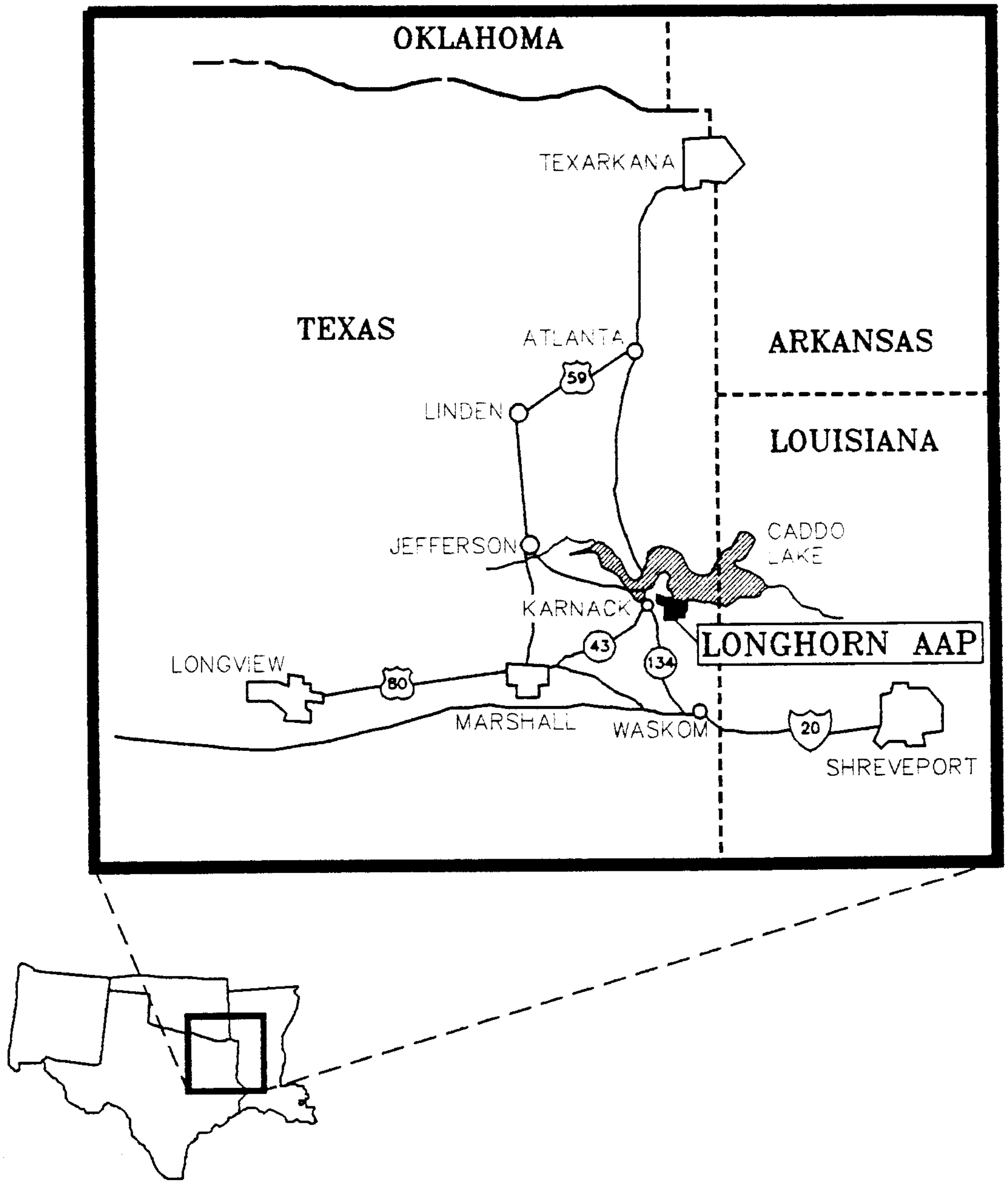
FACILITY BACKGROUND

2.1 Location

Longhorn Army Ammunition Plant (LHAAP) is located in central east Texas in the northeast corner of Harrison County, approximately 14 miles northeast of Marshall, Texas, and approximately 40 miles west of Shreveport, Louisiana. The installation occupies 8,493 acres between State Highway 43 and the western shore of Caddo Lake. State Highways 43 and 134 access the installation. A location map is shown on Figure 2-1.

2.2 Boundary Features

Longhorn Army Ammunition Plant is bounded to the north and east by Caddo Lake, a large fresh water lake lying on the Texas-Louisiana state line. The eastern fence of the installation is 3-1/2 miles from the 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.



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

SITE VICINITY MAP

Sverdrup Environmental

FIGURE 2-1

000086-3\CADD\LHS-16

2.3 Facility Background

Longhorn Army Ammunition Plant is a government-owned, contractor-operated (GOCO) industrial facility under the jurisdiction of the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM). Its primary mission is to load, assemble, and pack (LAP) pyrotechnic and illuminating/signal ammunition and solid propellant rocket motors. The Longhorn Division of Thiokol Corporation is the current operating contractor.

Longhorn Army Ammunition Plant was established in October 1942 with the primary mission of producing 2,4,6-trinitrotoluene (2,4,6-TNT) flake in the Plant 1 area. Monsanto Chemical Company was the first contract operator of the plant. Production of TNT continued through World War II until August 1945 when Monsanto's role ceased and the plant went on standby status until February 1952. From 1952 until 1956, Universal Match Corporation was the operating contractor, producing such pyrotechnic ammunition as photoflash bombs, simulators, hand signals, and tracers for 40mm.

In November 1955, Thiokol Corporation began operation of the Plant 3 area rocket motor facility. Thiokol 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 mission of LHAAP until 1965, when the production of pyrotechnic and illuminating ammunition was reestablished.

Current operations consist of compounding pyrotechnic and propellant mixtures, LAP 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 (INF) Treaty in effect between the United States and the former U.S.S.R.

2.4 Climate

Longhorn Army Ammunition Plant 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 almost always occurs as rain, with snow a rare occurrence.

2.5 Additional Information

Additional information about Longhorn Army Ammunition Plant, including topography and drainage, geology and soils, regional hydrogeology, surface water and groundwater usage, surrounding land use, ecologic conditions, and cultural resources may be referenced in Section 2.0, Facility Background of the final RI/FS Work Plan, Volume I - General.

SECTION 3.0

SITE NATURE AND EXTENT OF CONTAMINATION

3.1 LHAAP 11: Suspected TNT Burial Site at Avenues P and Q

3.1.1 Site History. The Suspected TNT Burial Site is an undocumented location where it is suspected that bulk TNT might have been disposed during the 1940s. Other than the designation of this location by USATHAMA in the early 1980s, where contamination investigations were later conducted, there is no confirmed documentation that TNT burial occurred at this site. The site has been inactive since its suspected use in the 1940s.

3.1.2 Site Description. The site is situated in the south central portion of LHAAP adjacent to the intersection of Avenues P & Q (Figure 1-1). A detailed map of the Suspected TNT Burial Site showing current site conditions is shown on Figure 3-1. 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. Power lines parallel Avenues P & Q on two sides of the site. A large forested area extending to Central Creek exists 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. A borrow pit exists north of the site. Aerial photographs do not document the presence of this 5-foot deep depression prior to 1963, and the area does not appear to be active in aerial photos dating as late as 1985.

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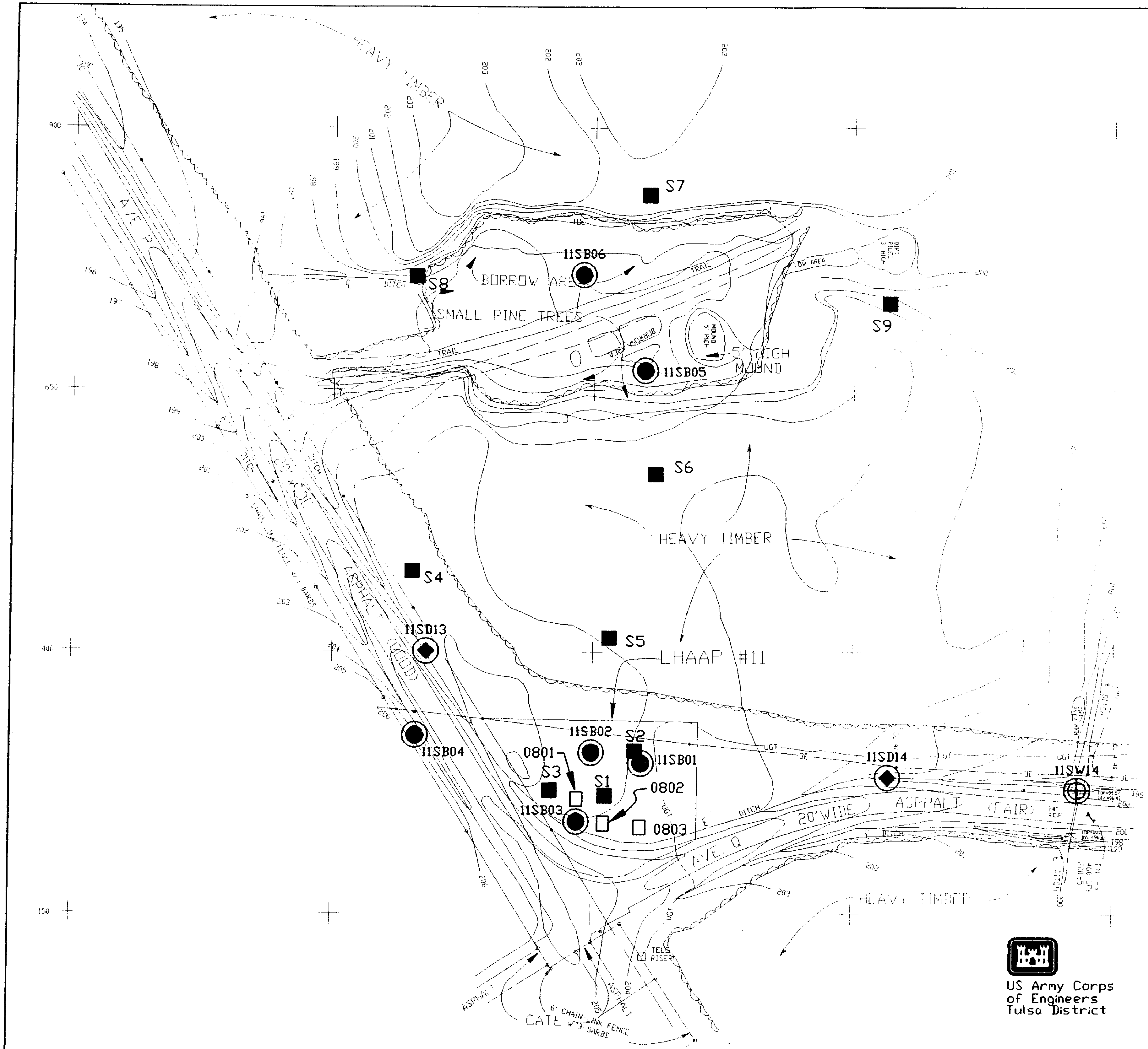


LEGEND

- GROUNDWATER FLOW DIRECTION
- SHALLOW SOIL SAMPLE AND NUMBER
- SURFACE WATER FLOW DIRECTION
- POINT OF COMPLIANCE
- SOIL BORING
- SURFACE WATER/SEDIMENT SAMPLE
- SURFACE WATER SAMPLE

100 0 100 200
SCALE IN FEET

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP 11
SUSPECTED TNT BURIAL SITE
PREVIOUS
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 3-1

3.1.3 Previous Investigations. The Suspected TNT Burial Site was originally investigated by Environmental Protection Systems Inc. (EPS) for USATHAMA and Morton Thiokol Inc., as documented in reports dated June 1984 and May 1988 (see RI/FS Work Plan Volume I - General, COE, June 1992). The investigations included four 5-ft deep soil borings and ten surface soil samples (Figure 3-1); the samples were analyzed for explosives compounds. In 1993, Ebasco Services Inc. (Ebasco) performed six soil borings and two sediment/surface water samples at the site (Figure 3-1); soil, sediment, surface water and groundwater grab samples were taken and analyzed for volatiles, semivolatiles, explosives, metals, and anions.

During the Phase 1 Remedial Investigation, 20 soil samples were taken at 5-ft depth intervals within unsaturated soils in six soil borings. Each boring was extended to at least 2 ft below groundwater and a groundwater grab sample obtained. The borings were drilled to total depths of 15 to 22 ft below the ground surface.

3.1.4 Potential Contaminants and Migration Pathways. The suspected source of contamination is a burial pit possibly used for the disposal of TNT in the 1940s. Previous investigations by EPS detected trace amounts of the explosive compound 2,4,6-TNT and low concentrations of 1,3,5-trinitrobenzene (TNB) in soils to depths of 5 feet.

The Phase 1 Remedial Investigation conducted by Ebasco in 1993 detected no volatile, semivolatile, or explosive compounds in any of the soil, sediment, surface water, or groundwater grab samples, with one exception. The groundwater grab sample from boring 11SB04 detected 1,3,5-TNB at 0.62 μg/l. Concentrations of lead and selenium exceeding twice the maximum site-specific background concentrations were detected in surficial samples from four borings, and in boring 11SB04 from 10 to 14 ft depth. Sulfate concentrations exceeding twice the site-specific background level were noted in about half of the soil samples, and in two groundwater grab samples, 11GG05 and 11GG06. Background concentrations for metals and anions for the entire LHAAP facility have yet to be determined.

A good stand of vegetation inhibits erosion of contaminated surface soils to surface migration pathways. However, water percolating downward through contaminated soils may leach contaminants into the shallow groundwater, which was observed from 3 to 16 feet below the ground surface during previous investigations. Because groundwater likely occurs under unconfined conditions, contaminants could eventually discharge to surface migration pathways.

3.1.5 Identification of Potential Receptors. The general public does not have ready access to the Suspected TNT Burial Site at Avenues P & Q because the site is located within the confines of LHAAP boundaries. The population having direct use of the site is primarily limited to few LHAAP or contract service personnel and occasional hunters who may cross the field to hunt in the adjacent woodland.

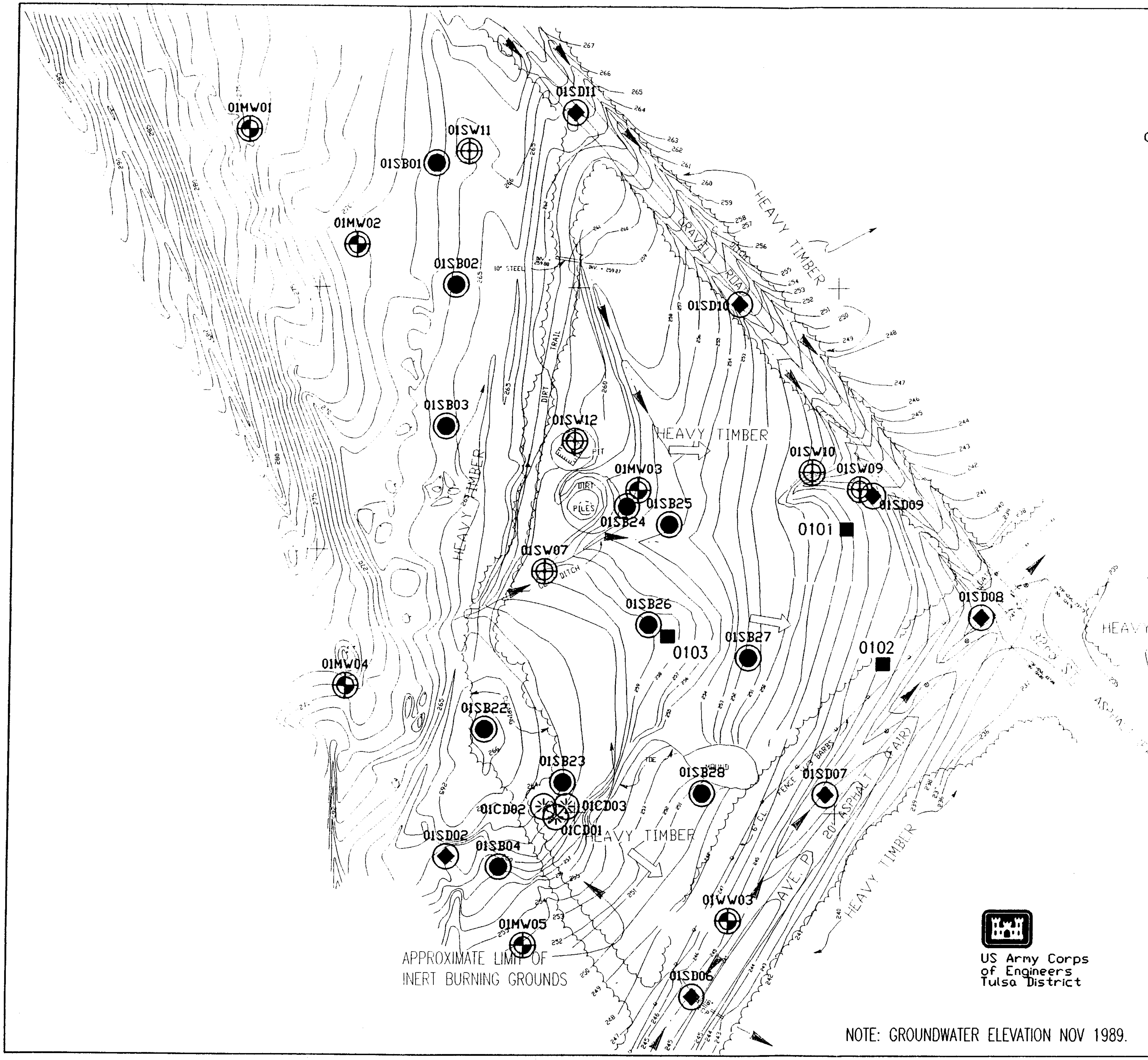
Because groundwater occurs under unconfined conditions over much of the installation, possible discharge of contaminated groundwater to the many surface water channels bisecting LHAAP poses a potential threat to human health and the environment. The horizontal distance that contaminants must travel to the nearest public supply well, Well 902, is approximately 1.8 miles to the southwest. Well 902 is located upgradient of the site but in the down-dip direction of the base of the Cypress aquifer. There are no public supply wells in the direction of regional groundwater flow towards Caddo Lake. It is not anticipated that groundwater in the vicinity of or downgradient to the site will be developed for future use.

3.2 LHAAP 1: Inert Burning Grounds

3.2.1 Site 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 (LHAAP 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.

3.2.2 Site Description. The site is situated in the extreme northwestern portion of LHAAP, near the intersection of Avenue P and 32nd Street (Figure 1-1). A detailed map of the Inert Burning Grounds and surrounding area is shown on Figure 3-2. It depicts detailed topography and surface drainage patterns, estimated groundwater flow direction, location of previous sampling points, and the suspected limit of the site. Also shown are roads, fences, and limited vegetation information with heavily timbered areas differentiated from lightly or nontimbered areas. The limits of this area of the site were established on the basis of field observations, detailed topographic information, and vegetation patterns. Current vegetation patterns serve as only a rough indicator of past disposal areas because there has been considerable regrowth of trees during the 25 or more years that have elapsed since the site was used for waste disposal. This portion of the site covers an area of approximately 1.5 acres.

General soil and geologic maps and the boring log data for nearby monitoring well 104 indicate the site is located within the outcrop of the Wilcox Group of sediments that typically consist of interbedded sands, silts, and clays. At this site, these sediments appear to be overlain by a few feet of residually-derived soils and/or fill materials. Depth to groundwater probably averages about 5 feet with some seasonal fluctuation. The groundwater hydraulic gradient is expected to be topographically controlled; the regional flow direction across the site is assumed to be toward the southeast.



NOTE: GROUNDWATER ELEVATION NOV 1989.

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP 1
INERT BURNING GROUND
PREVIOUS
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 3-2

000086-3\CADD\LH3-07

Surface drainage from the site collects in ditches alongside Avenue P and 32nd Street, then passes through either the concrete culvert across 32nd Street at its intersection with Avenue P or the concrete culvert across Avenue P near existing Well 104 (01-104). The site's surface drainage eventually enters Goose Prairie Creek, which flows into Caddo Lake. The total flow distance from the site to Caddo Lake is approximately 3 miles.

3.2.3 Previous Investigations. This site was investigated by EPS for USATHAMA, and a report was published in June of 1984. EPS installed and sampled one monitoring well (Well 01-104), and collected three surface soil samples. The soil and groundwater samples were analyzed for explosive compounds, selected (total) metals, and selected anions. Groundwater samples were also analyzed for volatile and semivolatile organic compounds.

In 1993, a Phase 1 Remedial Investigation was conducted at LHAAP-1 in two separate sections: LHAAP-1, situated to the south and east, was investigated by Ebasco Services, Inc. (Ebasco); LHAAP-1A, situated to the north and west, was investigated by Roy F. Weston (Weston). Ebasco collected 37 soil samples at 5-ft depth intervals within unsaturated soils from 8 soil borings. The borings extended to depths of 10 to 30 ft. Groundwater grab samples were collected from each boring. Seven sediment/surface water samples were also collected at the site, along with existing monitoring well 01-104 (labeled WW-03 in Ebasco's Field Investigation Summary Report).

Weston collected 70 soil samples at 5-ft depth intervals within unsaturated soils from 9 soil borings. The borings ranged in depth from 5 to 45 ft in depth. Five of the borings were completed as monitoring wells and groundwater samples were collected. Groundwater grab samples were also collected from the four borings which were not completed as monitoring wells. In addition, Weston collected three sediment/surface water samples, and three samples of construction debris. Samples from the Phase 1 investigations conducted by Ebasco and Weston were analyzed for the Phase 1 parameters list (which includes volatiles, semivolatiles, selected (total) metals, high explosives, and anions).

3.2.4 Potential Contaminants and Migration Pathways. The suspected source of contamination is burned explosive waste residues and possibly bulk explosive wastes that have been covered or mixed with fill materials. Previous investigations by EPS detected trace amounts of nitrobenzene and 1,3,5-TNB in the groundwater assumed to be downgradient of the site.

The Phase 1 Remedial Investigations conducted by Ebasco and Weston indicated only scattered and localized contamination of unsaturated soils. The surface soil sample from boring 01SB26 contained low concentrations of toluene and xylene. Low concentrations of PAHs were also detected in this sample, as well as the surface sample from boring 01MW03. No explosive compounds were detected in any soil samples from the Phase 1 investigations. Concentrations of several metals in soil samples were detected above that for the site background boring, but the reported concentrations are not particularly high compared with regional levels, and could be attributable to normal soil conditions. Facility-wide background concentrations of metals in soils are yet to be determined.

The groundwater sample from monitoring well 01MW04 contained 14 μg/l of 2,6-dinitrotoluene. Sulfate was detected at 3,490 mg/l in well 01MW04. Lead concentrations exceeded the 0.015 μg/l EPA action level for lead in groundwater samples from monitoring wells 01MW02, 01MW03, and 01MW04. Groundwater grab samples 01GG23, 01GG28, and 01GG29 contained detectable concentrations of sulfate or chloride.

Toluene was detected at 6.3 μg/l in surface water sample 01SW06, located downgradient of boring 01SB26, in which toluene was detected in the surface soil sample. Lead was detected at concentrations exceeding the water quality health criteria in seven surface water samples, although only one sample exceeded the site-specific background concentration of 0.027 μg/l. Sulfate concentrations were elevated above site background samples in four downgradient surface water samples.

Semivolatile organic compounds were detected in sediment sample 01SD09, as well as surface soil samples from 01SB26 and 01MW03. Cadmium and antimony were detected in 01SD10 at concentrations exceeding background samples. Mercury was detected above background samples levels in samples 01SD07, 01SD08, 01SD09, and 01SD11.

Potentially significant contaminant migration pathways include surface water, sediment, soil, and groundwater. Runoff from surficial fill materials could transport contaminants to the collection ditches. These ditches would then carry the contaminated surface water into Goose Prairie Creek and Caddo Lake. Erosion of contaminated materials during heavy rainfall could produce contaminated sediment that would be carried by surface water runoff to collection ditches adjacent to the site. Precipitation percolating downward through contaminated fill, surficial soils, and sediments may leach contaminants and carry them into the underlying soils and groundwater. Groundwater is encountered at a relatively shallow depth at the site and is an important pathway. During wet seasons, groundwater may rise to intercept surface drainageways downgradient from the site. Contaminated groundwater could then discharge to surface drainage.

3.2.5 Identification of Potential Receptors. The general public does not have ready access to the site because it is located within the confines of LHAAP. Also, installation personnel and authorized visitors do not have ready access to the site because the site and adjoining areas are enclosed by a security fence with a locked access gate. The site is seldom visited because it is not being used for anything except occasional hunting. There are no water supply wells located in the direction of expected groundwater flow from the site and none are expected to be installed. The nearest public water supply well, Well 502, is about 1.0 mile west-southwest of and hydraulically upgradient from the site. A potential threat to public health and the environment posed by contaminated groundwater originating at this site appears to be its possible emergence into the surface water flow regime.

3.3 LHAAP XX: Ground Signal Test Area

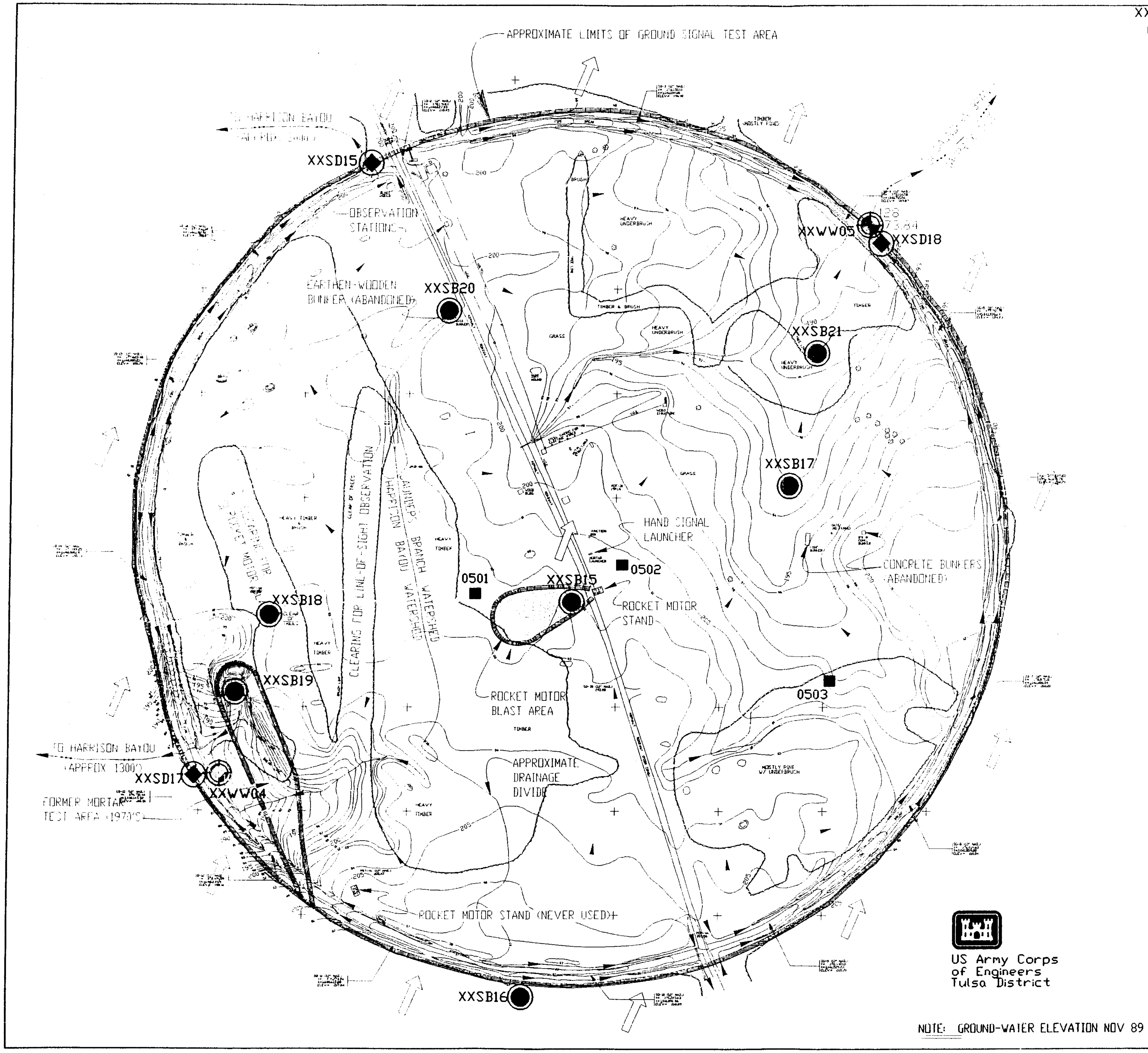
3.3.1 Site History. The Ground Signal Test Area is currently used for aerial and on-ground testing of various pyrotechnic, illuminant, and signal devices manufactured at LHAAP. Since late in 1988, the site has also been used for the burn-out of rocket motors in Pershing missiles destroyed in accordance with the INF Treaty.

The site 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.

3.3.2 Site Description. The Ground Signal Test Area is in the southeastern portion of LHAAP (Figure 1-1). Access to the site is provided by an asphalt gravel 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. It then continues for another 0.7 mile to the southern LHAAP boundary.

A detailed site map of the Ground Signal Test Area is provided on Figure 3-3. The map depicts detailed topography, general surface water flow directions and surface drainage patterns, estimated groundwater flow direction, locations of previous sampling points, and the approximate limit of the Ground Signal Test Area. Also shown is the access road crossing the site, the circular fire lane and dirt road that forms the site boundary, and limited vegetation information. The site inside the projected point of compliance encompasses an area of approximately 80 acres.

General soil and geologic maps and boring logs indicate the site is located on the outcrop of the Wilcox Group of sediments that typically consist of interbedded sands, silts, and clays. At this site, these sediments are overlain by a few feet of residually-derived soils consisting of silty to clayey sands. Depth to groundwater on the site averages about 15 feet with some seasonal fluctuation. The groundwater hydraulic gradient across the site is expected to be normally controlled by the regional flow direction to the north-northeast toward Caddo Lake. During very wet periods when the water table may rise several feet, the hydraulic gradient in the more steeply sloping southwestern part of the site may become topographically controlled and the flow direction in this area may swing to the northwest toward Harrison Bayou.



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP XX
GROUND SIGNAL TEST AREA
PREVIOUS
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 3-3

3.3.3 Previous Investigations. The Ground Signal Test Area was included in a contamination survey conducted by EPS under contract to USATHAMA, as documented in June 1984. EPS collected three shallow soil samples and installed two monitoring wells; soil and groundwater samples were analyzed for explosive compounds, selected metals (total), and selected anions. Groundwater from one well was also analyzed for volatile and semivolatile organic compounds.

During the Phase 1 RI conducted in 1993, Ebasco collected 15 samples from the unsaturated soils in 7 soil borings. Each boring was extended to collect a groundwater grab sample. The borings ranged in depth from 5 to 22 ft. Groundwater was typically encountered from 1 to 2 ft below the ground surface. Six sediment/surface water samples were collected at the site (Figure 3-3), and two existing monitoring wells were sampled. Soil, sediment, surface water, and groundwater samples were taken and analyzed for volatiles, semivolatiles, explosives, metals, and anions.

3.3.4 Potential Contaminants and Migration Pathways. No organic or explosive contaminants have been detected in any samples taken during the site investigations, with the exception of 12.4 μg/kg to 10,300 μg/kg of acetone detected in soil samples from 0 to 5 ft depth in boring XXSB19. No metals or anions with concentrations exceeding twice the maximum site background concentration were detected in soil samples.

No metals were detected in groundwater samples approaching MCLs. Sulfate concentrations were detected exceeding the MCL in groundwater grab samples from XXSB15 and background boring

XXSB16. Overall, TOX and TOC levels in the groundwater grab samples appeared elevated compared with the other five LHAAP sites investigated in Phase 1. Groundwater samples from two existing monitoring wells obtained concentrations of chloride and sulfate in excess of MCLs. Lead was detected in one surface water sample, XXSW19, slightly exceeding the water quality criteria for consumption of fish and water.

The primary sources of potential contamination at this site are the burn residues and non-burned fragments of various pyrotechnic and illuminant and signal devices that have been tested and destroyed on the site, and the residues from burn-out of rocket motors on the site. Elevated concentrations of anions have been found in the soils and groundwater at this site and may be attributed to contaminants produced by the aforementioned residues and fragments. There is no evidence of contamination by explosive compounds, volatiles, or semivolatiles.

Groundwater is an important pathway for contaminant migration at this site. The relative shallowness of the water table and its seasonal fluctuation elevates its importance as a pathway. During wet periods when the water table may rise to intercept drainageways downgradient from the site, contaminated groundwater could discharge to surface drainage.

3.3.5 Identification of Potential Receptors. The general public does not have ready access to the site because it is located within the confines of LHAAP. Access is further restricted when the site is being used for signal devices or rocket motor activities. There are no public water supply wells located in the directions of expected groundwater flow from the site and none are expected to be installed. Groundwater normally flows from the site in a north-northeasterly direction toward Caddo Lake. The nearest public water supply well, Well 902, is approximately 2.3 miles west-southwest of, and hydraulically upgradient from, the site.

A potential threat to public health and safety posed by contaminated groundwater originating at this site is its possible emergence into the surface water flow regime of Saunders Branch and its tributaries and, during very wet periods, into the surface water flow regime of Harrison Bayou.

3.4 LHAAP 27: South Test Area

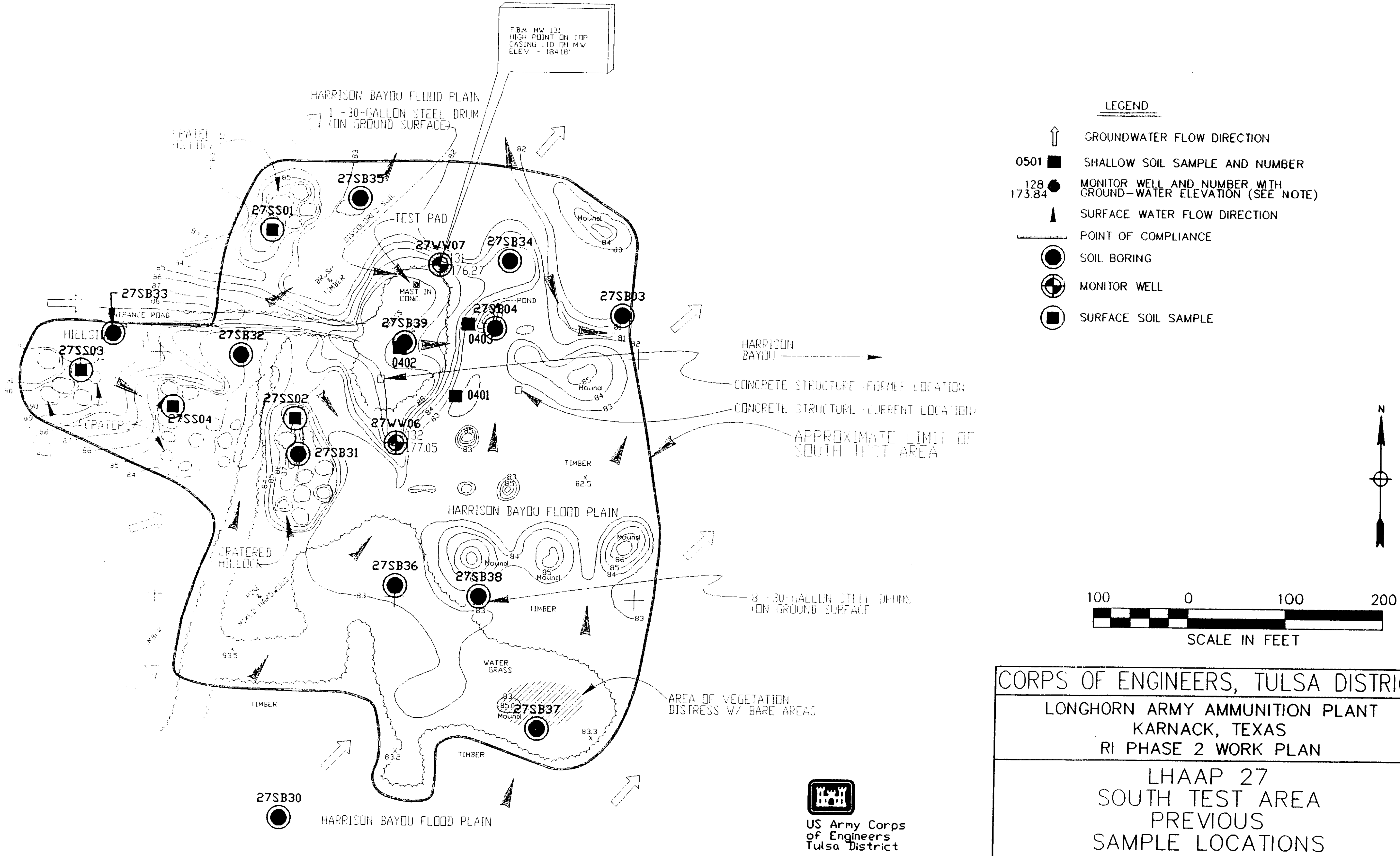
3.4.1 <u>Site History</u>. The South Test Area was constructed in 1954 and was used by Universal Match Corporation for testing photoflash bombs that were produced at LHAAP until about 1956. The bombs were tested by exploding them in the air over an elevated, semi-elliptical earthen Test Pad within the 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 apparently stored in three earth-covered concrete bunkers a few hundred feet west of the Observation Building.

During the late 1950s, illuminating (signal) devices were demilitarized 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 demilitarized in the vicinity of the Test Pad. In the early 1980s, approximately 52,000 1/2- and 1-pound photoflash cartridges were demilitarized in a 500-square foot area situated about 300 feet east of the Observation Building and immediately north of the road running from the Observation Building to the Test Pad.

3.4.2 Site Description. The South Test Area is in the south central portion of LHAAP (Figure 1-1). 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 about 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 situated alongside the road about 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.

A detailed current map of the Test Pad and contiguous areas is provided as Figure 3-4. The map depicts detailed topography, general surface water flow directions, estimated groundwater flow directions, location of previous sampling points, and the approximate limit of the site. 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.



NOTE: GROUND WATER ELEVATION NOV. 89

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP 27
SOUTH TEST AREA
PREVIOUS
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 3-4

General soil and geologic maps and the boring logs indicate that most of the site is situated on recent alluvium deposited in the floodplain of nearby Harrison Bayou. These alluvial deposits consist of silty to very silty sands that extend to a depth of about 18 feet below the natural flatter portions of the floodplain surface. Small earthen mounds that project 3 to 5 feet above the floodplain surface in the eastern part of the site are thought to be natural features resulting from accumulation of sediment and vegetation debris on natural obstructions to flow such as fallen trees. The more steeply-sloping western portion of the site is located on the outcrop of the Wilcox Group of sediments that typically consist of interbedded sands, silts, and clays. The Wilcox materials on the western hillside are likely mantled by a few feet of residually-derived soils or by terrace deposits.

The origin of the cratered hillocks to the southwest and northwest of the Test Pad is uncertain. Based on study of 1954 and 1963 aerial photographs, it appears that the hillocks may be remnants of excess fill material from the 1954 construction activities. The hillocks have obviously been used for testing or demilitarizing explosive devices as evidenced by the presence of numerous small craters. There are similar cratered areas to the west of the southwestern hillock. Judging by the size of trees growing within the cratered areas, the craters are over 25 years old.

Depth to groundwater in the more steeply-sloping western portion of the site likely exceeds 5 feet and the depth is expected to fluctuate seasonally. The groundwater hydraulic gradient in this hillside portion of the site is expected to be topographically controlled with a general flow direction to the east toward the floodplain of Harrison Bayou. Depth to groundwater below the flatter portions of floodplain surface averages about 4 feet with pronounced seasonal fluctuations. During the cool wet winters and spring when the floodplain is frequently flooded, the water table is at or near the ground surface. The groundwater hydraulic gradient in the floodplain may be locally controlled by the overall gently sloping floodplain surface. The general groundwater flow direction in the floodplain is to the northeast toward Caddo Lake.

3.4.3 Previous Investigations. This site was investigated by EPS for USATHAMA, and a contamination survey report was published in June 1984. EPS collected three shallow soil samples and installed two monitoring wells; soil and groundwater samples were analyzed for explosive compounds, selected metals (total), and selected anions. The groundwater from one well was also analyzed for PCBs, pesticides, volatile organic compounds, and semivolatile organic compounds.

During the Phase 1 RI conducted in 1993, Ebasco collected 20 soil samples from the unsaturated soils in 10 soil borings. The borings were extended to 7 to 8 ft in depth and groundwater grab samples were collected. Groundwater was encountered from 0.1 to 4.5 ft depth below the ground surface. Two existing monitoring wells were also sampled. The Phase 1 RI also included five sediment/surface water samples and four surface soil samples (Figure 3-4). Soil, sediment, surface water, and groundwater samples were taken and analyzed for volatiles, semivolatiles, explosives, metals, and anions.

3.4.4 Potential Contaminants and Migration Pathways. The groundwater grab sample from 27SB33, located in the area of cratered hillocks in the western portion of the site, detected the explosives nitrobenzene and RDX at 6.58 μg/l and 18.4 μg/l, respectively. The concentration of RDX was detected in excess of the SDWA health advisory of 2 μg/l; no standard for nitrobenzene has been established. No other organic compounds were detected on the site.

Chromium and mercury were detected in surface soil samples in borings 27SB39 and 27SB32, respectively, exceeding twice the maximum site-specific background concentration. Lead in one surface water sample exceeded the water quality criteria for consumption of fish and water. Sediment sample 27SD02 contained barium, mercury, nickel, and lead at concentrations exceeding twice the site-specific upgradient sediment concentration. Sediment samples 27SD03 and 27SD04 contained elevated concentrations of selenium, and barium and chromium, respectively.

Overall, chloride and sulfate concentrations in both soil and groundwater were found to be elevated in the southern portion of the site. Chloride concentrations were notably elevated in soil samples from borings 27SB36 and 2SB37. Chloride and sulfate concentrations notably exceeded the MCL in monitoring well 27WW06. The groundwater grab sample from boring 27SB38, located beside some empty drums, detected elevated nitrate concentrations. Generally, TOX and TOC concentrations were found to be higher than groundwater grab samples collected at the other Group 1 sites.

The primary sources of potential contamination at this site are the various components of the photoflash bombs, the illuminating devices, and other explosives that have been exploded and burned at the site. This would include metals comprising the ignitable powders in the photoflash bombs illuminating devices; metals comprising the casings, containers, and other parts of the bombs, illuminating devices, and other explosives; and explosive residues from fuses and booster charges in the bombs and illuminating devices. A possible source of potential contamination is the suspected dumping of wastes in a cleared area to the south and southeast of the Test Pad. Based upon study of historical aerial photographs and judging by the existing vegetation distress in parts of this area, dumping of liquid wastes is suspected. Such dumping may have occurred as early as 1954 during construction of the South Test Area.

Water percolating downward through contaminated soil materials may leach contaminants and carry them into underlying soils where they could eventually reach groundwater. Previous sampling of the two existing monitoring wells by EPS detected contamination, demonstrating that groundwater is an important pathway for contaminant migration at this site. The relative shallowness of the water table and its seasonal fluctuation elevates its importance as a pathway. During wet periods when the water table rises to intercept the nearby channel of Harrison Bayou, contaminated groundwater could be discharged to surface water flow.

3.4.5 Identification of Potential Receptors. The general public does not have ready access to the site because it is located within the confines of LHAAP. Also, installation personnel and authorized visitors do not have ready access to the site because its one access road is secured by a locked gate. The site is seldom visited and is not being used for anything but occasional hunting.

There are no public water supply wells located in the direction of expected groundwater flow from the site and none are expected to be installed. Groundwater flows from the site in a general northeasterly direction toward Caddo Lake. The nearest public water supply well, Well 902, is approximately 1.6 miles west of, and hydraulically upgradient from, the site. A potential threat to public health and safety posed by contaminated groundwater originating at this site appears to be its possible emergence into the surface water flow regime of Harrison Bayou.

SECTION 4.0

PLAN OF INVESTIGATIONS

Each plan of investigation described below is designed to obtain site-specific data to best characterize both the physical and chemical characteristics for the location being investigated based on the data presented for each site in Section 3.0. Unless otherwise stated, the following parameters will be analyzed for all soil, sediment, and groundwater samples: pH; specific conductance; volatile organic compounds (VOCs); semivolatile organic compounds (SVOCs); high explosives; antimony; arsenic; barium; cadmium; chromium; lead; mercury; nickel; selenium; silver; thallium; nitrate; sulfate; and chloride. All physical analyses for soil boring samples will include, at a minimum, visual classification, moisture content, gradation, plastic limit, and liquid limit tests. All sampling and analyses described in each plan of investigation will be performed in accordance with the procedures outlined in the Chemical Data Acquisition Plan (CDAP) and the Site Safety and Health Plan (SSHP).

4.1 LHAAP 11: Suspected TNT Burial Site at Avenues P and Q

Site LHAAP 11 is an undocumented location where bulk TNT may have been buried in the 1940s. Previous investigations by EPS included shallow (less than 5 feet deep) soil borings in which a trace of TNT and varying amounts of 1,3,5-trinitrobenzene (TNB), up to 117 μg/kg, were detected in soil samples.

The 1993 RI conducted by Ebasco generally did not detect notzble contamination, with one exception. The groundwater grab sample from background boring location 11-SB-04 detected 0.62 μg/L of 1,3,5-trinitrobenzene (TNB).

To further investigate potential groundwater contamination with explosives compounds in the vicinity of boring 11-SB-04, the Phase II RI includes the installation of three (3) monitoring wells, at the general locations shown on Figure 4-1. Soil samples for chemical analyses will be taken within the unsaturated zone at 5-ft depth intervals, beginning at the ground surface; groundwater is anticipated to be encountered within 10 ft of the ground surface. Soil samples for physical analyses will be taken at 5-ft depth intervals, beginning at the ground surface, for the entire boring length. Fifteen soil and three groundwater samples will be analyzed for the Phase I parameters listed previously.

4.2 LHAAP 1: Inert Burning Grounds

Site LHAAP 1 was originally used during World War II for burning trash, ashes, scrap lumber, and waste from burned TNT. Bulk TNT may also have been burned at the site. During the 1950s other wastes including photoflash powder were burned, and intermittent, small-scale burning operations may have continued into the 1960s.

Previous investigations by EPS included the collection of three surface soil samples and the installation of a monitoring well downgradient from the site. The soil samples indicated that barium, lead and sulfate

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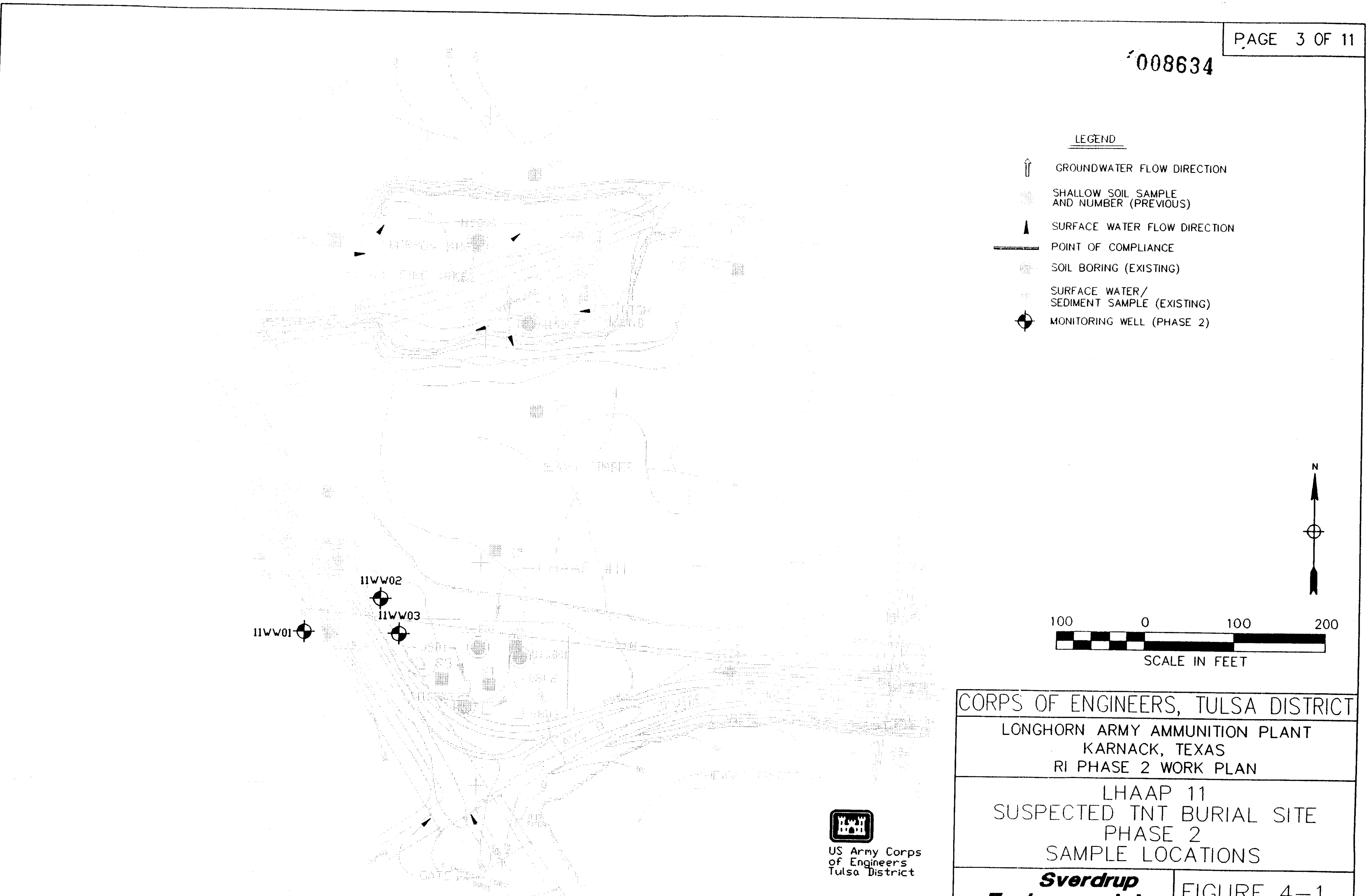


CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP 11
SUSPECTED TNT BURIAL SITE
PHASE 2
SAMPLE LOCATIONS

US Army Corps of Engineers Tulsa District

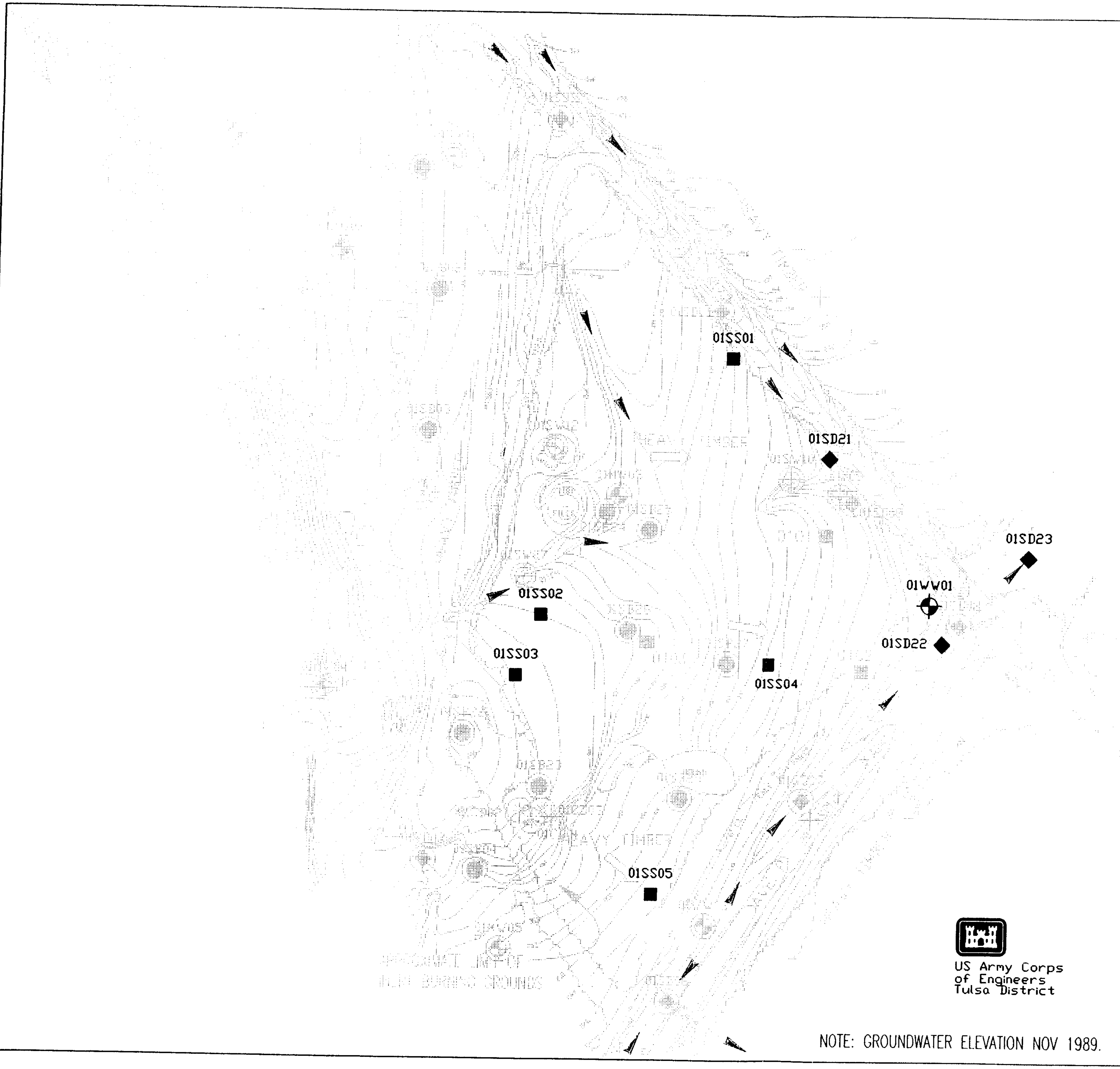
Sverdrup Environmental

FIGURE 4–1

concentrations may be elevated above local background levels. The groundwater sample indicated that concentrations of barium, chromium, lead and nitrate may exceed local background levels. The groundwater samples also contained the explosives nitrobenzene at 1.82 μg/L and trinitrobenzene at 9.74 μg/L.

More recent investigations by Ebasco and Weston detected trace concentrations of toluene and/or xylene in soil and surface water samples, and total concentrations of polyaromatic hydrocarbons (PAHs) in soil and sediment samples of 6 to 8 mg/kg. Elevated concentrations of lead and sulfate were observed in soil and groundwater samples from the southern portion of the site; these concentrations may be attributed to contaminated soils or fill materials, or may be naturally occurring. A groundwater sample from Well MW-04 contained 2,6-dinitrotoluene at 14 μg/L.

To further investigate potential groundwater contamination with explosives compounds in the southern portion of the site, the Phase II RI includes the installation of one (1) monitoring well, at the general location shown on Figure 4-2. Soil samples will be collected for physical analyses only at 5-ft depth intervals, beginning at the ground surface to an estimated total boring depth of 20 ft. A groundwater sample will be collected from the well and analyzed for the Phase I parameter list. The groundwater from existing monitoring well 01MW04 will be sampled and analyzed for semivolatiles and high explosives. Sediment samples will be collected at three (3) locations as shown on Figure 4-2. Two locations are along the gravel portion of 32nd Street, one to the north of existing sample location 01-SD-09, the other at the same location as 01-SD-08. The third location is near the northeastern corner of P Avenue and 32nd



NOTE: GROUNDWATER ELEVATION NOV 1989.

LEGEND

- SHALLOW SOIL SAMPLE AND NUMBER (PREVIOUS)
- SURFACE WATER FLOW DIRECTION
- SURFACE WATER/ SEDIMENT SAMPLE (EXISTING)
- MONITORING WELL (EXISTING)
- CONSTRUCTION DEBRIS SAMPLE (PREVIOUS)
- SURFACE WATER/ SEDIMENT SAMPLE (PHASE 2)
- MONITORING WELL (PHASE 2)
- SURFACE SOIL SAMPLE (PHASE 2)

100 0 100 200
SCALE IN FEET

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP 1
INERT BURNING GROUND
PHASE 2
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 4-2

Street. Sediment samples will be analyzed for the Phase I parameters list.

Additional surface soil samples will be collected from 0 to 0.5 ft depth at five (5) randomly selected locations (Figure 4-2); samples will be analyzed for barium, lead, and selenium.

4.3 LHAAP XX: Ground Signal Test Area

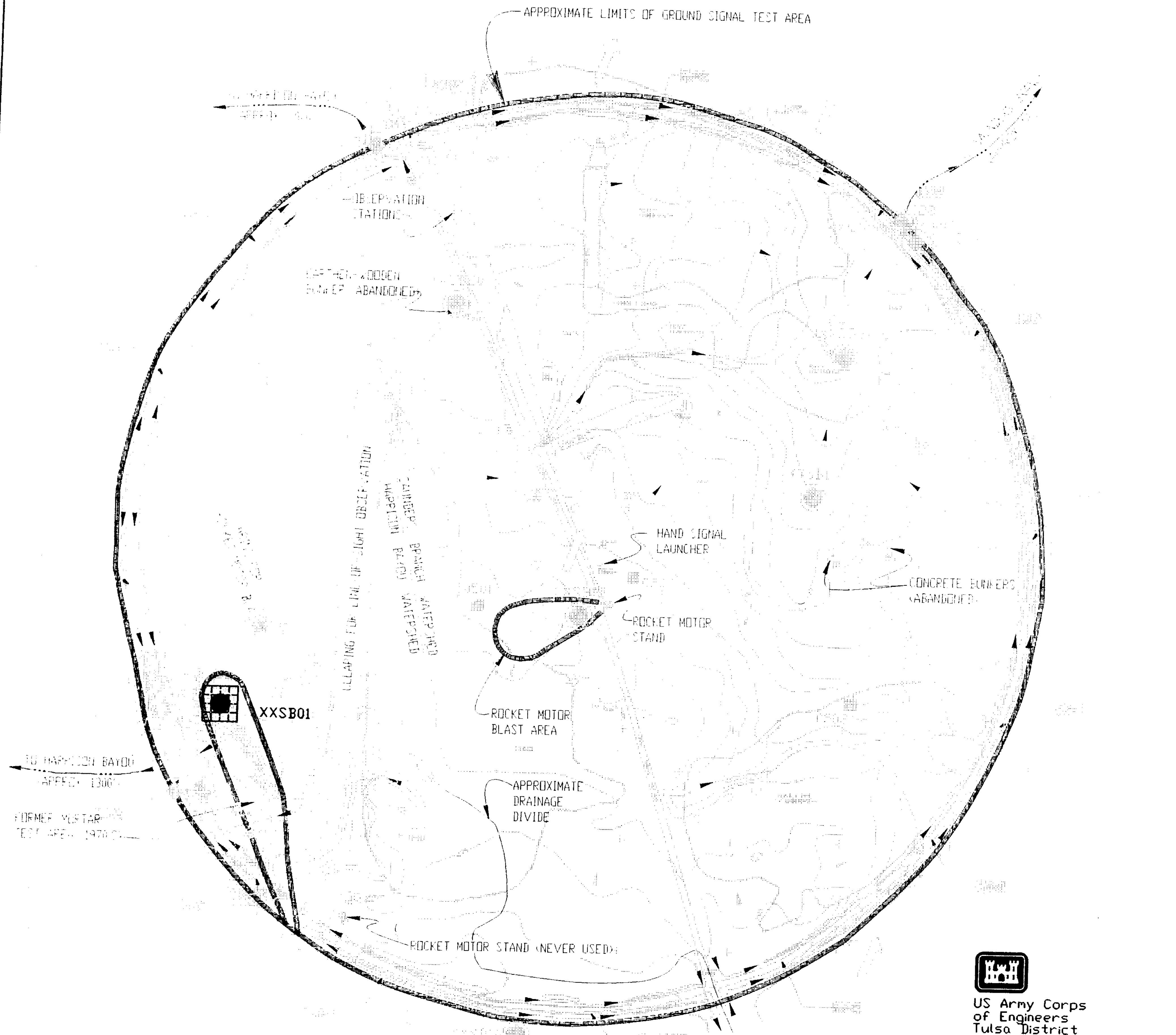
Site LHAAP XX is currently used for aerial and on-ground testing of various pyrotechnic, illuminant, and signal devices manufactured at LHAAP. From 1988 to 1992 the site was also used for the burn-out of rocket motors from the Pershing missiles destroyed in accordance with the INF Treaty. Over the past thirty years the site has been used for the testing and destruction of a variety of devices, including red phosphorous smoke wedges, infrared flares, illuminating mortar shells, and button bombs.

As documented in 1984, EPS drilled and installed two monitoring wells, and collected three shallow soil samples. Results indicated that concentrations of barium, lead and sulfate in soil may be elevated above local background levels. Concentrations of several metals including barium, cadmium, chromium, nickel and thallium may be elevated above local background levels in groundwater.

The 1993 RI conducted by Ebasco generally did not detect notable contamination, with one exception. Acetone was detected in soil boring XX-SB-19 at 10.3 mg/kg from 2.5-5.0 ft depth.

To further investigate potential soil and groundwater contamination with acetone and other volatile organic compounds in the vicinity of boring XX-SB-19, the Phase II RI includes conducting an active soil gas survey at and surrounding location XX-SB-19, as shown on Figure 4-3. The soil gas survey will consist of 6 to 26 sampling points taken within a 20-ft sampling grid; soil gas samples will be analyzed for acetone. If the survey detects no concentrations of acetone, a soil boring will be drilled to 10 ft depth at location XX-SB-19, with soil samples taken at 5-ft depth intervals beginning at the ground surface; soil samples within unsaturated soils will be chemically analyzed for volatile organic compounds only; soil samples will also be collected for physical analyses as performed in Phase I.

If contamination is indicated from the soil gas survey or soil boring, one monitoring well, approximately 20 ft deep, will be installed at the location of greatest observed contamination. Soil samples will be collected at 5-ft depth intervals, beginning at the ground surface, and analyzed for volatile organic compounds. Physical samples will be collected at 5 ft depth intervals, beginning at the ground surface, for the total boring depth of this optional well. One groundwater sample will be collected and analyzed for volatile organic compounds.



LEGEND

- GROUNDWATER FLOW DIRECTION
- SHALLOW SOIL SAMPLE AND NUMBER (PREVIOUS)
- SURFACE WATER FLOW DIRECTION
- POINT OF COMPLIANCE
- SOIL BORING (EXISTING)
- SURFACE WATER/ SEDIMENT SAMPLE (EXISTING)
- MONITORING WELL (EXISTING)
- SOIL BORING (PHASE 2)
- GRID FOR SOIL GAS SURVEY (20' SPACING)

250 0 250 500
SCALE IN FEET

NOTE: GROUND-WATER ELEVATION NOV 89

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP XX
GROUND SIGNAL TEST AREA
PHASE 2
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 4-3

4.4 LHAAP 27: South Test Area

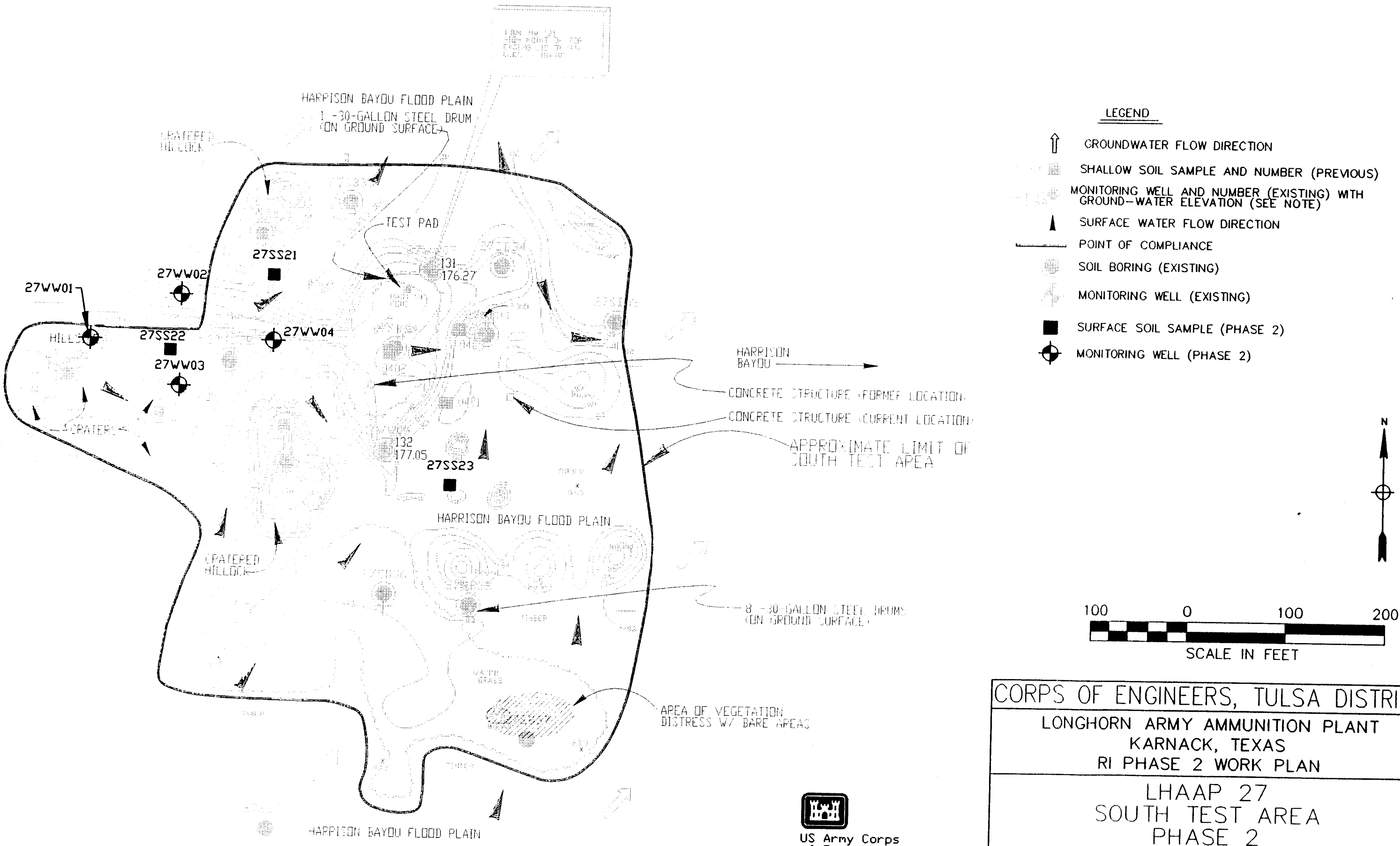
Site LHAAP 27 was used in the 1950s for testing photoflash bombs and demilitarizing signal devices and photoflash cartridges. The site is located within the Harrison Bayou floodplain. It contains a large area of vegetation distress on the southern portion of the site, and hillocks with small craters on the western portion.

As documented in 1984, EPS collected three shallow soil samples and installed two monitoring wells at the site. Soil sample results indicated that concentrations of several metals including barium, chromium, and lead, as well as nitrate and sulfate may be elevated above local background levels. Groundwater samples indicated that barium, cadmium, chromium, nickel, thallium, and chloride concentrations may be elevated above local background levels.

The 1993 RI conducted by Ebasco generally did not detect notable contamination, with the exception of one groundwater grab sample from boring 27-SB-33, which contained trace concentrations of explosives compounds; nitrobenzene was detected at 6.58 μg/L, and RDX was detected at 18.4 μg/L. In addition, two surface soil samples detected concentrations of chromium and mercury; background concentrations for these metals have not yet been established, however.

To further investigate potential groundwater contamination with explosives compounds in the vicinity of boring 27-SB-33, the Phase II RI includes the installation of four (4) monitoring wells, at the general locations shown on Figure 4-4. One well will be installed as closely as practical to existing boring 27-SB-33, and two wells will be installed to the east of location 27-SB-33 to form an equilateral triangle with 100-ft side lengths. After these wells are installed, developed, surveyed, and the groundwater flow direction established, the fourth well will be installed downgradient of the three.

Since groundwater is anticipated to be encountered at a depth of 5 ft or less, soil samples for chemical analyses within unsaturated soils will be taken at the ground surface (0-2 ft depth) in each boring; soil samples for physical analyses will be taken at 5 ft depth intervals, beginning at the ground surface, for the entire boring depth. Four (4) soil and four (4) groundwater samples will be analyzed for explosives, metals, and anions as listed in Phase I. In addition, surface soil samples (0 to 0.5 ft depth) will be collected at three (3) randomly selected locations (Figure 4-4) and analyzed for chromium and mercury.



NOTE: GROUND WATER ELEVATION NOV. 89

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 WORK PLAN

LHAAP 27
SOUTH TEST AREA
PHASE 2
SAMPLE LOCATIONS

Sverdrup Environmental

FIGURE 4-4

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FINAL

A-E
FIELD WORK PLAN

for the

PHASE II
REMEDIAL INVESTIGATION
SITES 11, 1, XX, 27

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted to:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

AUGUST 1994

Prepared by:

SVERDRUP ENVIRONMENTAL, INC.
ST. LOUIS, MISSOURI

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS/ABBREVIATIONS

CDAP	Chemical Data Acquisition Plan
COE	U.S. Army Corps of Engineers
IDW	Investigation Derived Waste
INF	Intermediate-Range Nuclear Forces
LHAAP	Longhorn Army Ammunition Plant
RCRA	Resource Conservation and Recovery Act
RDX	Cyclotrimethylenetetranitramine
RI/FS	Remedial Investigation/Feasibility Study
SvE	Sverdrup Environmental, Inc.
SWMU	Solid Waste Management Unit
TNT	Trinitrotoluene
USACE	U.S. Army Corps of Engineers
UXO	Unexploded Ordnance

1.0 INTRODUCTION

The purpose of this A-E Field Work Plan is to present the rationale and step-by-step plan of action for each field activity included in the Phase II Remedial Investigation (RI) for the Group No.1 sites at the Longhorn Army Ammunition Plant (LHAAP). This plan presents the number and qualifications of field crews, the type of equipment needed to complement the field crews, and a work schedule that coordinates and efficiently completes the RI tasks within the allotted 35 calendar days.

This A-E Field Work Plan has been written as a supplement to the LHAAP RI/FS Work Plan prepared by the U.S. Army Corps of Engineers (USACE) in June 1992 and the Field Work Plan Addendum prepared by Sverdrup Environmental, Inc. (SvE) in August 1994. As such, it does not repeat the rationale for determining the number and type of sampling locations. Please refer to those documents for this information.

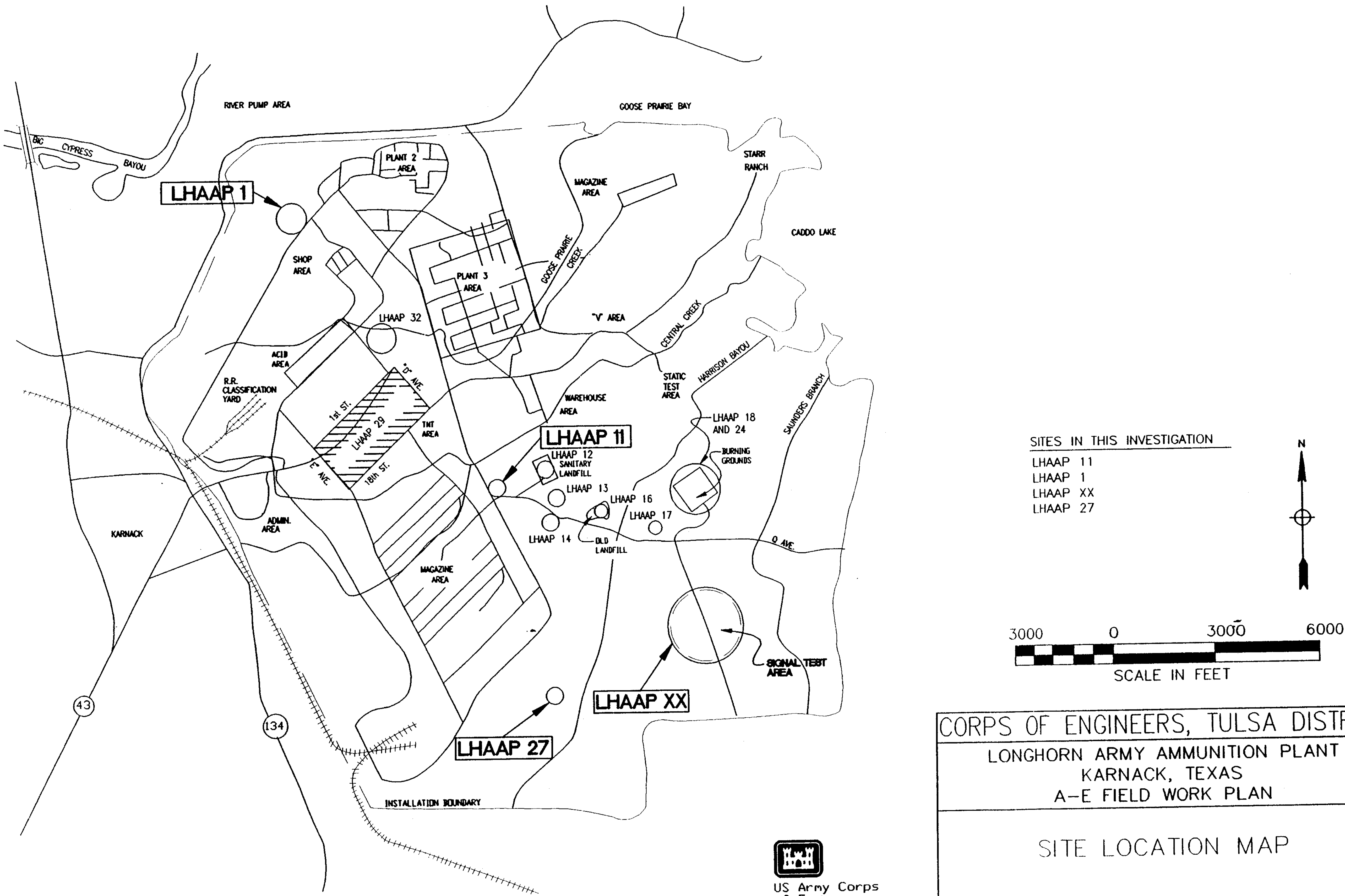
2.0 SUMMARY OF WORK

This A-E Field Work Plan includes the Remedial Investigation of four (4) sites, listed as follows:

LHAAP Unit No. 11*:	Suspected TNT Burial Site at Avenues P and Q
LHAAP Unit No. 1:	Inert Burning Grounds
LHAAP Unit No. XX:	Ground Signal Test Area
LHAAP Unit No. 27:	South Test Area

An "*" denotes a SWMU listed in the RCRA Permit as requiring corrective action. The site locations within LHAAP are shown on Figure 2-1.

This section presents a brief description of the work to be performed at each LHAAP unit during the Phase 2 field investigation. A summary of the nature and extent of contamination and the field work to be performed at each site during the Phase II remedial investigation is presented in the Field Work Plan Addendum, Section 3 and 4 (Sverdrup, 1994).



US Army Corps of Engineers Tulsa District

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
A-E FIELD WORK PLAN

SITE LOCATION MAP

Sverdrup Environmental

FIGURE 2-1

000086-3\CADD\LH3-19

2.1 LHAAP 11: Suspected TNT Burial Site at Avenues P and Q

LHAAP 11 is an undocumented location where bulk TNT may have been buried in the 1940s. The Phase 2 field investigation is designed to further evaluate the potential for groundwater contamination with explosives compounds in the vicinity of boring 11-SB-04. The field work will involve the installation of three (3) monitoring wells. Soil and groundwater samples will be collected at each well using the procedures outlined in the A-E Chemical Data Acquisition Plan (CDAP, Sverdrup, 1994).

2.2 LHAAP 1: Inert Burning Grounds

LHAAP 1 was originally used during World War II for burning trash, ashes, scrap lumber, and waste from burned TNT. Bulk TNT may also have been burned at the site. During the 1950s other wastes including photoflash powder were burned, and intermittent, small-scale burning operations may have continued into the 1960s.

The Phase 2 field investigation is designed to further evaluate the potential for groundwater contamination with explosives compounds in the southern portion of the site. The field work will involve the installation of one (1) monitoring well, sampling of existing well 01MW04, and the collection of three (3) sediment and five (5) surface (0 to 0.5 ft) soil samples. The samples will be collected using the procedures outlined in the A-E CDAP.

2.3 LHAAP XX: Ground Signal Test Area

LHAAP XX is currently used for aerial and on-ground testing of various pyrotechnic, illuminant, and signal devices manufactured at LHAAP. From 1988 to 1992 the site was also used for the burn-out of rocket motors form the Pershing missiles destroyed in accordance with the INF Treaty. Over the past thirty years the site has been used for the testing and destruction of a variety of devices, including red phosphorous smoke wedges, infrared flares, illuminating mortar shells, and button bombs.

The Phase 2 field investigation is designed to further investigate the potential for soil and groundwater contamination with acetone and other volatile organic compounds in the vicinity of XX-SB-19. The field work involves a 6 to 26 point soil-gas survey within a 20-ft sampling grid. If no contamination is indicated, one 10-ft soil boring will be installed. If contamination is indicated for the soil boring or the soil-gas survey, one monitoring well will be installed at the location of greatest observed contamination. The samples will be collected using the procedures outlined in the A-E CDAP.

2.4 LHAAP 27: South Test Area

LHAAP 27 was used in the 1950s for testing photoflash bombs and demilitarizing signal devices and photoflash cartridges. The Phase 2 field investigation is designed to further investigate the potential for groundwater contamination with explosives compounds in the vicinity of boring 27-SB-33. The field investigation involves the installation of four (4) monitoring wells and the collection of three (3) surface (0 to 0.5-ft) soil samples. The samples will be collected using the procedures outlined in the CDAP.

3.0 FIELD WORK TEAMS

In order to complete the work within the allotted 35 calendar days, SvE will mobilize two 2-person teams to the site, one drilling inspection team and one sample coordination/management team. Subcontracted services will consist of one 2-person UXO (unexploded ordnance) team; one 2-person team for location surveying; one 3-person team (includes analytical chemist) for soil-gas surveying; and one 3-person team for soil borings, monitoring well installation and development, and equipment decontamination.

The drilling inspection team will consist of one geologist and one sampling technician who will also serve as the Site Safety Officer. The drilling inspection team will coordinate UXO and underground utilities clearance, inspect soil borings and collect soil samples, inspect monitoring well installation and development, and manage staging of investigation derived waste (IDW).

The sample coordination/management team will consist of one site manager and one sample coordinator. The sample coordinator will ensure sample quality and timely sample delivery to the analytical laboratories, and will conduct and coordinate sampling of sediment, surface soils, and monitoring wells. The site manager will manage the overall field effort and provide the single point of contact for COE and LHAAP personnel. The site manager will also supervise subcontractors for location surveying and soil-gas surveying, join with the sample coordinator to sample sediment, surface soils, and monitoring wells, and conduct slug permeability testing on the newly installed monitoring wells.

The UXO team will consist of one UXO Supervisor and one UXO Specialist, and will locate and clear access to new locations for soil borings, monitoring well installations, and sediment and surface soil sampling. UXB International, headquartered in Chantilly, Virginia, will provide UXO and surveying services under subcontract to SvE.

The drilling team will consist of an equipment operator and two laborers. One laborer will be dedicated to drilling and well installation, the other to equipment decontamination and well development. Alliance Environmental, Inc. of Houston, Texas, will provide drilling, well installation, and well development services under subcontract to SvE.

The soil-gas survey crew will consist of an equipment operator, a laborer and an analytical chemist. GEO Environmental, Inc. of St. Louis, Missouri will provide soil-gas surveying under subcontract to SvE.

4.0 FIELD EQUIPMENT

4.1 UXO Clearance

The UXO Team will provide geophysical, excavation and sampling equipment necessary to clear locations for the presence of ammunition, pyrotechnics, or explosive concentrations of TNT and RDX. The UXO Team will provide surveying services to locate sampling locations, and clear access to these locations, including the surface area of the 26-point soil gas survey grid at LHAAP XX. In addition to a surface magnetometer sweep, the team will conduct a hand auger boring at each new soil boring, soil gas survey boring, and monitoring well location. The hand auger boring will extend to a depth of five feet, with soil samples taken at 2.5 foot intervals and screened in the field for TNT/RDX. A new location is defined as being situated more than 50 ft horizontal distance from any previously cleared location.

Proposed geophysical equipment include White's Eagle II metal detectors, Forester Ferex ordnance locators, and Schonstedt Model GA-52B magnetometers. Excavation equipment includes stainless steel hand augers and shovels. Support equipment includes a four-wheel drive vehicle, radio communicators, and mobile phones.

4.2 Soil Boring and Well Installation

One drill rig will be mobilized to the site to perform the soil borings and install the monitoring wells. The rig will be mounted on a four- or six-wheel drive truck or an all-terrain-vehicle. The drilling subcontractor will provide an appropriate support vehicle for the drill, a steam cleaner, and materials and miscellaneous equipment storage trailer.

The drill will have a spindle horsepower of at least 80 horsepower, an automatic drill rod and casing holder device, and a main hoist rated at least 5000 lb. Hollow-stem augers with an inside diameter (I.D.) of 3.25 to 4.25 inches will be used to drill soil borings and sample using the 2.0-inch and 3.0-inch outside diameter (O.D.) split-barrel soil sampler. Hollow-stem augers with inside diameter of 6.25 to 8.25 inches will be used to drill and install nominal 4-inch diameter monitoring wells.

Sampling tools will include new, standard steel 2.0-inch and 3.0-inch split-barrel samplers.

4.3 Soil Gas Survey

The soil gas survey will be performed using a Geoprobe™ sampling system to hydraulically drive a sampling probe into the ground to a depth of approximately 5 ft. A 500 μl vapor sample is drawn to the surface, a personal sampling pump is attached to a glass sampling bulb, and a sample is collected. The samples are then analyzed in the field using a gas chromatograph with an electron capture detector (ECD). Samples will be analyzed for acetone.

4.4 Monitoring Well Development, Sampling, and Slug Testing

Well development will be performed by the drilling subcontractor under the direction of SvE's management crew. Well development will be performed using electric submersible pumps, hand pumps, and bailers without the use of drill rigs and other heavy equipment. Monitoring wells may be developed as soon as 48 hours after installation.

Purging and sampling of wells will be performed no sooner than 48 hours after development of each well. Purging will be performed with a nominal 3.5-inch diameter PVC bailer or decontaminated electric, submersible pump. Purging of all wells will continue until at least five casing volumes are removed and the field parameters of pH, temperature, and conductivity are stable. After purging is satisfactorily completed, the wells will be sampled with a stainless steel bailer.

Slug tests will be conducted on each well installed during this field investigation. These tests will be performed after development but prior to purging and sampling of each well. The slug tests require the use of a PVC slug (a PVC pipe filled with sand and sealed at the top and bottom), a transducer secured within the well, and a datalogger to monitor changes of the potentiometric surface.

4.5 Decontamination Facilities

A decontamination facility will be constructed to collect spent decontamination fluids and contain them in closed-top drums. The facility will be capable of supporting drill rigs and support vehicles, and will contain racks or sawhorses to suspend augers, drill rods, monitoring well casing and screen, samplers, pumps, bailers, hand augers, tools, etc.

The facility will be lined to collect spent fluids into a sump, the contents of which will be regularly pumped into closed-top drums staged nearby on pallets. The liner will be constructed of plastic sheeting with a cumulative thickness of at least 20 mils. The liner will be protected from damage by tires with plywood boards or other means. A perimeter berm will be constructed to contain and collect fluids to the sump.

4.6 Field Office

A field office trailer will be mobilized to the site, and will be located next to the existing COE field office. This location is in the central portion of LHAAP, and offers ready access to water, sewers, electricity, telephone, and garbage disposal. Portable toilets and telephone will be contracted by Sverdrup; LHAAP will provide all other utilities.

5.0 FIELD WORK SCHEDULE

Figure 5-1 presents the Phase II Remedial Investigation Field Work Schedule using a start date of August 16, 1994 (assumed date of work plan approval by the COE Contracting Officer). The schedule lists the RI field work in a logical order of completion of the required tasks. The schedule breaks the work into two tours: one to perform the soil gas survey, perform soil borings, and install and develop the monitoring wells; and the second to sample monitoring wells and conduct slug permeability testing. One day was allotted for rain delays, and a 14-day rest period is included between monitoring well development and sampling. The schedule completes the field work within the allotted 35 days.

Mobilization includes an orientation meeting between the site manager and LHAAP personnel, an initial site health and safety meeting with all Sverdrup and subcontractor field personnel, underground utilities clearance, and setup of the field office trailer.

The UXO team will first coordinate with the site manager and the surveyors to stake out and clear all sampling locations, and then proceed with hand auger borings of new boring locations.

UXO clearance activities, and soil borings and monitoring well installation work, will begin at LHAAP XX and LHAAP 27, in order to reduce any interruptions in the field work while deciding where to install the fourth, downgradient monitoring well at LHAAP 27, and the optional well at LHAAP XX. The work will then proceed to LHAAP 11, and finish at LHAAP 1.

Sediment and surface soil sampling will be conducted concurrently with soil borings and monitoring well installations. Monitoring well development will be performed as soon as possible after completion of well installation; however, a minimum rest period of 48 hours is required.

The drilling subcontractor will demobilize at the end of the first tour, along with Sverdrup's drilling inspection team. Driller demobilization will consist of removing the decontamination facility, labeling and staging of IDW at the LHAAP storage facility located in the Plant 3 area; and removal of all equipment and supplies. Each drum will be labeled as to material type (soil, water, PPE), source location (site name, boring/well number), and accumulation start date. IDW will be stored on pallets and covered with canvas tarps at LHAAP Unit 16. The IDW management plan, presented in the CDAP Addendum (Sverdrup, 1994), will be implemented.

The sample coordinator and site manager will return to LHAAP for the second tour of work, to conduct monitoring well sampling and slug permeability testing. The office trailer will be removed and all utilities and services disconnected at the end of this second tour.

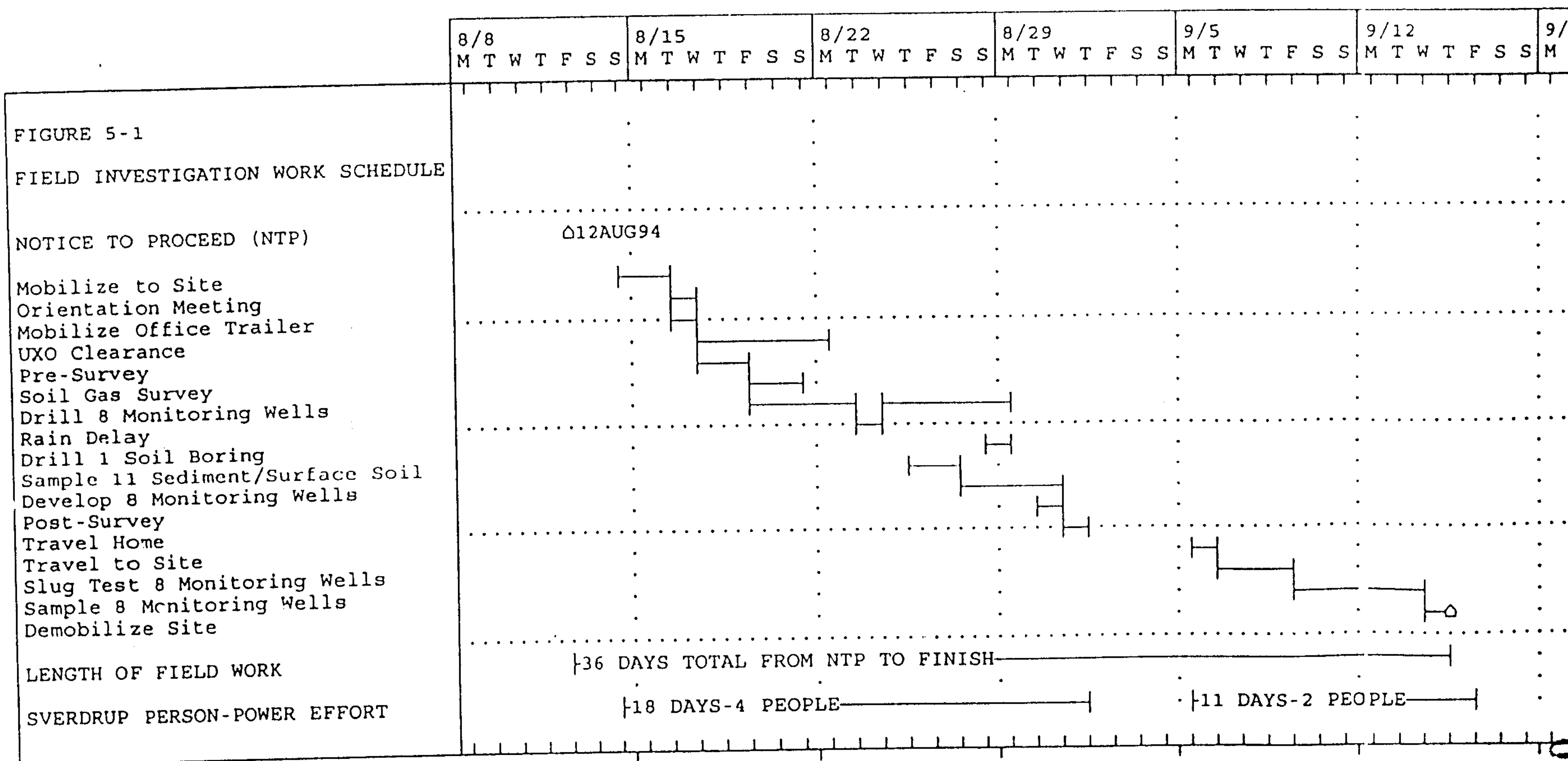


FIGURE 5-1
FIELD INVESTIGATION WORK SCHEDULE
8/8 M T W T F S S
8/15 M T W T F S S
8/22 M T W T F S S
8/29 M T W T F S S
9/5 M T W T F S S
9/12 M T W T F S S
9/ M
NOTICE TO PROCEED (NTP)
12AUG94
Mobilize to Site
Orientation Meeting
Mobilize Office Trailer
UXO Clearance
Pre-Survey
Soil Gas Survey
Drill 8 Monitoring Wells
Rain Delay
Drill 1 Soil Boring
Sample 11 Sediment/Surface Soil
Develop 8 Monitoring Wells
Post-Survey
Travel Home
Travel to Site
Slug Test 8 Monitoring Wells
Sample 8 Monitoring Wells
Demobilize Site
LENGTH OF FIELD WORK
36 DAYS TOTAL FROM NTP TO FINISH
SVERDRUP PERSON-POWER EFFORT
18 DAYS-4 PEOPLE
11 DAYS-2 PEOPLE

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