

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

ADMINISTRATIVE RECORD

VOLUME 13 of 13

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**Department of the Army
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**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
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VOLUME 13 of 13

1994

- S. Title:** Final Workplan - Phase 2 - Chemical Data Acquisition Plan For The Remedial Investigation (RI)
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Site(s): LHAAP-12 Active Landfill
LHAAP-16 Old Landfill
LHAAP-17 No. 2 Flashing Area / Burning Ground
LHAAP-18 & LHAAP-24 Burning Ground / Washout Pond & Evaporation Pond
LHAAP-29 Former TNT Production Area
LHAAP-32 Former TNT Waste Disposal Plant
Location: Longhorn Army Ammunition Plant, Marshall, Texas
Company: Sverdrup Environmental, Inc.
Author(s): Sverdrup Environmental, Inc.
Recipient: U.S. Army Corps of Engineers, Tulsa District
Date: December, 1994
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- T. Title:** Letter - Subject: Draft Soil Background Concentration Study
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Site(s): LHAAP-13 Suspected TNT Burial Between Active Landfill And Old Landfill
LHAAP-14 Area 54 Burial Ground
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Agency: Department Of The Army, Longhorn Army Ammunition Plant
Author(s): Lawrence J. Sowa, Lieutenant Colonel, U.S. Army
Recipient: Ms. Lisa Marie Price, Environmental Protection Agency
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Location: Longhorn Army Ammunition Plant, Marshall, Texas
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Recipient: Lisa Marie Price, Environmental Protection Agency
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Agency: Department Of The Army, Longhorn Army Ammunition Plant

July 12, 1995

**LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX**

VOLUME 13 of 13 (Continued)

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Author(s): Lawrence J. Sowa Lieutenant Colonel, U.S. Army Commanding Officer
Recipient: Ms. Lisa Price, Environmental Protection Agency
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FINAL

PHASE 2 CHEMICAL DATA ACQUISITION PLAN

for the

REMEDIAL INVESTIGATION
GROUP NO. 2 SITES

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted To:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

DECEMBER 1994

Prepared By:

SVERDRUP ENVIRONMENTAL, INC.
ST. LOUIS, MISSOURI

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	1 of 6
1.1 General	1 of 6
1.2 Site Location and Description	2 of 6
1.2.1 Site Location	2 of 6
1.2.2 Site Description	2 of 6
1.3 Organization	4 of 6
2.0 PROJECT ORGANIZATION	1 of 3
2.1 Field Personnel	1 of 3
2.2 Quality Control Personnel	1 of 3
2.3 Quality Assurance Personnel	2 of 3
2.4 Laboratory	3 of 3
3.0 DATA QUALITY OBJECTIVES	1 of 7
3.1 Accuracy	2 of 7
3.2 Precision	3 of 7
3.3 Completeness	5 of 7
3.4 Representativeness	6 of 7
3.5 Comparability	6 of 7
3.6 Sensitivity	7 of 7
3.7 Field Measurements	7 of 7
4.0 FIELD OPERATIONS	1 of 49
4.1 Drilling	22 of 49
4.1.1 Soil Sampling Equipment	23 of 49
4.1.1.1 Split Spoon	23 of 49
4.1.1.2 Shelby Tube	23 of 49
4.1.2 Protection of Lower Aquifers	24 of 49
4.1.3 Geological Logs	25 of 49
4.1.4 Borehole Abandonment	26 of 49
4.2 Monitoring Wells	26 of 49
4.2.1 Drilling and Installation	26 of 49
4.2.1.1 Well Casing	28 of 49

TABLE OF CONTENTS (CONTINUED)

Section	Page
4.6.2 Downhole Geophysics	43 of 49
4.6.2.1 Spontaneous Potential	43 of 49
4.6.2.2 Natural Gamma Ray	43 of 49
4.6.2.3 Resistivity Logs	43 of 49
4.7 Air Monitoring for Worker Protection	44 of 49
4.8 Decontamination	44 of 49
4.8.1 Drilling Equipment	44 of 49
4.8.2 Well Casing	45 of 49
4.8.3 Sampling Equipment	45 of 49
4.9 Field QA/QC	46 of 49
4.9.1 Chemical Samples	46 of 49
4.9.1.1 Travel Blanks	47 of 49
4.9.1.2 Equipment Blanks	47 of 49
4.9.1.3 Replicate Samples	47 of 49
4.9.2 Samples for Physical Testing	48 of 49
4.10 Investigation Derived Waste	48 of 49
5.0 DNAPL Contingency Plan	1 of 4
5.1 Detection of NAPLs	1 of 4
5.1.1 Soils	2 of 5
5.1.2 Groundwater	2 of 5
5.1.3 Drilling Fluids	2 of 5
5.2 Drilling and Installation of Monitoring Wells	3 of 5
6.0 SAMPLE HANDLING AND TESTING	1 of 3
6.1 Sample Numbering System	1 of 3
6.2 Preparing Samples	2 of 3
6.3 Receiving Samples	3 of 3
6.4 Laboratory Procedures	3 of 3
7.0 SAMPLE INTEGRITY	1 of 4
7.1 Security	1 of 4

TABLE OF CONTENTS (CONTINUED)

Section	Page
7.1.1 Security of Wells and Samples in Field	1 of 4
7.1.2 Security of the Sample in the Lab	1 of 4
7.2 Custody	2 of 4
7.2.1 Chain of Custody Form	2 of 4
7.2.2 Laboratory Traffic Report	2 of 4
7.2.3 Bill of Lading	2 of 4
7.2.4 Cooler Receipt Form	3 of 4
7.3 Sample Tracking and Identification	3 of 4
7.3.1 Field Log Book	3 of 4
7.3.2 Field Data Form	4 of 4
7.3.3 Sample Labels	4 of 4
8.0 DATA REDUCTION, VALIDATION, AND REPORTING	1 of 5
8.1 Analytical Data	1 of 5
8.1.1 Field Data	1 of 5
8.1.2 Laboratory Data	1 of 5
8.2 Technical Data	3 of 5
8.3 Data Validation Report	3 of 5
8.4 Corps Data Validation Report	5 of 5
9.0 AUDITS	1 of 2
9.1 Systems Audits	1 of 2
9.2 Performance Audits	1 of 2
10.0 CORRECTIVE ACTION	1 of 2
10.1 Field Activities	1 of 2
10.2 Field Data	1 of 2
10.3 Laboratory	1 of 2
10.4 Implementing and Reporting	1 of 2
11.0 REFERENCES	1 of 1

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1-1	Site Vicinity Map	3 of 6
1-2	Site Location Map	5 of 6
2-1	Project Organization	2 of 3
4-1	LHAAP 12- Active Landfill Sample Locations	6 of 49
4-2	LHAAP 16- Old Landfill Sample Locations	9 of 49
4-3	LHAAP 17- Burning Ground No. 2 Sample Locations	11 of 49
4-4A	LHAAP 18 and 24- Burning Ground No. 3 and Unlined Evaporation Pond Sample Locations	14 of 49
4-4B	LHAAP 18 and 24- Burning Ground No. 3 and Unlined Evaporation Pond Geoprobe Borings and Wells	15 of 49
4-5	LHAAP 29- Former TNT Production Area Sample Locations	18 of 49
4-6	LHAAP 32- Former Waste Disposal Plant Sample Locations	20 of 49
4-7	Group 2 Sites Additional Sediment/Surface Water Sample Locations	21 of 49
4-8	Monitoring Well Diagram	27 of 49

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
4-1	Chemical Sampling Plan Summary	3 of 49
4-2	Physical Sampling Plan Summary	4 of 49
10-1	Audit Elements for Longhorn Investigations	2 of 2

APPENDICES

Appendix A Forms Used in Field Sampling Activities

Groundwater Monitoring Well Inspection Form
Chain of Custody Form
Field Data Form for Water Samples
Rinsate Water Samples Parameter Sheet
Geological Log Form
State of Texas Well Report
State of Texas Plugging Report
Sample Jar Label and Custody Seal

Appendix B Tables

- B.1 Sample Containers, Preservation, and Preparation for Water Samples
- B.2 Maximum Holding Times and Analytical Methods in Soil and Water
- B.3 Methods for Physical Tests
- B.4 Required Quantitation Limits for Volatile Analyses in Soil and Water by Method 8240
- B.6 Required Quantitation Limits for Explosives Analyses in Soil and Water by Method 8330
- B.7 Required Quantitation Limits for Other Analyses in Soil and Water
- B.8 Guidance for Submittal of Data on Electronic Media for the Tulsa HTRW Project Database

Appendix C Investigation Derived Waste Management Plan

LIST OF ACRONYMS/ABBREVIATIONS

AAP	Army Ammunition Plant
ASTM	American Society of Testing Materials
CDAP	Chemical Data Acquisition Plan
COC	Chain of Custody Form
COE	Corps of Engineers
DNAPL	Dense Non-Aqueous Phase Liquid
DNB	dinitrobenzene
DNT	dinitrotoluene
DQO	Data Quality Objective
EB	equipment blank
EPA	U. S. Environmental Protection Agency
HCl	hydrochloric acid
HMX	cyclotetramethylenetetranitramine
HTW	Hazardous and Toxic Waste
IDW	investigation derived waste
LHAAP	Longhorn Army Ammunition Plant
MEK	methyl ethyl ketone, 2-butanone
MRD Lab	Corps of Engineers Missouri River Division Laboratory
NAD	North American Datum
NAPL	Non Aqueous Phase Liquid
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute of Occupational Safety and Health
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PB	probe boring
PCB	polychlorinated biphenyl
POC	point of contact
PVC	polyvinylchloride
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetetranitramine
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
SB	soil boring
SD	sediment
SS	shallow soil
SW	surface water
SSHPP	Site Specific Health and Safety Plan
SWD Lab	Corps of Engineers Southwestern Division Laboratory
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TB	trip blank
TCLP	toxicity characteristics leaching procedure
TNB	trinitrobenzene
TNRCC	Texas Natural Resources Conservation Commission
TNT	Trinitrotoluene
UEP	Unlined Evaporation Pond

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USACE	U.S. Army Corps of Engineers
VOA	volatile organic analysis
VOC	volatile organic compound
WW	monitoring well

SECTION 1.0

INTRODUCTION

1.1 **General.** The purpose of this Phase 2 Chemical Data Acquisition Plan (CDAP) is to document the procedures required to ensure that all data obtained from the Phase 2 Remedial Investigation activities at Longhorn are of acceptable quality. This Phase 2 CDAP provides modifications to the Longhorn Army Ammunition Plant RI/FS Work Plan (Ref. 5), which should be referenced for general facility and site information, and the health and safety requirements for field activities. This Phase 2 CDAP has been written as a stand-alone document with regard to the field and laboratory data acquisition for the Phase 2 Remedial Investigation at the Longhorn Group 2 sites.

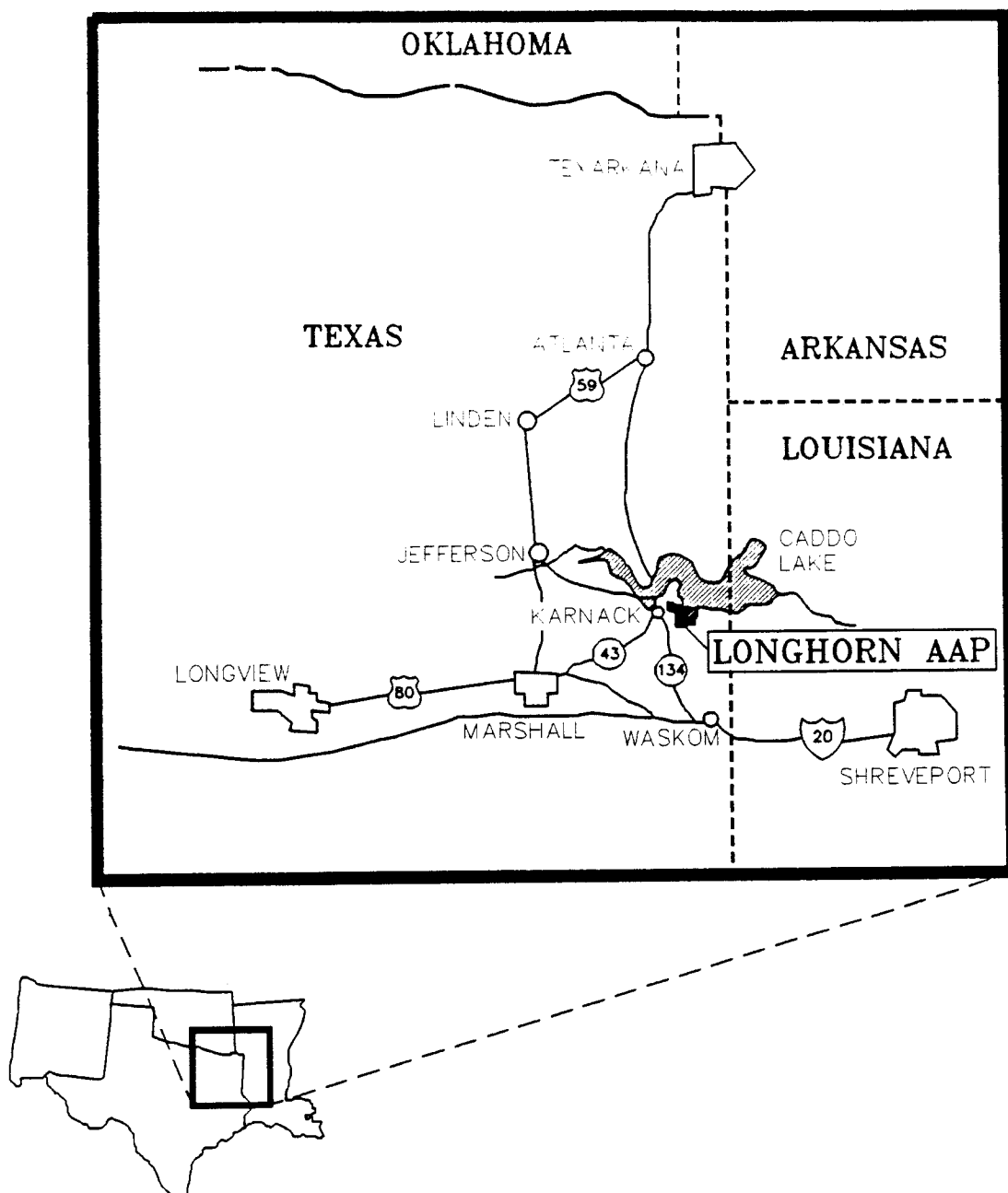
Quality assurance (QA) is the Government activity required to assure desired and verifiable levels of quality in all aspects of an investigation. Quality control (QC) is the functional mechanism to achieve quality data. The QA program, administered by the Government, will ensure that the QC program will 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. 3), a Corps of Engineers regulation, with additional guidance from Development of an RFI Work Plan for RCRA Facility Investigations, SW-87-001 (Ref. 9), and Minimum Chemistry Data Reporting Requirements, (Ref. 2).

LHAAP Group 2 RI Phase 2 CDAP
Section: 1
Revision: 3
Date: December 1994
Page: 2 of 6

1.2 Site Location and Description.

1.2.1. Site Location. Longhorn AAP occupies 8,493 acres between State Highway 43 at Karnack, Harrison County, Texas, and Caddo Lake, as presented in Figure 1-1. The nearest major cities are Marshall, Texas, approximately 14 miles southwest, and Shreveport, Louisiana, approximately 40 miles east. Longhorn AAP is located in a region of moist, subhumid to humid, mild climate. The average annual rainfall is 46 inches. Average precipitation is fairly evenly distributed throughout the year; however, December through May could be considered the heavier season. Frequently, summer and fall are drought seasons. The facility is included on the National Priorities List (NPL).

1.2.2 Site Description. Longhorn AAP is a government-owned, contractor-operated industrial installation under the jurisdiction of the U. S. Army Armament, Munitions, and Chemical Command. Longhorn AAP was established in October 1942 with the primary mission of production of 2,4,6-trinitrotoluene flake with supporting acid production for munitions production. Flake production was halted in 1945 and the primary mission changed to the load, assembly and pack of pyrotechnic and illuminating/signal munitions and solid propellant rocket motors. Industrial operations at Longhorn resulted in the disposal of various hazardous wastes into ditches, streams, and earthen impoundments where contamination has been identified. The Longhorn Division of Morton-Thiokol Corporation is the current operating contractor.



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 CDAP

SITE VICINITY MAP

Sverdrup
Environmental

FIGURE 1-1

LHAAP Group 2 RI Phase 2 CDAP
Section: 1
Revision: 3
Date: December 1994
Page: 4 of 6

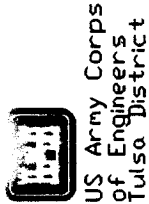
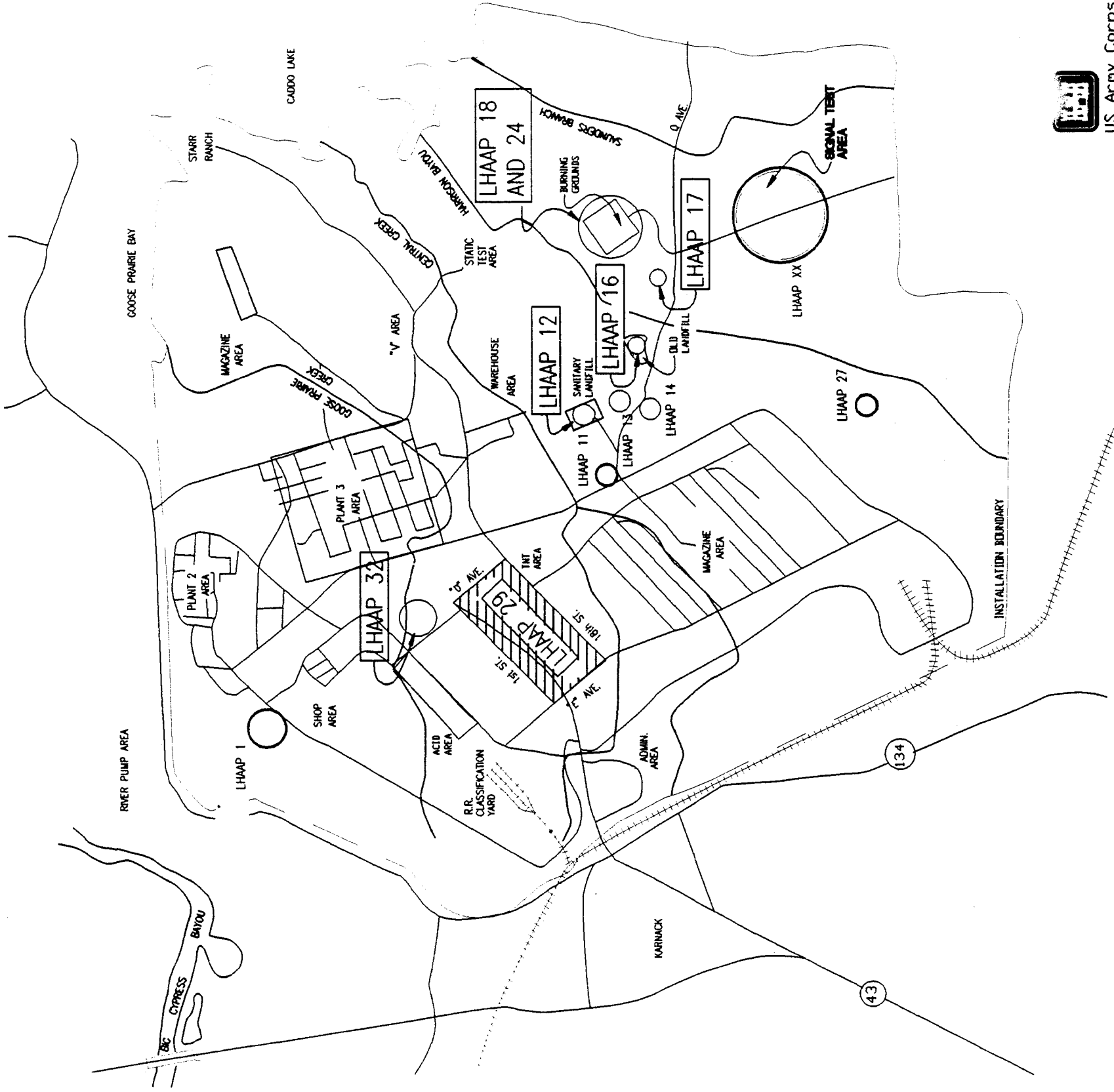
The seven (7) areas addressed in the Phase 2 field investigation are situated at various locations on the LHAAP installation. Grouped together, these seven sites are known as the Longhorn Group 2 Sites. The Group 2 Sites are listed below and their locations are presented in Figure 1-2.

<u>LHAAP NO.</u>	<u>AREA NAME</u>
12	Active Landfill
16	Old Landfill
17	Burning Ground No. 2/Flashing Area
18 & 24	Burning Ground No.3 and Unlined Evaporation Pond/Rocket Motor Washout Lagoon
29	Former TNT Production Area
32	Former TNT Waste Disposal Plant

Individual sites are described in detail in the Phase 2 Work Plan and the RI/FS Work Plan.

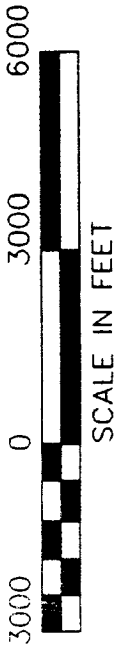
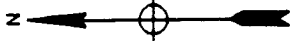
1.3 Organization. This document discusses the data quality procedures and techniques to be used in the work plan for investigations at Longhorn. The study will be accomplished through the sampling and analysis of soil, sediment, surface water and groundwater, and the installation of monitoring wells. Section 2 discusses project organization; Section 3 discusses the quality assurance objectives for this project; Section 4 discusses the procedures to be used in drilling, well installation, and sampling; Section 5 presents a DNAPL Contingency

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GROUP 2 SITES IN THIS INVESTIGATION

- LHAAP 12
- LHAAP 16
- LHAAP 17
- LHAAP 18/24
- LHAAP 29
- LHAAP 32



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LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

RI PHASE 2 CDAP

SITE LOCATION MAP

Sverdrup
Environmental

FIGURE 1-2

091701

LHAAP Group 2 RI Phase 2 CDAP

Section: 1

Revision: 3

Date: December 1994

Page: 6 of 6

Plan designed to identify the presence of dense non-aqueous phase liquids (DNAPLs) during the field investigations, in order to take measures to reduce the potential for contamination of underlying water-bearing strata. Section 6 describes sample handling and testing, and Sections 7 through 10 discuss sample integrity, data reduction and validation, audits, and corrective action.

LHAAP Group 2 RI Phase 2 CDAP
Section: 2
Revision: 3
Date: December 1994
Page: 1 of 3

SECTION 2.0

PROJECT ORGANIZATION

The U.S. Army Corps of Engineers (COE) will use a multi-disciplinary project team to oversee all project activities. Project management will be performed by Tulsa District. Project activities will be performed by Sverdrup Environmental, Inc. under contract to Tulsa District. This organizational structure is shown in Figure 2-1.

2.1 Field Personnel. Field operations will be conducted by the contractors listed in Section 2.0 or their subcontractors. Later investigative phases will be performed by contractors or the COE.

2.2 Quality Control Personnel. All program personnel 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 work plan is accurate, complete, precise and representative of the site studied. An individual on each field crew will be designated as the Quality Control Officer and will be responsible for the proper execution of field QC, as discussed in Section 4.9.

LHAAP Group 2 RI Phase 2 CDAP

Section: 2

Revision: 3

Date: December 1994

Page: 2 of 3

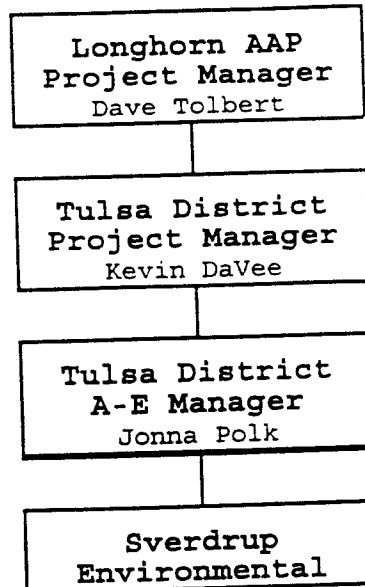


Figure 2-1. Organizational structure of the Longhorn Group No. 2 Phase 2 Remedial Investigation.

2.3 Quality Assurance Personnel. Quality assurance will be performed by the Tulsa District, Geotechnical Branch, Chemistry and Industrial Hygiene Section (Chem and IH). This section reports to the Chief, Geotechnical Branch and will be responsible for performance and system audits of this investigative program, data validation, on-going reviews of QA procedures, and coordination of QA training for project personnel. Data validation reports will be prepared by each contractor. The Tulsa District will add the sections on comparability (based on the QA samples as discussed in section 2.4).

LHAAP Group 2 RI Phase 2 CDAP

Section: 2

Revision: 3

Date: December 1994

Page: 3 of 3

2.4 Laboratory. Analytical testing and quality control testing will be performed by PDP Analytical Services. The point of contact for PDP Analytical Services, Reddy Pakanati, can be contacted at the following address: 24900 Pitkin Drive, Suite 300, Spring, Texas, 77386, Tel: (713) 363-2233, Fax: (713) 298-5784. QA testing will be performed by the Corps of Engineers Southwestern Division Laboratory (SWD Lab). 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. Samples taken by the contractors will be sent to their laboratories, with the exception of the QA samples, which will be sent to SWD Lab. If sampling should be performed by COE field crews, SWD Lab will receive shipments of samples from the field, which it will pass on to its contract laboratories. Either SWD Lab or a separate contract lab will analyze the QA samples. All analytical laboratories used for this work will be validated by the Corps of Engineers Missouri River Division Laboratory (MRD Lab). The validation process involves review of their laboratory quality management manual, laboratory performance on audit sample analyses, and an onsite inspection. This validation process is discussed in detail in Appendix C of ER-1110-1-263 (Ref. 3).

011700

LHAAP Group 2 RI Phase 2 CDAP
Section: 3
Revision: 3
Date: December 1994
Page: 1 of 7

SECTION 3.0

DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) of this project have been chosen to meet the goals of site characterization, risk assessment, and remedial design. DQOs are qualitative and quantitative statements which specify the quality of data required to support decisions made during remedial response activities. These DQOs will be used to develop a plan to be used throughout the RI/FS process. Data developed during the study will be used to determine the presence and lateral and vertical extent of contamination in the soil, surface water, and groundwater, as well as the rate of migration. The evaluation of this data will be used to screen remedial alternatives and to begin remediation. These goals can be achieved with analytical support between Level III and Level IV, as described in Ref. 8. Level I will be used for field testing. The minimum internal data reporting requirements (from Ref. 2) which will be required of all analytical laboratories includes the following:

- Sample identification numbers cross-referenced with laboratory ID's and QC sample numbers.
- Problems with arriving samples noted on an appropriate form.
- Each analyte reported as an actual value or less than a specified quantitation limit as listed in tables B.4 to B.8.
- Dilution factors, extraction dates, and analysis dates also reported.

LHAAP Group 2 RI Phase 2 CDAP
Section: 3
Revision: 3
Date: December 1994
Page: 2 of 7

- QC samples to be included as laboratory blanks, surrogate spikes, matrix spikes, laboratory duplicates, field duplicates, and field blanks.

The data developed from the investigations described in this work plan will 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.

3.1 **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 lab will be required to perform matrix spiking on 10% of field samples, as well as on 5 to 10% of standard matrix samples. 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.

LHAAP Group 2 RI Phase 2 CDAP

Section: 3

Revision: 3

Date: December 1994

Page: 3 of 7

After analysis for the spike is completed, the accuracy of the procedure is expressed as a percent recovery as shown by the following equation:

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

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.

3.2 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. Precision of the analytical method, at each

LHAAP Group 2 RI Phase 2 CDAP

Section: 3

Revision: 3

Date: December 1994

Page: 4 of 7

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:

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

where C_1 = analyte concentration in the sample,
 C_2 = analyte concentration in the sample replicate,
and $| \quad |$ = 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.

Precision will be further evaluated by comparing the analytical results of the field sample with its quality control duplicate sample. Multiplicative factors shall be used to determine the significance of differing concentration values. For water samples, should the field sample and its QA/QC duplicate samples differ in value by greater than a factor of 2, a minor disagreement between the values exists. If the values differ by a factor greater than 5, a disagreement between the values exists. For soil/sediment samples, the factors shall be 5 and 10, respectively. The significance, or impact, upon data quality will be discussed in the laboratory Data Validation Report as outlined in Section 7.0.

LHAAP Group 2 RI Phase 2 CDAP

Section: 3

Revision: 3

Date: December 1994

Page: 5 of 7

3.3 **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 will be examined and possible solutions explored.

LHAAP Group 2 RI Phase 2 CDAP
Section: 3
Revision: 3
Date: December 1994
Page: 6 of 7

3.4 **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 and chain of custody forms to those described in the work plan,
- Identifying and eliminating nonrepresentative data in site characterization activities,
- Evaluating holding times and condition of samples on arrival at the laboratory,
- Examining blanks for cross contamination.

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

3.5 **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 work plan, 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

LHAAP Group 2 RI Phase 2 CDAP
Section: 3
Revision: 3
Date: December 1994
Page: 7 of 7

will be evaluated by comparing the QA sample analyzed by an independent laboratory to its field replicate.

3.6 **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.8.

3.7 **Field measurements**. Field measurements will be performed to Level I standards. These will include measurements of pH, conductivity, and temperature on groundwater samples. Precision on field measurements will be assessed by four replicate measurements to determine reproducibility. These consecutive readings should be $\pm 1^\circ$ for temperature, ± 0.02 units for pH, and $\pm 10\%$ for conductivity.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 1 of 49

SECTION 4.0

FIELD OPERATIONS

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

The basis for selecting the general locations, types of samples to be collected, and the analytical parameters at each of the seven LHAAP areas are developed in the USACE RI/FS Work Plan, Volume 1, and the Phase 2 Work Plan for the Group No. 2 Sites, December, 1994. To accomplish the overall objectives in performing the field investigation for the RI, a field investigation plan has been developed for each LHAAP area and is summarized in this section.

Tables 4-1 and 4-2 present the chemical and physical sampling plan summaries, respectively, for each of the seven (7) LHAAP sites. A complete list of chemical analytical parameters is listed below. Individual compounds to be analyzed in the volatile organics and high explosives categories are listed in Appendix B.

Complete list of Parameters

Volatile Organic Compounds (VOCs)

High Explosives

Nitrates

Chlorides

Sulfates

Total Hardness

pH

Specific Conductance

Metals:

Antimony

Arsenic

Barium

Cadmium

Chromium

Lead

Mercury

Nickel

Selenium

Silver

Thallium

TABLE 4-1

CHEMICAL SAMPLING PLAN SUMMARY

LONGHORN ARMY AMMUNITION PLANT

GROUP NO. 2 SITES

PHASE 2 REMEDIAL INVESTIGATION

SITE	CHEMICAL ANALYSIS														TRAVEL BLANKS	EQUIP. BLANKS						
	SITE INVESTIGATION				SURFACE																	
	GEOPROBE BORINGS				GROUNDWATER FROM WELLS					GROUNDWATER FROM GEOPROBE BORINGS							SEDIMENT		SURFACE SOIL/ SHALLOW SOIL BORINGS			
	MW	SB	SURFACE WATER	SEDIMENT	SOIL	SAMPLE TYPE		SAMPLE TYPE			SAMPLE TYPE			SAMPLE TYPE			QA	QC				
						WATER	QC	WATER	QA	QC	WATER	QA	QC	SOIL					QA	QC		
LHAAP 12	4	1	18	11	0	13	1	1	18	2	2	11	1	1	11	1	1	0	0	0	6	5
LHAAP 16	4	1	15	15	0	16	2	2	15	2	2	15	2	2	15	2	2	0	0	0	7	6
LHAAP 17	4	1	16	6	20	6	1	1	16	2	2	6	1	1	6	1	1	20	2	2	4	5
LHAAP 18/24	19	5	30	18	25	19	2	2	30	3	3	18	2	2	18	2	2	25	3	3	9	11
LHAAP 29	8	2	39	3	48	11	1	1	39	4	4	3	1	1	3	1	1	48	5	5	0	10
LHAAP 32	0	0	0	9	0	0	0	0	0	0	0	9	1	1	9	1	1	0	0	0	0	2
TOTALS	39	10	118	62	93	65	7	7	118	13	13	62	8	8	62	8	8	93	10	10	26	39

011714

TABLE 4-2
PHYSICAL SAMPLING PLAN SUMMARY
LONGHORN ARMY AMMUNITION PLANT
GROUP NO. 2 SITES
PHASE 2 REMEDIAL INVESTIGATION

SITE	SITE INVESTIGATION										PHYSICAL ANALYSIS																						
	MONITORING WELLS PIEZOMETERS		SOIL BORINGS	GEOPROBE BORINGS	SHALLOW SOIL BORINGS		SURFACE SOIL		SEDIMENT	SOIL FROM SOIL BORINGS WELLS, & PIEZOMETERS			SOIL FROM GEOPROBE BORINGS			SHALLOW SOIL BORINGS			SURFACE SOIL			SEDIMENT											
										SAMPLE TYPE			SAMPLE TYPE			SAMPLE TYPE			SAMPLE TYPE			SAMPLE TYPE											
										SOIL	QC		SOIL	QC		SOIL	QC		SOIL	QC		SOIL	QC		SOIL	QC		SOIL	QC		SOIL	QC	
											QA	QB		QA	QB		QA	QB		QA	QB		QA	QB		QA	QB		QA	QB		QA	QB
LHAAP 12	6		1		18		0		11	72	7	7	36	4	4	0	0	0	0	0	0	0	0	0	0	0							
LHAAP 16	4		1		15		0		15	58	6	6	30	3	3	0	0	0	0	0	0	0	0	0	0	0							
LHAAP 17	4		1		16		0		6	56	6	6	32	3	3	0	0	0	0	0	0	0	0	0	0	0							
LHAAP 18/24	19		5		30		0		18	323	32	32	60	6	6	0	0	0	0	0	0	0	0	0	0	0							
LHAAP 29	8		2		39		24		3	133	13	13	78	8	8	0	0	0	0	0	0	0	0	0	0	0							
LHAAP 32	0		0		0		0		9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
TOTALS	41		10		118		24		62	640	64	64	236	25	25	0	0	0	0	0	0	0	0	0	0	0							

Physical analysis consists of moisture content, Atterberg limits, and combined washed sieve and hydrometer analysis.

011715

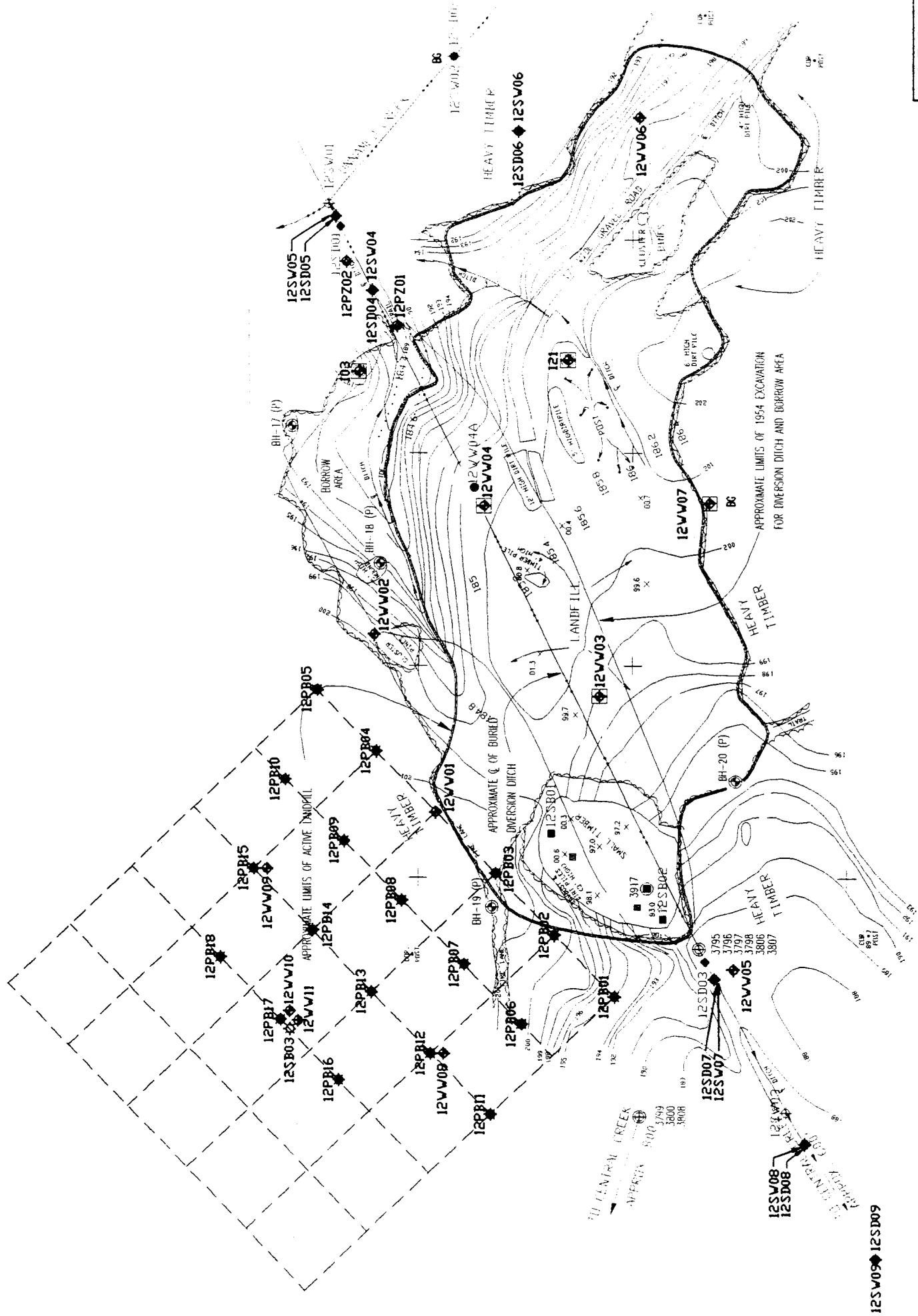
LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 5 of 49

LHAAP 12 - Active Landfill

The field investigation plan developed for LHAAP 12 incorporates the following:

- collection of eighteen (18) Geoprobe™ groundwater samples,
- drilling one (1) stratigraphic soil boring,
- installation of three (3) shallow, downgradient monitoring wells,
- installation of one (1) deep monitoring well,
- installation of two (2) piezometers,
- confirmation groundwater sampling of nine (9) existing monitoring wells,
- groundwater sampling of four (4) new monitoring wells,
- collection of eleven (11) surface water and sediment samples, and
- plugging of five (5) existing monitoring wells.

Proposed locations are shown on Figure 4-1. Five (5) additional sediment and surface water sampling locations in Harrison Bayou are shown in Figure 4-7. Groundwater is anticipated to be encountered at depths of 15-25 ft. Shallow wells will be installed with screens placed immediately above any clay layer, if encountered, in order to detect dense, non-aqueous phase liquids. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. The deep stratigraphic boring will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. The deep well will be installed with its screen placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

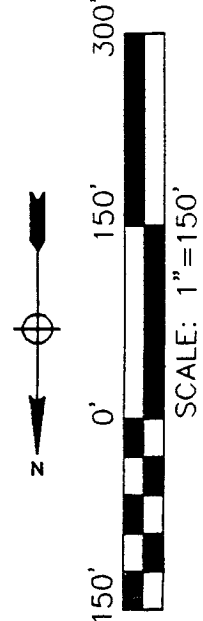


LEGEND

- ◆ SURFACE SEDIMENT SAMPLE (PHASE 1)
- SURFACE WATER SAMPLE (PHASE 1)
- ⊕ SURFACE WATER/SUBMERGED SAMPLE (PREVIOUS)
- SURFACE SOIL SAMPLE (PHASE 1)
- SURFACE SOIL SAMPLE (PREVIOUS)
- SHALLOW MONITORING WELL (PHASE 1)
- ⊗ MONITORING WELL (PREVIOUS)
- SOIL BORING (PHASE 1)
- SOIL BORING (PREVIOUS)
- BC BACKGROUND SAMPLE LOCATION
- (P) MONITORING WELL PLUGGED DURING RI
- SURFACE WATER FLOW DIRECTION
- - - APPROXIMATE LIMITS OF WASTE MANAGEMENT AREA
- - - CIRCUMFERENCE ELEVATION CONTOUR

RI PHASE 2 LEGEND

- ◆ PROBE BORING (18)
- ◆ SHALLOW MONITORING WELL (3)
- ◆ DEEP MONITORING WELL (1)
- ◆ DEEP STRATIGRAPHIC BORING (1)
- ◆ PIEZOMETER (2)
- ◆ SEDIMENT/SURFACE WATER SAMPLE (6)
- ◆ MONITORING WELL TO BE PLUGGED DURING PHASE 2 (5)



NOTE: CONTOURS ARE STRICTLY INTERPOLATED.

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 CDAP

LHAAP 12
ACTIVE LANDFILL
SAMPLE LOCATIONS

Sverdrup
Environmental

FIGURE 4-1

011718

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 7 of 49

One groundwater sample will be collected from each Geoprobe boring, new well, and existing well scheduled for confirmation sampling and analyzed for volatiles, explosives, and metals. Sediment and surface water samples will be analyzed for volatiles, explosives, and metals. Three of the surface water samples obtained from Central Creek will also be analyzed for total hardness. Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples.

LHAAP 16 - Old Landfill

The field investigation plan developed for LHAAP 16 incorporates the following:

- collection of fifteen (15) Geoprobe groundwater samples,
- one (1) stratigraphic soil boring,
- installation of three (3) shallow, downgradient monitoring wells,
- installation of one (1) deep monitoring well,
- confirmation sampling of groundwater in twelve (12) existing monitoring wells,
- sampling of groundwater in four (4) new monitoring wells, and
- collection of fifteen (15) surface water and sediment samples.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

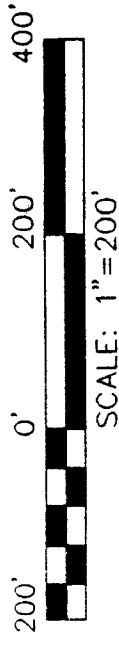
Page: 8 of 49

Proposed locations are shown on Figure 4-2. Nine (9) additional sediment and surface water sampling locations in Harrison Bayou are shown in Figure 4-7. Groundwater is anticipated to be encountered at depths of 5-15 ft. Shallow wells will be installed with screens placed immediately above any clay layer, if encountered, in order to detect dense, non-aqueous phase liquids. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. The deep stratigraphic boring will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. The deep well will be installed with its screen placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

One groundwater sample will be collected from each Geoprobe boring, new well, and existing well scheduled for confirmation sampling and analyzed for volatiles, explosives, and metals. Sediment and surface water samples will be analyzed for volatiles, explosives, and metals. Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples.

- ### RI PHASE 2 LEGEND

- ☀ PROBE BORING (15)
- ⬢ SHALLOW MONITORING WELL (3)
- ⬢ DEEP MONITORING WELL (1)
- ☼ DEEP WELL/STRATIGRAPHIC BORING (1)
- ⬢ SEDIMENT/SURFACE WATER SAMPLE (6)



LHAAP 16 -- OLD LANDFILL
SAMPLE LOCATIONS

CONTOURS ARE STRICTLY INTERPOLATED.

**Sverdrup
Environmental**

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LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 10 of 49

LHAAP 17 - Burning Ground No.2/ Flashing Area

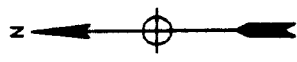
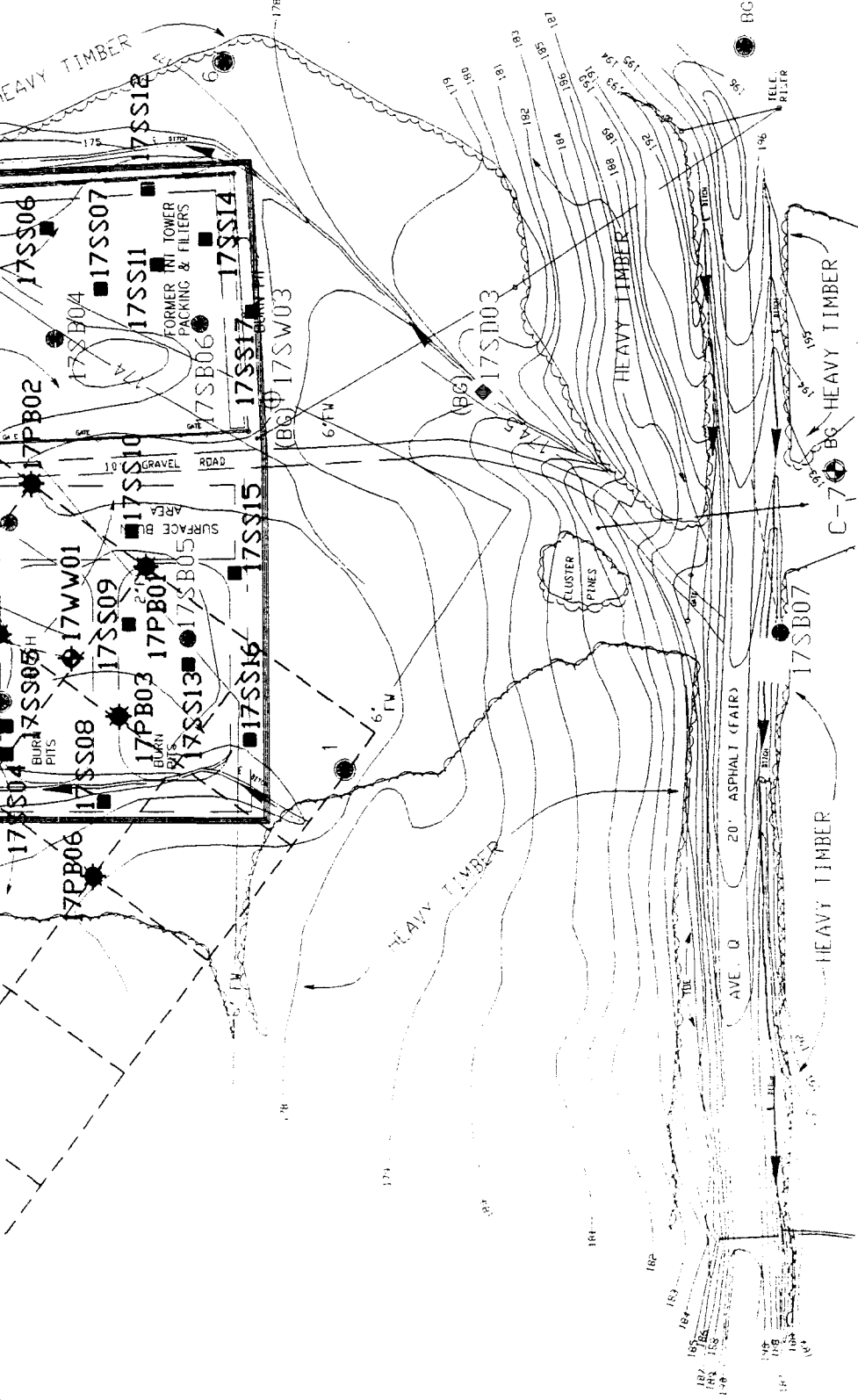
The field investigation plan developed for LHAAP 17 incorporates the following:

- collection of sixteen (16) Geoprobe groundwater samples,
- one (1) stratigraphic soil boring,
- installation of three (3) shallow, downgradient monitoring wells,
- installation of one (1) deep monitoring well,
- confirmation groundwater sampling of two (2) existing monitoring wells,
- groundwater sampling of four (4) new monitoring wells,
- collection of six (6) surface water and sediment samples, and
- collection of twenty (20) surface (0 to 6 inches) soil samples.

Proposed locations are shown on Figure 4-3. Groundwater is anticipated to be encountered at depths of 0-10 ft. Shallow wells will be installed across the upper portion of the shallow aquifer beneath the site. Because of TNRCC regulations, the top of screen will not extend above 5 ft below the ground surface. The deep stratigraphic boring will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. The deep well will be installed with its screen placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

- ## RI PHASE 2 LEGEND

- ☀ PROBE BORING (16)
- ☼ SHALLOW MONITORING WELL (3)
- ☼ DEEP MONITORING WELL (1)
- ☀ DEEP STRATIGRAPHIC BORING (1)
- ☼ SEDIMENT/SURFACE WATER SAMPLE (6)
- SURFACE SOIL SAMPLE (20)



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LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 CDAP

LHAAP 17
BURNING GROUND NO. 2
SAMPLE LOCATIONS

***Sverdrup
Environmental***

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 12 of 49

One groundwater sample will be collected from each Geoprobe boring, new well, and existing well scheduled for confirmation sampling and analyzed for volatiles, explosives, and metals. Groundwater samples from new wells will also be analyzed for the anions chloride, nitrate, and sulfate. Sediment and surface water samples will be analyzed for volatiles, explosives, metals, and anions. Surface soil samples will be analyzed for volatiles, explosives, and metals.

Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples obtained from borings.

LHAAP 18 & 24 - Burning Ground No.3 and UEP/Rocket Motor Washout Facility

The field investigation plan developed for LHAAP 18 & 24 incorporates the following:

- collection of thirty (30) Geoprobe groundwater samples,
- five (5) stratigraphic soil boring,
- installation of eight (8) shallow monitoring wells,
- installation of six (6) intermediate monitoring wells,
- installation of five (5) deep monitoring wells,

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 13 of 49

- collection of eighteen (18) surface water and sediment samples, and
- collection of twenty-five (25) surface (0 to 6 inches) soil samples.

Proposed locations are shown on Figure 4-4. Ten (10) additional sediment and surface water sampling locations in Harrison Bayou and Saunder's Branch are shown in Figure 4-7. Groundwater is anticipated to be encountered at depths of 0-10 ft. Shallow wells will be installed with screens placed immediately above any clay layer, if encountered, in order to detect dense, non-aqueous phase liquids. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. Intermediate wells will be installed at locations clustered with a shallow well. Intermediate wells will be installed in the aquifer encountered beneath the clay layer observed in the shallow well installation. If encountered, intermediate wells will also be installed with screens placed immediately above any deeper clay layer, in order to detect any dense, non-aqueous phase liquids. If no clay layer is observed during drilling, intermediate wells will not be extended below 100 ft total depth. Deep stratigraphic borings will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. Deep wells will be installed with screens placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

[illegible]

SHALLOW MONITORING WELL (8)
INTERMEDIATE MONITORING WELL (6)
DEEP MONITORING WELL (5)
DEEP STRATIGRAPHIC BORING (5)
SEDIMENT/SURFACE WATER SAMPLE (8)
SURFACE SOIL SAMPLE (25)

GROUND WATER FLOW DIRECTION
MONITOR WELL, PUMP AND GROUNDWATER
SURFACE WATER/ DITCH SAMPLE AND
SEDIMENT SAMPLE (PHASE D)
SURFACE WATER SAMPLE (PHASE D)
SURFACE WATER FLOW DIRECTION
GROUND WATER SURFACE ELEVATION

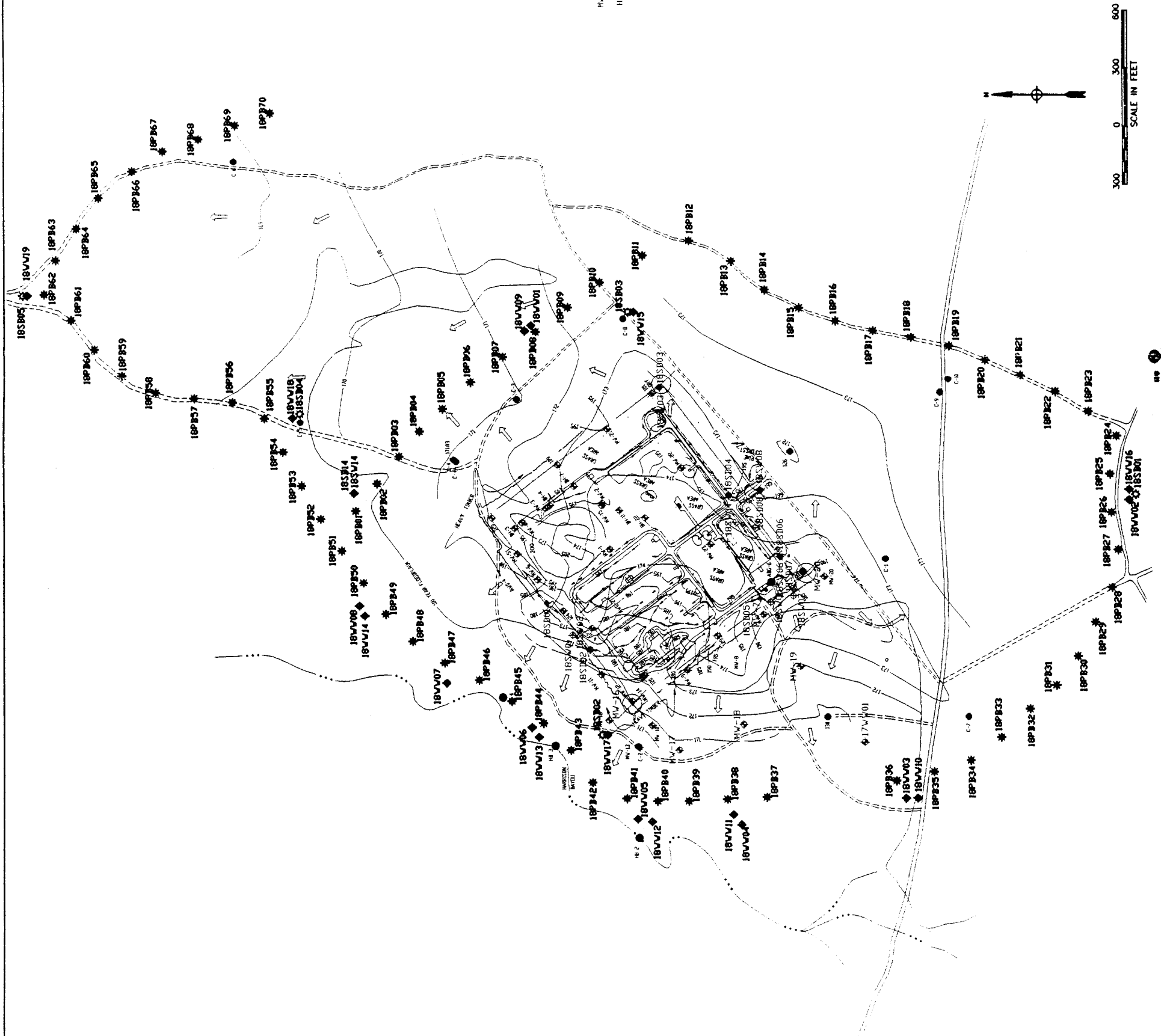
LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 CDAP	LHAAP 18 AND 24 BURNING GROUND NO. 3 AND UNLINED EVAPORATION POND SAMPLE LOCATIONS	Sverdrup Environmental	FIGURE 4-4A
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**Sverdrup
Environmental**

FIGURE 4-4A

000086-5/LHS-23A

011720



LEGEND

- * PROBE BORING (70)
- ◆ SHALLOW MONITORING WELL (8)
- ◆ INTERMEDIATE MONITORING WELL (6)
- ◆ DEEP MONITORING WELL (5)
- ◆ DEEP STRATIGRAPHIC BORING (5)
- ◆ SEDIMENT/SURFACE WATER SAMPLE (8)
- ◆ SURFACE SOIL SAMPLE (25)
- ↑↑ GROUND-WATER FLOW DIRECTION
- MONITOR WELL NUMBER AND GROUNDWATER ELEVATION (EXISTING)
- SURFACE WATER/SE DITCH SAMPLE AND NUMBER (EXISTING)
- SEDIMENT SAMPLE (PHASE 1)
- SURFACE WATER SAMPLE (PHASE 1)
- SURFACE WATER FLOW DIRECTION
- GROUND-WATER SURFACE ELEVATION

NOTE:

ADDITIONAL PROBE BORINGS WILL BE LOCATED AS NECESSARY TO DEFINE ANY GROUNDWATER CONTAMINATION DETECTED IN THE FIRST LINE OF PROBE BORINGS.

CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

RI PHASE 2 CDAP

LHAAP 18 AND 24
BURNING GROUND NO. 3 AND
UNLINED EVAPORATION POND
GEOPROBE BORINGS AND WELLS

Sverdrup
Environmental

FIGURE 4-4B

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 16 of 49

One groundwater sample will be collected from each Geoprobe boring and analyzed for volatiles. One groundwater sample will be collected from each new well and analyzed for volatiles and metals. Sediment and surface water samples will be analyzed for volatiles and metals. Three (3) surface water samples obtained from Harrison Bayou, and three from Saunder's Branch, will also be analyzed for total hardness. Surface soil samples will be analyzed for metals, and fifteen (15) samples will also be analyzed for volatiles.

Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples obtained from borings.

LHAAP 29- Former TNT Production Area

The field investigation plan developed for LHAAP 29 incorporates the following:
Production Area

- collection of sixteen (16) Geoprobe or Hydropunch™ groundwater samples,
- one (1) stratigraphic soil boring,
- installation of three (3) shallow, downgradient monitoring wells,
- installation of one (1) deep downgradient monitoring well,
- confirmation groundwater sampling of three (3) existing monitoring wells,

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 17 of 49

- collection of three (3) surface water and sediment samples, and
- collection of surface (0 to 6 inches) soil samples, and soil samples from 4-5 ft depth, at 24 locations, four (4) locations at each of the six (6) production lines.

Cooling Ditch Area

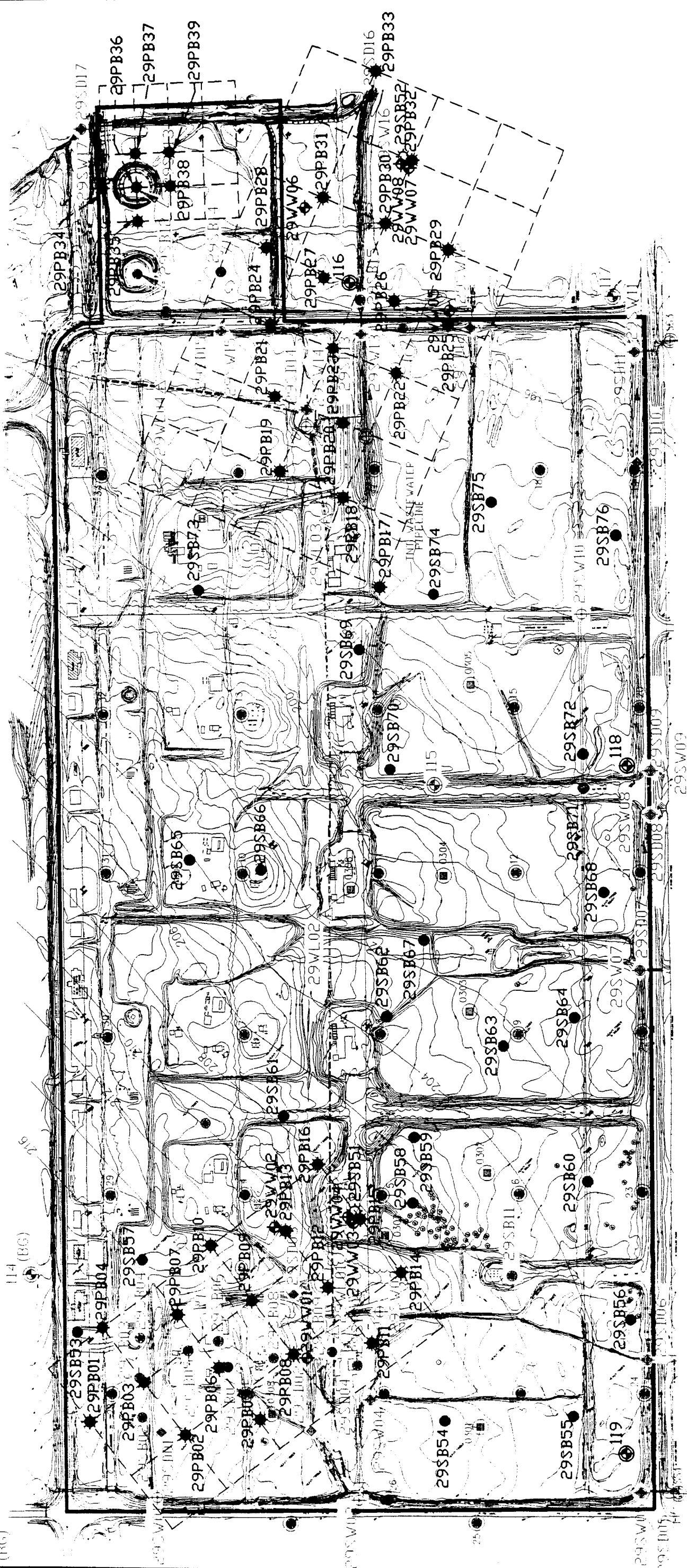
- collection of seventeen (17) Geoprobe/Hydropunch groundwater samples.
- one (1) stratigraphic soil boring,
- installation of three (3) shallow, downgradient monitoring wells, and
- installation of one (1) deep downgradient monitoring well.

Bulk Toluene Storage Tanks

- collection of six (6) Geoprobe/Hydropunch groundwater samples.

Proposed locations are shown on Figure 4-5. Three (3) additional sediment and surface water sampling locations in Central Creek are shown in Figure 4-7. Groundwater is anticipated to be encountered at depths of 20 to 40 ft. Shallow wells will be installed across the upper portion of the shallow aquifer beneath the site. Deep stratigraphic borings will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. Deep wells will be installed with its screens placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

011729

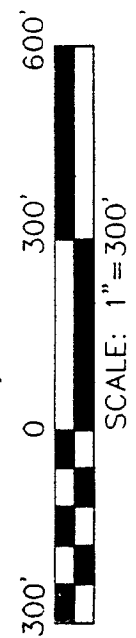
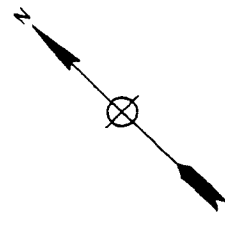


RI PHASE 2 LEGEND

- ◆ PROBE BORING (39)
- SHALLOW MONITORING WELL (6)
- DEEP MONITORING WELL (2)
- DEEP STRATIGRAPHIC BORING (2)
- 5' SOIL BORING (24)

- ◆ SURFACE SEDIMENT SAMPLE (PHASE 1)
- SURFACE WATER SAMPLE (PHASE 1)
- SURFACE WATER SEDIMENT SAMPLE (PREVIOUS)
- SURFACE SOIL SAMPLE (PREVIOUS)
- MONITORING WELL (PHASE 1)
- SOIL BORING (PHASE 1)
- SOIL BORING (PHASE 2)
- WASTEWATER TREATMENT SAMPLE (PHASE 1)
- SURFACE WATER TREATMENT SAMPLE (PHASE 1)
- APPROXIMATE ELEVATION
- APPROXIMATE SURFACE ELEVATION
- APPROXIMATE SURFACE ELEVATION

NOTE: GROUNDWATER POTENTIOMETRIC SURFACE
CONTOURS ARE INTERFERED.



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LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 CDAP	
LHAAP 29 FORMER TNT PRODUCTION AREA SAMPLE LOCATIONS	
Sverdrup Environmental	FIGURE 4-5

LHAAP Group 2 RI, Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 19 of 49

One groundwater sample will be collected from each Geoprobe boring and new well and analyzed for explosives and metals. Geoprobe groundwater samples collected from the Bulk Toluene Storage Tanks area will also be analyzed for toluene. Groundwater samples from existing Well 116 will be analyzed for explosives, Well 118 for selenium and mercury, and Well 119 for cadmium. Sediment and surface water samples will be analyzed for explosives and metals. In addition, three (3) surface water samples obtained from Central Creek will be analyzed for total hardness. The twenty-four (24) surface soil samples and soil samples from 4-5 ft depth will be analyzed for explosives and metals. Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples obtained from borings.

LHAAP 32- Former TNT Waste Disposal Plant

The field investigation plan for LHAAP 32 incorporates the following:

- collection of nine (9) surface water and sediment samples.

Proposed locations are shown on Figures 4-6 and 4-7. Sediment and surface water samples will be analyzed for explosives and metals. In addition, the three (3) surface water samples obtained from Goose Prairie Creek will be analyzed for total hardness.

011731

LEGEND

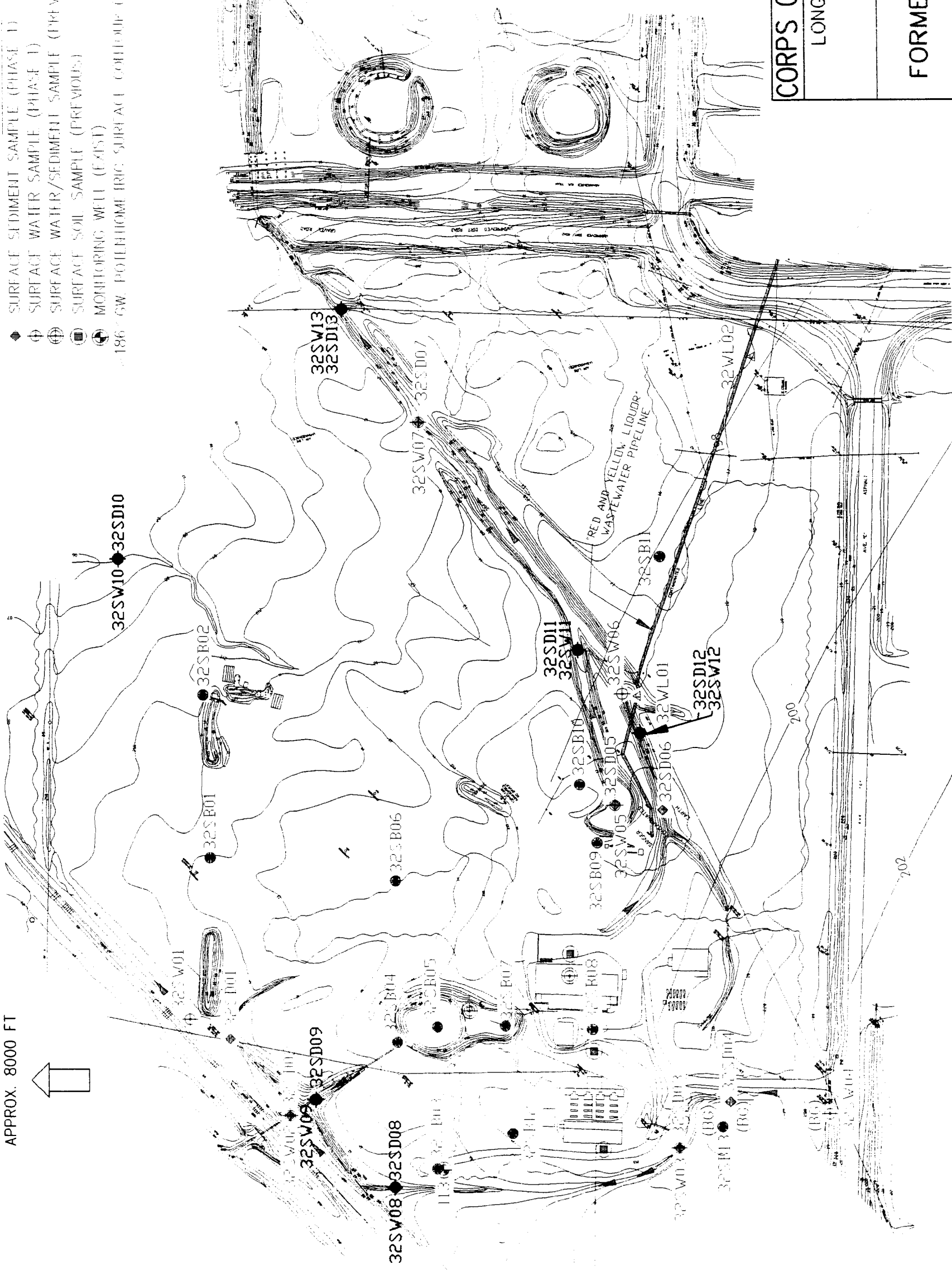
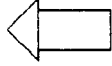
- ◆ SURFACE SEDIMENT SAMPLE (PHASE 1)
- ⊕ SURFACE WATER SAMPLE (PHASE 1)
- ⊕ SURFACE WATER/SEDIMENT SAMPLE (PREVIOUS)
- ⊕ SURFACE SOIL SAMPLE (PREVIOUS)
- ⊕ MONITORING WELL (EXIST)
- 186' GW POTENTIAL IIRIC SURFACE CONTOUR (11 FPM)

- SOIL BORING (PHASE 1)
- SOIL BORING (PREVIOUS)
- △ WASTEWATER LINE SAMPLE
- BG BACKGROUND SAMPLE LOCATION

RI PHASE 2 LEGEND

- ◆ SEDIMENT/SURFACE WATER SAMPLE (6)

CADDO LAKE
APPROX. 8000 FT



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LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS
RI PHASE 2 CDAP

LHAAP 32
FORMER WASTE DISPOSAL PLANT
SAMPLE LOCATIONS

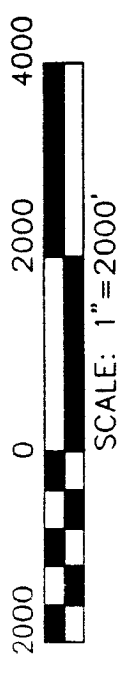
Sverdrup
Environmental

NOTE: GROUNDWATER POTENTIAL IIRIC SURFACE
CONTOURS ARE INTERPOLATED.

FIGURE 4-6

RI PHASE 2 LEGEND

SEDIMENT	SURFACE	WATER	SAMPLE (30)
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CORPS OF ENGINEERS, TULSA DISTRICT	
LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 CDAP	
GROUP 2 SITES ADDITIONAL SEDIMENT\ SURFACE WATER SAMPLE LOCATIONS	
Sverdrup Environmental	FIGURE 4--7

4.1 **Drilling.** An experienced geologist, engineer or technician will serve as an inspector for all drilling activities. The inspector will prepare and describe samples and cuttings, monitor drilling operations, oversee well installation, record groundwater data, and prepare well diagrams and geologic logs. Drilling of most borings will be done by hollow stem auger. This drilling technique utilizes hollow flight augers with a cutting head attached to penetrate the formation. Sampling of these borings will be performed by split spoon, or Shelby tube. Drill pipe, augers, and other equipment used below ground will be steam cleaned as discussed in Section 4.8. Static water levels will be taken from each open borehole after completion of drilling and immediately prior to grouting.

Drilling of deep stratigraphic borings for geophysical logging will be performed using mud rotary drilling. Outer surface casings will be installed to isolate all deeper water-bearing strata from shallower saturated zones prior to advancement of the boring. The deeper saturated zones should be separated by at least 2 ft thickness of lower permeability materials. Borehole geophysical logging will be conducted within the openhole portion of the boring, below any surface casings.

Deep (> 100 ft) monitoring wells will be installed within the deeper water-bearing strata using driven casing combined with air rotary drilling to clean out the casing as it is advanced. Outer surface casings will be installed using mud

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 23 of 49

rotary drilling methods to isolate all deeper water-bearing strata from shallower saturated zones.

4.1.1 Soil Sampling Equipment. Sampling equipment to be used in conjunction with the drilling techniques discussed above is described in this section. Sampling techniques for sediments are discussed in Section 4.5.2. Samples will be taken at a minimum of one every five feet or every change of lithology, whichever occurs more frequently. Drill action and examination of the materials on the auger flights will be used to determine the location of stratigraphic changes.

4.1.1.1 Split Spoon. A split spoon is a small 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 can be used for samples for chemical tests or physical tests not requiring an undisturbed sample such as Atterberg limits.

4.1.1.2 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 overburden sediments. It also does not produce an undisturbed sample.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 24 of 49

4.1.2 Protection of Lower Aquifers. If a perched aquifer is encountered that is potentially contaminated, that water-bearing zone will be cased off with the casing thoroughly seated into the lower permeability materials beneath. Drilling will continue through the casing. In the same manner, to reduce the potential for contamination of underlying water-bearing strata by dense non-aqueous phase liquids (DNAPL) migrating downward via the borehole, outer surface casings will be used when drilling through water-bearing strata to reach deeper saturated zones during the installation of intermediate and deep monitoring wells, and to reach the Midway Formation in deep stratigraphic borings. The surface casings will be thoroughly seated into a lower permeability layer of at least 2-ft thickness prior to advancement of the boring.

Steel surface casings will be installed, set a minimum of two (2) ft into the lower permeability stratum. Casings will be installed using mud rotary drilling; boreholes will have a minimum annular space of two (2) inches between the casing and the formation. Centralizers will be used to facilitate keeping the casing centralized in the borehole so that grout is more uniform in thickness around the casing. Mud rotary drilling fluids will be weighted to a minimum density of 11 lbs per gallon. Casings will be grouted using a high solids bentonite grout containing no cement, as specified in Section 4.2.1.6. The grout will be allowed to set for a minimum of 12 hours prior to further drilling.

The surface casing will be installed as follows. The borehole will be drilled

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 25 of 49

and sampled using the mud rotary technique. The drilling fluid will be weighted with barite such that The surface casing, open at the bottom, will be installed into the mud-filled borehole. High solids bentonite grout will then be pumped into the casing using a tremie pipe to displace the drilling mud. Excess drilling mud will be collected at the ground surface and placed in steel drums for later characterization and disposal. The grout contained within the surface casing will then be pushed downward using a pump-down plug, forced out of the casing bottom, and into the borehole annulus. The pump-down plug is pushed from the top of the casing to the bottom using the drill rods. As such, grout will be forced under pressure up the borehole annulus until it reaches the ground surface. As the grout is pushed downward in front of the pump-down plug, drilling mud will be forced out ahead of it. The drilling mud will be forced through the borehole annulus and return to the ground surface, where it will be collected in steel drums. The grout volume will be measured to confirm that the calculated grout volume was installed. After the grout has been installed, the surface casing will be pushed downward another two (2) ft to seat it into the lower permeability stratum.

4.1.3 Geological Logs. The strata encountered during drilling will be described in detail, using the Corps of Engineers geological log form (Eng Form 1836). The log will describe each lithologic unit encountered, groundwater information, sample depths, and drilling methods. The descriptions will include lithology, color, grain size, plasticity, stiffness, cementation, moisture

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 26 of 49

content, sedimentary structures, presence and general orientation of fractures, and other data determined to be pertinent by the geologist. Boring descriptions will be determined from geological logs or from characterization of cuttings and drill action, where samples are not taken. A geologic log form is shown in Appendix A. It will be used for all soil borings, monitoring wells, and shallow soil samples.

4.1.4 Borehole Abandonment. All borings not converted into monitoring wells will be abandoned by filling with a high solids bentonite grout containing no cement, as described in Section 4.2.1.5. After the grout has setup for at least 12 hours, the settlement depression will be filled to the surface with additional grout.

4.2 Monitoring Wells.

4.2.1 Drilling and Installation. Monitoring wells for this project will be drilled by an auger as discussed in Section 4.1. Wells can be installed in borings dedicated for that purpose or in borings drilled for environmental samples, geologic, or water information, as long as the minimum diameter is 8 inches. A typical well schematic is shown in Figure 4-8. If more than one water bearing zone is found, then well clusters will be installed to monitor each zone. In such a case, the upper zone will be cased and/or grouted. Large diameter casing will be installed through the upper water bearing zone to an underlying clay bed, and the annulus will be grouted to the surface.

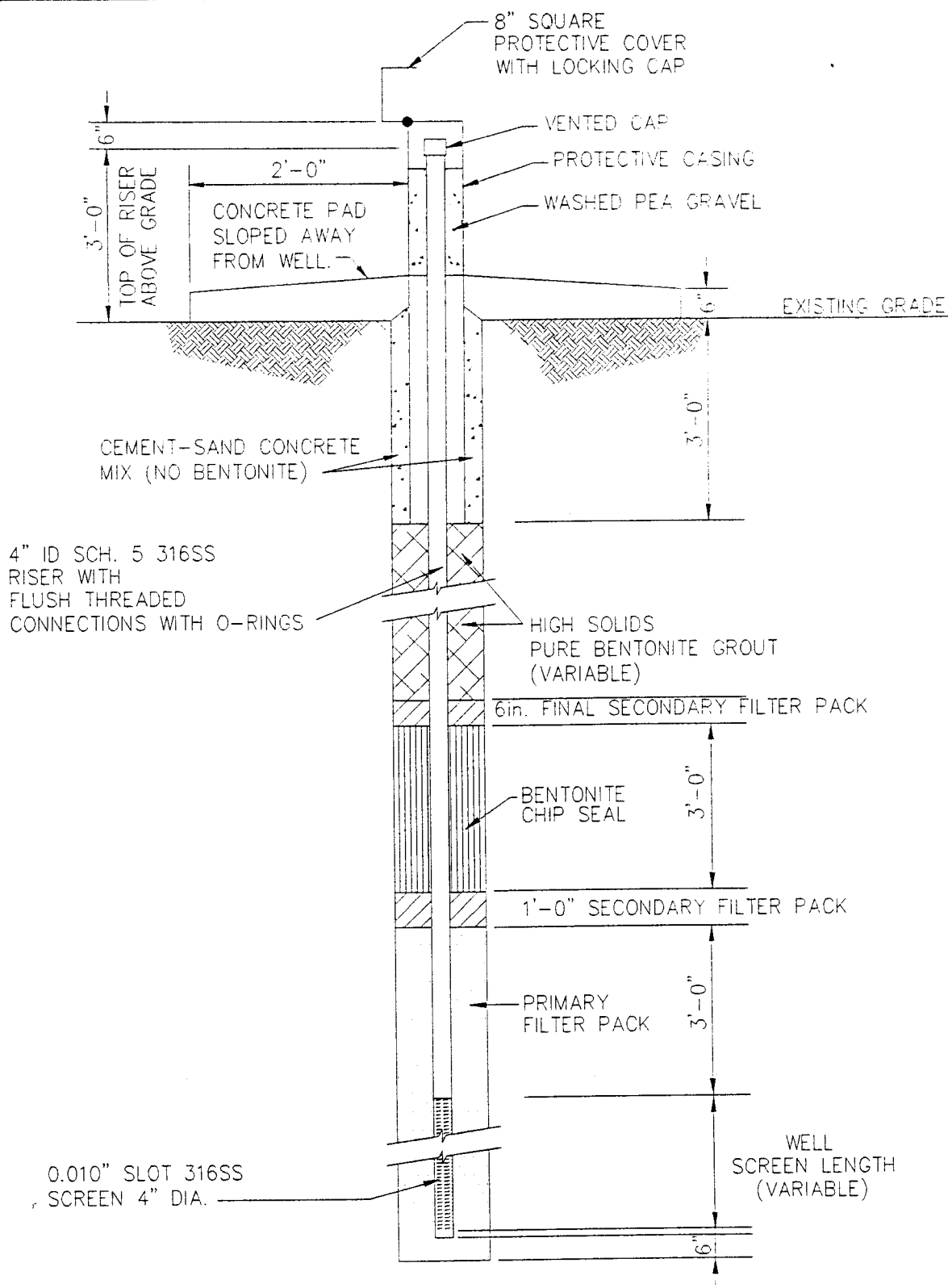


FIGURE 4-8
MONITORING WELL DETAIL
NOT TO SCALE

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 28 of 49

4.2.1.1 Well Casing. Four-inch nominal diameter, flush-threaded, schedule 5 stainless steel 316 casing will be installed from the screen to an elevation above the potentiometric surface. Schedule 40 PVC casing will then be installed to approximately three feet above the ground surface. Centralizers may be used near the well screen to keep the casing centered in the well bore.

The potentiometric surface elevation will be measured, using the procedure described in Section 4.4.1.1, at the completion of drilling and prior to monitor well installation. Potentiometric measurements will be taken at regular time intervals (5-10 minutes) until a consistent, repeatable depth of the potentiometric surface is obtained.

4.2.1.2 Riser and Cap. Surface construction of well pads, covers, etc., will comply with Corps of Engineers requirements as well as requirements of the Technical Enforcement Guidance Document, Ref. 6. Approximately 3 feet of well casing will be left above ground and enclosed in a protective steel casing. The protective casing will extend below the ground surface and will have a locking cover to prevent entry of rainwater and unauthorized personnel. It will also have a drainhole near the base. A four by four-foot concrete pad, four to six inches thick, will be poured around the protective casing at the ground surface, and will be sloped to promote drainage. A cage or metal posts will be placed in the concrete pad to protect the well.

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 29 of 49

4.2.1.3 Screen. Wells will be screened with 4-inch diameter stainless steel 316 slotted or continuous wire-wrapped screen, with a slot size of 0.01 inches, and a maximum screen length of 10 ft. In order to detect the presence of any DNAPLs, all wells (shallow, intermediate, or deep) will be placed at the bottom of the water-bearing stratum, such that the bottom 4 to 6 inches of slotted screen is installed below the observed top of the low permeability (clay) confining layer.

4.2.1.4 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. Filter pack thickness may be adjusted in the field based on the borehole stratigraphy. The filter sand will be placed with a slow, continuous stream. Continuous depth soundings of the bottom of the hole will be taken to monitor the level of the sand and detect any bridging of sand. The sand will be either bagged or purchased from a batch plant and will have a 20-40 gradation. A 0.5-foot thick secondary filter pack will be installed above the primary filter pack prior to installation of the bentonite seal and above the bentonite seal prior to installation of the grout. Placement of the secondary filter pack above the bentonite seal assists in preventing infiltration of the grout into the bentonite seal. The secondary filter will be installed in the same manner as the primary filter pack. The secondary filter material shall be clean silica sand with 100 percent passing the No. 30 U.S. Standard sieve.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 30 of 49

4.2.1.5 Bentonite Seal. An approximately two-foot thick bentonite seal will be placed above the filter sand in the well annulus. This will be accomplished by using pellets or chips installed via a tremie pipe or by dropping them directly into the annulus. Bentonite pellets or chips will be hydrated with reagent-free water and allowed to hydrate for approximately 30 minutes before proceeding with the installation.

4.2.1.6 Grout. A high solids bentonite grout containing no cement will be used to fill the annulus between the bentonite seal and the top of the ground, as well as for borehole abandonment. The grout will be prepared using 30 lbs. of natural, unaltered bentonite powder with 100 gallons of water, and then adding 125 lbs. of granular bentonite into the slurry using a venturi pump. This grout has been found to adhere to steel casing, has low permeability, good swelling characteristics and flexibility, and is an excellent sealant (Ref. 2). Grouting will be accomplished in an appropriate manner for the specific application. Grout will be pumped through a tremie or poured into an open hole or pipe. The quantities of grout used will be recorded in the field log.

4.2.2 Well Development. After the monitoring well installation has been completed for at least 24 hours, wells will be developed to remove drill fluid and cuttings as well as any fines from the sand filter which might clog up the well screen. Each well will be surged, bailed and/or pumped until the sediments in the water are reduced substantially. At least 5 well volumes must be removed

and temperature, pH, and conductivity must have stabilized over four consecutive readings as discussed in Section 4.5.1.1.2. Water and cuttings will be disposed of in accordance with Appendix C.

4.2.3 Well Acceptance. It is the responsibility of the drilling agency to drill and install a monitoring well which meets the criteria of Section 4.2. If a well is not constructed of the proper materials by the proper methods or if the well does not perform in such a manner to yield water representative of the aquifer which it monitors, then that well shall not be accepted by the Corps.

4.2.4 Well Schematics and Reports. A well diagram will be prepared for each well which will contain all pertinent information concerning the well, such as 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 geologic log will also be prepared for each well. A typical well schematic is shown in Figure 4-5. A Texas Well Driller's Report, also shown in Appendix A, will be prepared for each well.

4.2.5 Well Abandonment. Wells which have been abandoned because of construction problems or because they are no longer needed will be backfilled in the following manner:

- Well casing and screen will be removed.
- The hole will be overdrilled.

- The hole will be grouted with a tremie pipe from the bottom of the boring to the top. The grout will consist of a high solids, pure bentonite grout as described in section 4.2.1.6.

4.3 Location Surveys. All borings, monitoring wells, and sampling points 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 bench marks set from approved established control monumentation in the area. Horizontal control will be in accordance with NAD 1983, and vertical control will be referenced to the NGVD, 1929.

4.4 Water Measurements.

4.4.1 Groundwater.

4.4.1.1 Potentiometric Surface. Once the well is completed, both the water level and bottom of well will be measured to the nearest 0.01 foot. Measurements will be made from a notch or mark at the top of the casing and recorded in the field journal and other appropriate forms. An electronic probe will be used to establish equilibrium water levels. Depth to bottom of well will also be measured. The probe will be decontaminated between wells as described in Section 4.8.

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 33 of 49

4.4.1.2 Slug Tests. Slug tests are performed to calculate the hydraulic properties of the aquifer. The purpose of this test is to determine the permeability of the water-bearing strata, 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. Slug tests will be conducted using the recovery test analytical method introduced by Bouwer and Rice (1976). The rising head method is preferred over falling head tests for unconfined water-bearing units in which the well screen is placed across the potentiometric surface elevation. In addition, the test data is generally less disturbed by the sudden insertion of the slug into the water column within the well.

Water level data from the slug tests will be collected using a pressure transducer placed beneath the water column near the bottom of the well and connected to a datalogger set to record data on a logarithmic sampling schedule. The transducer cable will be firmly attached to the top of the well casing using duct tape, such that it will be minimally disturbed during introduction and removal of the slug. A slug will be constructed using a 5-ft length of PVC pipe, filled with sand to allow it to sink into the water column. The pipe will be sealed on both ends using slip caps and thermoplastic glue. An eyebolt will be secured into the top cap, from which nylon rope can be attached. Four-inch nominal diameter wells will be tested using a slug constructed with two-inch nominal diameter pipe; two-inch wells will be tested using a nominal one-inch diameter slug.

After the pressure transducer has been secured within the well, the PVC slug will be lowered into the well until it is fully submerged within the water column. The datalogger will be monitored until the potentiometric surface returns to equilibrium. The slug will then be removed from the water column while simultaneously starting to record potentiometric data with the datalogger. The datalogger will be monitored as the potentiometric elevation within the well increases and returns to equilibrium, at which time the test is complete.

The slug test data from each test will be downloaded from the datalogger to ASCII file and analyzed in the office using the Bouwer-Rice recovery time-lag test method. The data will be plotted and analyzed using AQTESOLV, developed by Geraghty and Miller.

4.4.2 Pondwater. Elevations of water samples and sediment samples will be determined by subtracting the depth of the sample from the elevation of the water surface as determined by a survey stake at the water's edge.

4.5 Sampling.

4.5.1 Groundwater Sampling. Groundwater samples for laboratory chemical analysis will be collected from monitoring wells only. Groundwater samples from monitoring wells may only be collected beyond 7 days after well development. Groundwater samples for field screening will be collected using Geoprobe borings. At locations where the Geoprobe boring is unable to penetrate sufficiently to

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 35 of 49

reach groundwater, a hollow-stem auger boring will be drilled and a Hydropunch sampler used to collect groundwater samples for field screening.

At a minimum, the following information will be recorded in a bound field logbook for each sample collected:

- date and time of collection
- climatic conditions with ambient air temperature
- well identification number
- sample number
- name of collector
- water level and time of measurement
- total depth and diameter of well
- depth of water column and minimum purge volume
- PID or FID readings
- sample type (duplicate, split, field blank if applicable)
- purging and sampling method (bailer, submersible pump, etc.)
- temperature, conductivity, and pH of water during purging until stable readings are obtained
- color or turbidity of sample
- volume purged prior to sampling
- four replicate measurements of pH, temperature, and specific conductance
- sample preparation and preservation (filtering, HNO₃, etc.)
- instrument calibration check
- remarks on any special problems or observations

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 36 of 49

4.5.1.1 Sampling from Monitoring Wells.

4.5.1.1.1 Open and Dedicated Wells. Open wells are wells which will not be fitted with dedicated purging and sampling equipment. Dedicated wells are wells which have permanently installed sampling and/or purging equipment. At Longhorn, all wells will be dedicated with pumps or bailers. Stainless steel wells will have dedicated stainless steel pumps or bailers. Wells will be purged and pumped using the pump or bailer dedicated to each well. Upon arrival at the well-head during any sampling event, the Groundwater Monitoring Well Inspection Form contained in Appendix A will be filled out completely. Completed inspection forms will be delivered to the LHAAP Environmental Quality office, who will review them to determine if wells need some type of maintenance.

4.5.1.1.2 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. The Groundwater Sampling Field Data Form contained in Appendix A contains the formula used to calculate the volume of water to be purged. If the well does not yield five volumes, it will be evacuated at a rate slow enough to yield two volumes before it goes dry. If after removing five volumes of water, pH, temperature, and conductivity have not stabilized, then additional volumes will be removed. These parameters will be considered to be stabilized if temperature for four consecutive readings is $\pm 1^{\circ}\text{C}$, pH is ± 0.5 units, and conductivity is $\pm 10\%$ of the previous reading. Handling and disposal of purge water is discussed in Appendix C.

The well will be sampled as soon as possible after purging, but not before 85% recovery. In all cases, sampling will take place within 24 hours of purging. The sampling crew will record the recharge rate, the date, time, and rate of purging, and any unusual conditions noted with this operation. Dedicated sampling equipment will be used to both purge and sample wells. If the equipment becomes heavily contaminated by an immiscible layer encountered in the well during purging, it will be decontaminated prior to sampling using the procedures described in Section 4.8.

4.5.1.1.3 Sampling Procedures. Wells will be sampled with a stainless steel bailer, which will be slowly lowered into the well. Each sample container will be filled directly from the bailer. 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. Samples of groundwater for chemical analysis are collected and containerized in order of volatilization sensitivity as listed below:

- Volatile organics
- High explosives
- Metals
- Anions
- Total Hardness
- Field parameters

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 38 of 49

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:

- Check for presence and thickness of immiscible layers within the well as per section 5.1.2.
- Purge slow-recharging wells (if any) at the outset of the sampling day.
- Purge and sample other wells.
- Sample slow rechargers, if possible.
- Preserve the samples.
- Package and ship the samples to the laboratory.

4.5.1.2 Geoprobe/Hydropunch Sampling.

4.5.1.2.1 Geoprobe Borings. Geoprobe borings are temporary, short term groundwater sampling locations. These borings are performed by hydraulically pressing or driving a cone sampling device with hollow drill rods into the ground to a depth of approximately five feet below the initial detection of groundwater. Identification of water-bearing strata will be facilitated by collecting split-spoon soil samples, approximately one sample per 5 to 10 feet of Geoprobe boring. The field geologist will examine the soil samples to help determine which stratum from which to collect the groundwater sample.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 39 of 49

The water-bearing stratum is then sampled using polyethylene tubing inserted through the hollow drill rods to extract the groundwater with a peristaltic pump. In the event that groundwater is too deep for the peristaltic pump to draw the groundwater from the tubing, the drill rods will be removed, a 1-inch diameter slotted PVC casing will be placed in the borehole, and a smaller diameter bailer used to extract the groundwater.

In probeholes which very slowly recharge groundwater, a temporary well will be installed. A manually slotted, polyethylene tubing having a threaded plug is inserted into the hollow rod system and secured to the cone by screwing the plug into the cone. The hollow rods are then removed from the probehole and the annulus between the polyethylene tubing and the soil sides of the probehole is backfilled using a 20-40 gradation silica sand. Groundwater is then extracted from the temporary well by inserting a smaller diameter polyethylene tubing attached to a peristaltic pump.

4.5.1.2.2 Hydropunch Borings. Hydropunch borings will be used at locations where the Geoprobe sampler is unable to penetrate sufficiently to reach groundwater. Hydropunch borings are drilled using hollow-stem augers until groundwater is encountered. The Hydropunch groundwater sampler is then driven beneath the auger, in the same manner as a split spoon soil sampler, the sampler is allowed to fill with groundwater, and then the sampler is retrieved. Up to one liter of groundwater can be retrieved from each Hydropunch sample.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 40 of 49

4.5.1.2.3 Sampling. Geoprobe borings will be sampled using a smaller diameter polyethylene tubing that is inserted into the larger diameter polyethylene tubing that is in the probehole. The smaller diameter tubing is attached to silicon tubing which is routed through a peristaltic pump used to extract the groundwater. Each sample container will be filled directly from the tubing. Samples of groundwater for chemical analysis are obtained in the following order:

- Volatile Organics
- High explosives
- Metals
- Anions
- Field parameters

Table B.1 lists container, preservation, and handling requirements for each parameter and Table B.2 lists holding times.

4.5.2 Surface Water and Sediment 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 and will be taken several feet below the surface of the ponds. Water samples will also be taken from drainage ditches as described in the work plan. If the ditches are dry, then sampling will be done after a rainfall when the ditches are again flowing. Sediment samples will be taken by a push tube or other suitable device composed of

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 41 of 49

stainless steel or other inert material. After extraction from the tube, the upper five inches of sediment will be composited and placed in two 1/2 L wide-mouth glass jars with teflon-lined lids for chemical testing. If sufficient sample volume is present, three sample jars will be filled. Samples for volatiles, however, will be discrete with as little disturbance as possible. Sample locations will be accessed by a small boat or by wading.

4.5.3 Soil Sampling. Samples of soil from drill holes and Geoprobe borings will be taken using a split spoon or shelby tube, as discussed in Section 4.1.1.3. Shallow soil samples will be taken with clean, stainless steel shovel, sample push tube, or drill rig sampling equipment. For each shallow soil sample, a composite of the uppermost foot will be taken and placed in two (three if sufficient volume is present) 1/2 L glass jars with teflon-lined caps. Samples taken for volatile analysis, however, will not be composites, but discrete samples with as little disturbance as possible.

4.5.3.1 Physical Testing. Soil samples will be described in the field and classified using the Unified Soil Classification System. They will be tested for Atterberg limits, grain size distribution, and moisture content. Samples will be taken every five feet or change of material and shipped to SWD Lab or to a contract laboratory in plastic or glass jars for testing. All samples will be as representative of the strata as possible. Replicates will be taken as needed for QA/QC purposes by splitting a sample into three portions or

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 42 of 49

taking three grabs from the sampler. The two additional samples will consist of a QC sample to be tested by the same lab and a QA sample to be tested by SWD Lab. Methods for physical tests are given in Table B.3.

4.5.3.2 Chemical Testing. Samples will be placed in pre-cleaned glass jars with teflon-lined caps. Each sample shall consists of two (2) 1/2-L jars of soil. Samples collected for volatiles analysis will be contained separately in two (2) 45-ml jars. The samples will be taken at a minimum every five feet at discrete depths from borings and as composites for shallow soil samples. The samples will be packed in ice-filled coolers, and shipped to the laboratory by bus or overnight carrier to SWD Lab. QA/QC samples for soil and rock consist of equipment blanks and replicates as discussed in Section 4.8.

4.6 Geophysics.

4.6.1 Electromagnetic Survey. Electromagnetic surveys measure the electrical conductivity of the subsurface soil, rock, and groundwater. Electrical conductivity is a function of the soil type, porosity, permeability, and the type of fluids which fill the pore spaces. This technique can determine subsurface hydrogeologic conditions, map contaminant plumes when the contaminants alter the conductivity of the groundwater, and locate trench boundaries, buried wastes, and drums.

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 43 of 49

4.6.2 Downhole Geophysics. Geophysical logging will be performed in the deeper borings at LHAAP, as discussed in the Work Plan. Geophysical logs will be used to yield information on lithology and stratigraphy, and to allow correlation of boreholes. Specific types of logs which may be employed during the investigations are discussed below.

4.6.2.1 Spontaneous Potential. This log is applicable in water or mud filled open holes. Natural electrical potential 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.

4.6.2.2 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.

4.6.2.3 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

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 44 of 49

logs are available commercially, e.g. induction logs, multiple point and spacing resistivity logs, laterologs, microresistivity logs, and micro-laterologs. Typical uses include thin bed recognition, correlation, and estimation and/or calculation of water saturation.

4.7 Air Monitoring for Worker Protection. Instantaneous air monitoring will be conducted during all drilling and monitoring well sampling activities using a flame ionization detector or a photoionization detector with 11.7 eV lamp, and a combustible gas meter. Integrated sampling will be conducted on a selected basis using air sampling pumps and collection media, or passive dosimeters. Air monitoring procedures are described in the Site Specific Health and Safety Plan (SSHP).

4.8 Decontamination.

4.8.1 Drilling Equipment. Drilling equipment (augers, bits, split spoons, rods, and tools) will be steam cleaned or hot water pressure cleaned prior to use in each boring. A decontamination station will be established for the washing of drilling and sampling equipment. This station may be located onsite or nearby in order to serve several sites. Waste wash water will be collected and disposed of as discussed in Appendix C. 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

011758

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 45 of 49

them between each sampling interval. Used gloves will be bagged and disposed of in a manner which meets RCRA guidelines, as discussed in Appendix C.

4.8.2 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 potable water.

4.8.3 Sampling Equipment. All equipment that comes into contact with groundwater will be decontaminated using the following procedure:

- Wash equipment thoroughly using about 5 ml of a 1% solution ofalconox (or equivalent laboratory glassware detergent) per gallon of tap water.
- Fully immerse hose, measuring tape, and other equipment and brush clean.
- Rinse equipment with tap water.
- Rinse equipment with distilled water.
- Rinse equipment with distilled water.
- Hexane spray outside of equipment.

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.

4.9 Field QA/QC.

4.9.1 Chemical Samples. QA/QC samples for water, sediment, and soil will be used to verify that the sampling and analytical techniques are being performed properly. QC samples are taken in the field and analyzed with the field samples by the same laboratory. QA samples are analyzed by SWD Lab to check the performance of the contract laboratory. QC samples required for soils and water sampling include travel blanks, equipment blanks, and replicates. QA samples also include replicates. QA/QC samples are described below.

4.9.1.1 Travel Blanks. Travel blanks consist of American Society of Testing Materials (ASTM) Type II reagent water sealed into a sample vial in the field laboratory. The blank is not opened again until it is received in the laboratory. One travel blank will be prepared for each shipment of water samples containing volatiles, all of which are shipped in the same ice chest to the lab each day. Travel blanks measure cross contamination during shipment and contamination sources contacted during shipment. They are only analyzed for volatiles.

LHAAP Group 2 RI Phase 2 CDAP
Section: 4
Revision: 3
Date: December 1994
Page: 47 of 49

4.9.1.2 Equipment Blanks. Equipment blanks for water or soil samples will consist of ASTM Type II water used as the final rinse collected after it has been poured over or through non-dedicated sampling equipment such as augers, knives, spoons, or bailers. They will be shipped in the ice chest with the associated samples from the site. Equipment blanks will be prepared and preserved in the same manner as a water sample. Equipment blanks measure the effectiveness of equipment decontamination. Equipment blanks are taken at a rate of 1 for every 20, or fewer, samples and are analyzed for the same constituents and/or parameters as the associated soil or water samples.

4.9.1.3 Replicate Samples. Quality assurance/quality control (QA/QC) samples for water, sediment, and soil will be used to verify that the sampling and analytical techniques are being performed properly. Every tenth, or fewer, field sample is collected with sufficient volume for three portions. One portion is designated as the field sample's quality control duplicate sample (this is a replicate sample). One portion is designated as the field sample's quality assurance duplicated sample (this is a replicate sample). The field sample and QC duplicate sample are both analyzed by the same analytical laboratory. The QA duplicate samples are analyzed by SWD Laboratory to check the performance of the analytical laboratory which performed the analysis on the actual field sample and the QC duplicate sample.

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 48 of 49

In cases where only sufficient sample material exists for a duplicate sample, every fifth sample will be collected with sufficient volume for two portions. One portion is designated as the field sample. One portion is designated alternately as the QA or QC duplicate sample. The field sample and the QC duplicate sample are both analyzed by the same analytical laboratory. For the sets containing a field sample and QA duplicate sample, the field sample shall be shipped along with other field samples to the analytical laboratory. The QA duplicate sample shall be analyzed by SWD Laboratory to check the performance of the analytical laboratory which performed the analysis on the field sample.

4.9.2 Samples for Physical Testing. QA/QC on samples for physical testing consists of replicate samples as described in Section 4.9.1.3.

4.10 Investigation Derived Waste. The Investigation Derived Waste (IDW) Management Plan, developed by the U. S. Army Corps of Engineers - Tulsa District in June 1992, is included as Appendix C. Table C-2 in Appendix C contains an estimate of the IDW generated by the Phase 2 Remedial Investigation. IDW from the Phase 2 RI will be temporarily stored at LHAAP 16, placed on pallets and covered with tarps, until characterized for disposal.

Samples from representative drums of IDW will be analyzed for disposal characterization per Section 4.1.2 of the Appendix C. All soil samples from the Phase 2 borings will be field screened for NAPLs as described in Section 5.1.1.

011760

LHAAP Group 2 RI Phase 2 CDAP

Section: 4

Revision: 3

Date: December 1994

Page: 49 of 49

Analytical data from monitoring well groundwater samples will be used to help evaluate contamination of associated IDW consisting of saturated soils, groundwater, and drilling fluids. Unsaturated soils are not anticipated to be contaminated, since the Phase 2 borings and wells are situated to investigate downgradient groundwater contamination and are outside of known source areas.

LHAAP Group 2 RI Phase 2 CDAP
Section: 5
Revision: 3
Date: December 1994
Page: 1 of 5

SECTION 5.0

DNAPL CONTINGENCY PLAN

Based on the disposal history of individual sites as described in the Phase 2 Work Plan and the RI/FS Work Plan, dense non-aqueous phase liquids (DNAPLs) have the potential for presence at the following Group 2 Sites:

<u>LHAAP No.</u>	<u>Site Name</u>
12	Active Landfill
16	Old Landfill
17	Burning Ground No. 2
18/24	Burning Ground No. 3/Unlined Evaporation Pond

This section presents a contingency plan designed to identify the presence of dense non-aqueous phase liquids (DNAPLs) during the field investigations, and to take measures to reduce the potential for DNAPLs to contaminate underlying water-bearing strata.

5.1 Detection of NAPLs. This section describes field techniques which will be utilized to detect non-aqueous phase liquids (NAPLs) during drilling and prior to groundwater sampling. If NAPLs are indicated by field screening during drilling, the boring will be abandoned and grouted.

LHAAP Group 2 RI Phase 2 CDAP
Section: 5
Revision: 3
Date: December 1994
Page: 2 of 5

5.1.1 **Soils.** Hydrophobic dyes (such as Sudan IV produced by Aldrich Chemical Co.) will be used to detect the presence of non-aqueous phase liquids (NAPLs) in each of the split-spoon soil samples collected during drilling. Field screening for DNAPLs with hydrophobic dyes has been described by Cohen and Mercer (Ref. 2) and has also been suggested by personnel at EPA's Kerr Environmental Laboratory. A suggested field screening procedure is as follows: fill a 40-ml vial with approximately 20 ml of deionized water, add 1 mg of Sudan IV, add 20-40 g of soil, shake the vial while visually inspecting for red-colored NAPL layers. This method also allows determination of NAPL density relative to water.

5.1.2 **Groundwater.** Monitoring wells will be checked for the presence of DNAPLs prior to purging and sampling of each well. An electronic probe capable of monitoring for the interface between an immiscible layer and groundwater will be extended to the bottom of the well. The presence and apparent thickness of any interface will be noted in the sampling field log. A groundwater sample will then be collected from the bottom of the well, prior to purging, using a transparent, bottom-filling, polyethylene bailer. The presence of any immiscible layer will be confirmed using a hydrophobic dye and noted in the sampling field log. Care will be taken not to disturb any DNAPL layer during insertion of the interface probe and sampling with the bailer.

5.1.3 **Drilling Fluids.** Hydrophobic dyes will also be used to detect the presence of non-aqueous phase liquids in drilling fluids collected during mud

LHAAP Group 2 RI Phase 2 CDAP

Section: 5

Revision: 3

Date: December 1994

Page: 3 of 5

rotary drilling. A suggested general field screening procedure is as follows: Fill a 40-ml vial with approximately 20 ml of drilling fluid, add 1 mg of hydrophobic dye (Sudan IV), and shake the vial while visually inspecting for red-colored NAPL layers. This method also allows determination of NAPL density relative to water.

5.2 Drilling and Installation of Monitoring Wells. Care must be exercised to prevent creation of contaminant migration pathways during drilling and well installation procedures. At LHAAP, there may be several water-bearing strata separated by lower permeability strata (clay layers). Drilling operations will utilize the following techniques to reduce the potential for cross-contamination between these water-bearing strata.

All water-bearing zones will be cased off with the casing thoroughly seated into the lower permeability materials beneath prior to advancement of the boring. Such water-bearing zones must be separated by a lower permeability clay layer of at least two feet thickness. Drilling will then continue through the casing. Outer surface casings will be used in the same manner when drilling through water-bearing strata to reach intermediate and deep aquifers during the installation of intermediate and deep monitoring wells, and to reach the Midway Formation in deep stratigraphic borings. A pure bentonite grout containing no cement used to seal surface casings.

LHAAP Group 2 RI Phase 2 CDAP
Section: 5
Revision: 3
Date: December 1994
Page: 4 of 5

Steel surface casings will be installed, set a minimum of two (2) ft into the lower permeability stratum. Casings will be installed using mud rotary drilling; boreholes will have a minimum annular space of two (2) inches between the casing and the formation. Centralizers will be used to facilitate keeping the casing centralized in the borehole so that grout is more uniform in thickness around the casing. Mud rotary drilling fluids will be weighted to a minimum density of 11 lbs per gallon. Casings will be grouted using a high solids bentonite grout containing no cement. The grout will be allowed to setup for a minimum of 12 hours prior to further drilling.

The bentonite grout will be prepared using 30 lbs. of natural, unaltered bentonite powder with 100 gallons of water, and then adding 125 lbs. of granular bentonite into the slurry using a venturi pump. This grout has been found to adhere to steel casing, has low permeability, good swelling characteristics and flexibility, and is an excellent sealant (Ref. 2).

The surface casing will be installed as follows. The borehole will be drilled and sampled using the mud rotary technique. The surface casing, open at the bottom, will be installed into the mud-filled borehole. High solids bentonite grout will then be pumped into the casing using a tremie pipe to displace the drilling mud. Excess drilling mud will be collected at the ground surface and placed in steel drums for later characterization and disposal. The grout contained within the surface casing will then be pushed downward using a pump-

LHAAP Group 2 RI Phase 2 CDAP

Section: 5

Revision: 3

Date: December 1994

Page: 5 of 5

down plug, forced out of the casing bottom, and into the borehole annulus. The pump-down plug is pushed from the top of the casing to the bottom using the drill rods. As such, grout will be forced under pressure up the borehole annulus until it reaches the ground surface. As the grout is pushed downward in front of the pump-down plug, drilling mud will be forced out ahead of it. The drilling mud will be forced through the borehole annulus and return to the ground surface, where it will be collected in steel drums. The grout volume will be measured to confirm that the calculated grout volume was installed. After the grout has been installed, the surface casing will be pushed downward another two (2) ft to seat it into the lower permeability stratum.

LHAAP Group 2 RI Phase 2 CDAP
Section: 6
Revision: 3
Date: December 1994
Page: 1 of 3

SECTION 6.0

SAMPLE HANDLING AND TESTING

6.1 Sample Numbering System. Sample numbers are assigned by the project manager and are unique to each site. Sample numbers identify the site, well or boring, and type of blank or replicate. Sample numbers are assigned as follows:

LHss-xx-yy(zz-zz)-bb

where: LH = Longhorn

ss = Unit Site Number

xx = Sample Type, where:

PB = probe boring
WW = monitoring well
SD = sediment
SW = surface water
SB = soil borehole
SS = shallow soil

yy = Location Number

(zz-zz) = Depth Range, in feet below surface grade

bb = QA/QC Modifier, when needed, where:

QA = QA sample for COE lab
QC = QC field replicate for contract lab
TB = Travel or trip blank
EB = Equipment blank or rinsate

As an example, a QA split from the 5 to 7 foot interval of the first soil boring at Unit 12 would be LH12-SB-01(5-7)-QA. The modifications were made to the COE numbering system so that the "ss-xx-yy" portion of the number can be used as

LHAAP Group 2 RI Phase 2 CDAP
Section: 6
Revision: 3
Date: December 1994
Page: 2 of 3

location numbers for all sampling points in the text and the figures of the RI report. As an example, the third sediment sample location at Unit 29 would be labeled as 29-SD-03. This numbering scheme provides a number that not only gives the unit area and type of sample, but also provides a unique number from all other previous investigation sample numbers at LHAAP.

6.2 Preparing Samples. When samples are taken in the field, they are preserved according to Table B.1. They are then placed in the ice chest in styrofoam inserts which have cutouts to accommodate the jars. The ice chest is filled with 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 internal temperature of the ice chest is measured and recorded, the ice chest is wrapped with strapping, and a chain-of-custody seal is placed on the strapping. The samples are then delivered to the bus station or shipper. Samples collected for chemical analysis are shipped on the day they are sampled if possible, but in no event kept onsite longer than 48 hours. If samples are anticipated to arrive at SWD on Friday or the weekend, SWD Laboratory will be contacted prior to shipment to ensure they will have personnel available to receive the sample shipments. SWD's telephone number is (214) 905-9130. If the SWD lab will not have personnel available, samples will be held until delivery on Tuesday. Samples kept onsite will be stored in sealed coolers and will be chilled to 4°C.

LHAAP Group 2 RI Phase 2 CDAP

Section: 6

Revision: 3

Date: December 1994

Page: 3 of 3

6.3 Receiving Samples. After the ice chests are received at the laboratory, the samples are logged in, the COC is signed, and a cooler receipt form is filled out. This form documents the condition of the samples as received. The samples are checked for breakage or leakage and 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 COC and the District office is notified of the problem. Samples are repackaged and shipped to contract laboratories using similar procedures as described in Section 7.2.

6.4 Laboratory Procedures. Laboratory analytical procedures come from the following sources: U. S. Environmental Protection Agency (SW 846 and EPA-600, Refs. 7 and 4), and Standard Methods (Ref. 1). Analytical methods from these sources are given in Table B.2. Quantitation limits are given in Tables B.4 through B.8. Quantitation limits, however, are dependent on the concentration of the components in the matrix to be analyzed.

LHAAP Group 2 RI Phase 2 CDAP
Section: 7
Revision: 3
Date: December 1994
Page: 1 of 4

SECTION 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 and Samples in the Field. Each well will have a locking cap and keys will be given out only to those who need them. 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.

7.1.2 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.

LHAAP Group 2 RI Phase 2 CDAP
Section: 7
Revision: 3
Date: December 1994
Page: 2 of 4

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 of sampling, and the analyses, with method numbers included, required. The COC will also have the name and telephone number of the Tulsa District POC, Mr. Chris Kennedy, (918) 669-7072. 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. The individual preparing the samples for shipment maintains a copy. The original COC is incorporated into 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 SWD Lab 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 incorporated into the hard copy laboratory reports.

7.2.3 Bill of Lading. A bill of lading (bus bill or air bill) documents receipt of the samples by the carrier. It is not possible for the

LHAAP Group 2 RI Phase 2 CDAP
Section: 7
Revision: 3
Date: December 1994
Page: 3 of 4

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.

7.2.4 Cooler Receipt Form. The cooler receipt form is completed by the laboratory and documents the condition of the samples as received by the lab. This form is available in the hard copy 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 water 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.

LHAAP Group 2 RI Phase 2 CDAP

Section: 7

Revision: 3

Date: December 1994

Page: 4 of 4

7.3.2 Field Data Form. The field data form transmits necessary information about the sample to the lab. Field measurements such as pH, conductivity, and water levels as well as problems with the location or the sample are noted on this form. Field data forms are taken for all sampling events. Examples are shown in Appendix A.

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

LHAAP Group 2 RI Phase 2 CDAP
Section: 8
Revision: 3
Date: December 1994
Page: 1 of 5

SECTION 8.0

DATA REDUCTION, VALIDATION, AND REPORTING

8.1 Analytical Data.

8.1.1 Field Data. Field data reduction will be performed by the contractor or the COE. 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 District in the hard copy lab reports.

8.1.2 Laboratory Data. Laboratory data are reduced at the contract lab, which generates a laboratory report containing the analytical data, field and quality control duplicate data comparisons, and lab quality control data. Tulsa District performs a QA validation and generates a summary report, which is submitted to the project staff. Laboratory deliverables include the following:

- a. Results of field samples, laboratory blanks, surrogate spikes, surrogate recoveries, matrix spikes, laboratory control samples, laboratory duplicates, matrix spike duplicates, relative percent differences, field duplicates, and field blanks.

LHAAP Group 2 RI Phase 2 CDAP

Section: 8

Revision: 3

Date: December 1994

Page: 2 of 5

- b. Sample identification numbers will be cross-referenced with laboratory ID's and QC sample numbers. Table(s) which cross reference field samples with associated method blanks, matrix spikes and matrix spike duplicate samples.
- c. Legible copies of the fully executed chain-of-custody forms and cooler receipt forms on which the laboratory has documented the condition of the samples on arrival.
- d. Each analyte will be reported as an actual value or less than a specified quantitation limit. Actual sample results, sample quantitation limits, and practical quantitation limits will be reported in tabular format. Data qualifiers will be used to address sample/analytical anomalies associated with an analyte.
- e. Soil samples will be reported on a dry weight basis with moisture content. Dilution factors, extraction data, and analysis dates will also be reported.
- f. A data validation report which addresses the accuracy, precision, completeness, and representativeness of each analysis. This report will contain a table which indicates the sample field identification number, the date the sample was collected, and

LHAAP Group 2 RI Phase 2 CDAP
Section: 8
Revision: 3
Date: December 1994
Page: 3 of 5

will indicate what methods of analysis (biological/chemical/physical) were conducted at various laboratories. A discussion regarding the data quality goals and their achievement will be included. The report will also include the name, address, phone number, and point of contact of all laboratories involved with the analytical effort. The comparability section of the report will be added during the review process by the U.S. Army Corps of Engineers or their representatives.

- g. ASCII or DBASE format data files, submitted per the "Guidance for Submittal of Data of Electronic Media for the Tulsa District HTRW Project Database."

Calibration and internal standards information, raw data (which includes equipment/analyst worksheets/logbooks, mass spectra, GC/MS tuning calibrations, chromatographs, 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 groundwater

011776

LHAAP Group 2 RI Phase 2 CDAP
Section: 8
Revision: 3
Date: December 1994
Page: 4 of 5

models. Technical data will be reduced, validated, and reported by the project staff.

8.3 Data Validation Report. Data validation reports shall include an executive summary, an introduction which describes the number of samples tested by medium, QC samples, QA samples, the testing laboratories, and a table arranged by sample batch showing the field and laboratory I.D. numbers and parameters tested, with a code for each laboratory if more than one is used, a detailed discussion by type of compound (i.e. metals, volatiles, explosives), and a conclusion which summarizes problems and corrective action. The detailed discussion shall include the following (discussed in detail in Section 3.0 'Data Quality Objectives'):

1. Accuracy, including matrix spike recoveries, reagent spike recoveries, blank spike recoveries, laboratory control sample spike recoveries, and surrogate recoveries. The discussion will address the number and type of recoveries which were outside quality control limits.
2. Precision, including all spike duplicate recoveries. The discussion will address the number and type of recoveries which were outside quality control limits. The discussion will include RPDs and the number which were outside quality control limits. The discussion will include a comparison of the field sample(s) and its (their) quality control duplicate sample(s).

011777

LHAAP Group 2 RI Phase 2 CDAP

Section: 8

Revision: 3

Date: December 1994

Page: 5 of 5

3. Representativeness, including field and instrument blanks, holding times, condition of samples upon arrival at laboratory. Discussion will include impact of matrix spike interference(s) if present.

The report shall conclude whether or not the data is suitable for its intended purpose and meets the data quality objectives as specified in this CDAP.

8.4 Corps Data Validation Report. The Corps data validation report, which will address Comparability and contain the comparison of the field sample(s) and its (their) quality assurance duplicate sample(s), will also include a review of the contractor's report and a judgement as to the suitability of the data. This complete report shall constitute acceptance or rejection of the data.

011778

LHAAP Group 2 RI Phase 2 CDAP
Section: 9
Revision: 3
Date: December 1994
Page: 1 of 2

SECTION 9.0

AUDITS

Audits, which are QA procedures designed to meet the data quality objectives discussed in Section 4, are of two basic types as discussed below. Table 9.1 gives the audit elements for the Longhorn investigations.

9.1 Systems 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 Tulsa District, and system audits for laboratory work will be performed by the MRD Lab. These audits consist primarily of site inspections.

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 Lab, and laboratory QA procedures as specified by the analytical method.

LHAAP Group 2 RI Phase 2 CDAP
Section: 9
Revision: 3
Date: December 1994
Page: 2 of 2

TABLE 9-1 AUDIT ELEMENTS FOR LONGHORN INVESTIGATIONS

Element	By Frequency
laboratory site inspection	MRD Lab at laboratory selection and then every 18 months
field inspections	COE at least monthly at first less frequently thereafter
technical data inspections	COE as needed
laboratory check samples	MRD Lab at laboratory selection and then every 18 months
analysis of field replicates	SWD Lab every 10 samples
lab QA summary report	SWD Lab one for each lab report

LHAAP Group 2 RI Phase 2 CDAP
Section: 10
Revision: 3
Date: December 1994
Page: 1 of 2

SECTION 10.0

CORRECTIVE ACTION

10.1 Field Activities. Field activities which are improper will be corrected as quickly as possible. The inspector or crew chief 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 when-ever there is a possibility that the error might be repeated.

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:

- pH - Measurements should agree within 0.02 pH unit.
- Conductivity - Measurements should agree within two 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.

10.3 Laboratory. Laboratory corrective action is described in the analytical method for that analysis.

LHAAP Group 2 RI Phase 2 CDAP

Section: 10

Revision: 3

Date: December 1994

Page: 2 of 2

10.4 Implementing and Reporting. Corrective action should be initiated at the lowest level possible. Corrective action which involves correcting a mistake for little potential of repetition need not be reported as long as the error was not reported. For example, an erroneous water level measurement, such as 40 feet in a 30 foot well, would be corrected by making several additional readings which agreed with each other and looked reasonable. It would not be necessary to report this error. Corrective action involving a potentially repetitive error or one which had been reported should be documented in writing. For example, an erroneous water level measurement due to a low battery in the water level indicator, should be documented because previous suspect water levels may need to be flagged and/or checked. The corrective action report would state the nature of the problem and the potential ramifications as well as what actions have been taken. In this case, it would be to replace the battery and check the last several days of readings of the indicator. This report will be sent to the project manager.

LHAAP Group 2 RI Phase 2 CDAP

Section: 11

Revision: 3

Date: December 1994

Page: 1 of 1

SECTION 11

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011780

APPENDIX A

FORMS USED IN FIELD SAMPLING ACTIVITIES

011781

APPENDIX A

FORMS USED IN FIELD SAMPLING ACTIVITIES

011785

GROUNDWATER MONITORING WELL INSPECTION FORM
Longhorn Army Ammunition Plant

WELL NUMBER: _____

DATE: _____

TIME: _____

INSPECTED BY: _____

Directions: Indicate conditions with a yes, no, or n/a for non applicable. Explain conditions in comments section.

PHYSICAL CONDITION OF WELL

- | | |
|----------------------------------|-----------------------------|
| 1. _____ Outer Well Casing | 6. _____ Lock |
| 2. _____ Surface Pad | 7. _____ Grout inside well |
| 3. _____ Erosion around well pad | 8. _____ Grout outside well |
| 4. _____ Bumper Poles | 9. _____ Weephole |
| 5. _____ Locking Cap | 10. _____ Inside cap |

COMMENTS: _____

CONDITION OF AREA SURROUNDING WELL (10 ft. radius)

- | | |
|--|--|
| 1. _____ Vegetation | 6. _____ Indication of pesticide usage |
| 2. _____ Poison Ivy | 7. _____ Wasps, spiders, snakes, etc. |
| 3. _____ Fireants | |
| 4. _____ Debris | |
| 5. _____ Indication of herbicide usage | |

COMMENTS: _____

CONDITION OF DEDICATED PUMP OR BAILER

1. _____ Pump Removed?

If yes answer remaining questions.

_____ Corrosion visible?

_____ Tubing condition?

Describe pump condition. _____

011787

SverdrupGROUNDWATER SAMPLING
FIELD DATA FORM

PROJECT NAME:

DATE:

SAMPLING POINT:

TIME:

SAMPLED BY:

WEATHER:

TOP OF CASING ELEVATION: _____ FEET

DEPTH TO STATIC WATER LEVEL: _____ FEET

DEPTH TO WELL BOTTOM: _____ FEET

HEIGHT OF WATER COLUMN, H = _____ FEET

DIAMETER OF WELL CASING, D = _____ FEET

VOLUME OF WATER COLUMN, $\pi \times H \times \frac{D^2}{4} \times 7.48 =$ _____ GALLONS

VOLUME OF WATER EVACUATED: _____ GALLONS

DID WELL READILY RECOVER? _____ YES _____ NO

METHOD OF EVACUATION: _____

METHOD OF SAMPLING: _____

SAMPLE TEMPERATURE: _____ °C _____ °F

SAMPLE pH: _____

SAMPLE SPECIFIC CONDUCTANCE: _____ $\mu\text{mhos/cm}$

SAMPLE COLOR: _____

SAMPLE TURBIDITY: _____ HIGH

MODERATE

LOW

SAMPLE ODOR: _____

OTHER OBSERVATIONS: _____

ADDITIONAL COMMENTS ON METHODOLOGY, ETC.: _____

**LONGHORN AAP
RINSATE WATER SAMPLES
PARAMETER SHEET
FY - 92**

CONTAINERS		PARAMETERS	EPA METHOD	PRESERVATIVES
NO.	SIZE		NO./SHIP	

GLASS			(7)	
1	w/m jar	pH, Conductivity, & Temp. (4 sets)	*****	dispose
2	1 liter	Semi-Volatiles	8270	Brim full & 4°C
2	1 liter	Explosives	8330	Brim full & 4°C
2	1 liter	Herbicides, Pesticides & PCB's (2,4-D & 2,4,5-TP)	8150/8080	4°C
1	1 liter	Nitrate	353.1	4°C
PLASTIC			[1]	
1	1 liter	Total Metals (Ag, As, Ba, Cd, Cr, Hg, Ni, Pb, Sb, Se & Tl)	6010/7041/7060 7470/7740/7841	pH < 2 w/HNO ₃
VIALS			{3}	
3	40 ml vials	Volatile Organics	8240	4 drops HCl, n/a, n/b & 4°C

LH/RB/PAR/27JAN92

One rinsate sample should be taken for every (20) soil samples. The rinsate must be taken on the actual piece of equipment used to obtain the soil sample, (split spoon, auger, knife, etc.) and should have the same I.D. as the corresponding boring/depth number taken with that equipment.

DRILLING LOG		DIVISION		INSTALLATION		SHEET OF SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Address)				11. DEPTH FOR ELEVATION SHOWN (FEET or METERS)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing sheet 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			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE ☐ STARTED ☐ COMPLETED			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OF SAMPLE NO. f	REMARKS (Dwelling, town, name of town, depth of overburden, etc., if significant) g	

011789

ATTENTION OWNER: Confidentially Privacy Notice on Reverse Side		State of Texas WELL REPORT		Texas Water Well Drillers Board P.O. Box 13587 Austin, Texas 78711																																																																											
1) OWNER _____ (Name)		ADDRESS _____ (Street or RFD) (City) (State) (Zip)																																																																													
2) LOCATION OF WELL: County _____ miles in _____ direction from _____ (NE, SW, etc.) (Town)																																																																															
Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.																																																																															
☐ LEGAL DESCRIPTION: Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name _____ Distance and direction from two intersecting section or survey lines _____																																																																															
☐ SEE ATTACHED MAP																																																																															
3) TYPE OF WORK (Check): ☐ New Well ☐ Deepening ☐ Reconditioning ☐ Plugging		4) PROPOSED USE (Check): ☐ Domestic ☐ Industrial ☐ Monitor ☐ Public Supply ☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering		5) DRILLING METHOD (Check): ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored ☐ Air Rotary ☐ Cable Tool ☐ Other _____																																																																											
6) WELL LOG: Date Drilling: _____ Started _____ 19____ Completed _____ 19____		DIAMETER OF HOLE <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tr> <th>Dia. (in.)</th> <th>From (ft.)</th> <th>To (ft.)</th> </tr> <tr> <td></td> <td>Surface</td> <td></td> </tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>		Dia. (in.)	From (ft.)	To (ft.)		Surface											7) BOREHOLE COMPLETION: ☐ Open Hole ☐ Straight Wall ☐ Underreamed ☐ Gravel Packed ☐ Other _____ If Gravel Packed give interval ... from _____ ft. to _____ ft.																																																												
Dia. (in.)	From (ft.)	To (ft.)																																																																													
	Surface																																																																														
<table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tr> <th>From (ft.)</th> <th>To (ft.)</th> <th>Description and color of formation material</th> </tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </table>		From (ft.)	To (ft.)	Description and color of formation material																												8) CASING, BLANK PIPE, AND WELL SCREEN DATA: <table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tr> <th rowspan="2">Dia. (in.)</th> <th rowspan="2">New or Used</th> <th rowspan="2">Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial</th> <th colspan="2">Setting (ft.)</th> <th rowspan="2">Gage Casing Screen</th> </tr> <tr> <th>From</th> <th>To</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>				Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casing Screen	From	To																																				
From (ft.)	To (ft.)	Description and color of formation material																																																																													
Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casing Screen																																																																										
			From	To																																																																											
13) TYPE PUMP: ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder ☐ Other _____ Depth to pump bows, cylinder, jet, etc., _____ ft.		9) CEMENTING DATA [Rule 287.44(1)] Cemented from _____ ft. to _____ ft. No. of Sacks Used _____ _____ ft. to _____ ft. No. of Sacks Used _____ Method used _____ Cemented by _____																																																																													
14) WELL TESTS: Type Test ☐ Pump ☐ Baker ☐ Jetted ☐ Estimated Yield: _____ gpm with _____ ft. drawdown after _____ hrs.		10) SURFACE COMPLETION ☐ Specified Surface Slab Installed [Rule 287.44(2)(A)] ☐ Specified Steel Sleeve Installed [Rule 287.44(3)(A)] ☐ Pitless Adapter Used [Rule 287.44(3)(B)] ☐ Approved Alternative Procedure Used [Rule 287.71]																																																																													
15) WATER QUALITY: Did you knowingly penetrate any strata which contained undesirable constituents? ☐ Yes ☐ No If yes, submit "REPORT OF UNDESIRABLE WATER" Type of water? _____ Depth of strata _____ Was a chemical analysis made? ☐ Yes ☐ No		11) WATER LEVEL: Static level _____ ft. below land surface Date _____ Artesian flow _____ gpm. Date _____																																																																													
		12) PACKERS: Type Depth																																																																													
I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.																																																																															
COMPANY NAME _____ (Type or print)		WELL DRILLER'S LICENSE NO. _____																																																																													
ADDRESS _____ (Street or RFD)		(City) _____		(State) _____ (Zip) _____																																																																											
(Signed) _____ (Licensed Well Driller)		(Signed) _____ (Registered Driller Trainee)																																																																													
Please attach electric log, chemical analysis, and other pertinent information, if available.																																																																															
For TWC use only: Well No. _____ Located on map _____																																																																															

011792

EAGLE  PICHER ENVIRONMENTAL SERVICES 368 J. TUNNELL BLVD. - MIAMI, OK 74354 1-800-331-7425		Specially Cleaned Sample Container LOT #:
DATE:	TIME:	COLLECTED BY:
SAMPLING SITE:		
SAMPLE TYPE:		
☐ Grab ☐ Composite ☐ Other		
TESTS REQUIRED:		PRESERVATIVE

CUSTODY SEAL

Person Collecting Sample _____ Sample No. _____
 _____ (signature)
 Date Collected _____ Time Collected _____

CUSTODY SEALS

011793

APPENDIX B

TABLES

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

PARAMETER	SIZE AND TYPE OF CONTAINER	# OF CONTAINERS	ICE	METHOD OF PRESERVATION
pH	½ L, glass	4*	N	field test
conductivity	½ L, glass	4*	N	field test
temperature	½ L, glass	4*	N	field test
metals	1 liter, plastic	1	Y	nitric acid to pH <2
volatiles	40 ml, VOA vial	3	Y	HCl to pH <2, no head space or air bubbles
explosives	1 liter, amber glass	2**	Y	none
chloride and sulfate	1 liter, glass	1**	Y	none
nitrate-nitrite	1 liter, glass	1**	Y	sulfuric acid to pH<2
Total Hardness	500 ml, polyethylene	1	N	nitric acid to pH<2

* May see pH sample aliquot for this sample

** Where sufficient sample volume exists, add one additional container for this parameter.

TABLE B.2 MAXIMUM HOLDING TIMES AND ANALYTICAL METHODS IN SOIL AND WATER

ANALYTICAL METHOD PARAMETER	EXTRACTION	ANALYSIS	REFERENCE	METHOD #
Field tests				
pH	-	immediate		
conductivity	-	immediate		
temperature	-	immediate		
Metals				
antimony	-	6 months	SW-846 (1)	7041
arsenic	-	6 months	SW-846	7060
selenium	-	6 months	SW-846	7740
lead	-	6 months	SW-846	7421
mercury in water	-	28 days	SW-846	7470
mercury in soil	-	28 days	SW-846	7471
thallium	-	6 months	SW-846	7841
others	-	6 months	SW-846	6010
Volatiles	-	14 days	SW-846	8240
Explosives				
in water	7 days	40 days	SW-846	8330
in soil	14 days	40 days	SW-846	8330
Anions				
nitrate-nitrite	-	28 days	EPA-600 (2)	353.3
chloride	-	28 days	EPA-600 (2)	300.0
sulfate	-	28 days	EPA-600 (2)	300.0
Total Hardness	-	6 months	EPA-600	130.1/130.2

(1) SW-846 reference 6

(2) EPA-600 reference 4

TABLE B.3 METHODS FOR PHYSICAL TESTS

TEST	METHOD SOURCE
grain size	ASTM D421, D422, D1140
atterberg limits	ASTM D4318
moisture content	ASTM D2216

ASTM American Society of Testing and Materials.

TABLE B.4 QUANTITATION LIMITS FOR VOLATILE ANALYSES IN SOIL AND WATER
BY METHOD 8240

PARAMETER	WATER (ug/l)	LOW LEVEL SOIL/SEDIMENT (ug/kg)
chloromethane	10	10
bromomethane	10	10
vinyl chloride	10	10
chloromethane	10	10
methylene chloride	5	5
acetone	10	10
carbon disulfide	5	5
1,1-dichloroethane	5	5
1,1-dichloroethene	5	5
cis-1,2-dichloroethene	5	5
trans-1,2-dichloroethene	5	5
chloroform	5	5
1,2-dichloroethane	5	5
2-butanone (MEK)	10	10
1,1,1-trichloroethane	5	5
carbon tetrachloride	5	5
vinyl acetate	10	5
bromodichloromethane	5	5
1,2-dichloropropane	5	5
trichloroethene	5	5
dibromochloromethane	5	5
1,1,2-trichloroethane	5	5
benzene	5	5
trans-1,3-dichloropropene	5	5
4-methyl-2-pentanone	10	10
2-hexanone	10	10
tetrachloroethene	5	5
toluene	5	5
1,1,2,2-tetrachloroethane	5	5
chlorobenzene	5	5
ethylbenzene	5	5
styrene	5	5
xylenes (total)	5	5
acrolein	5	5
acrylonitrile	10	10
dibromomethane	5	5
dichlorodifluoromethane	5	5
1,4-dichloro-2-butene	10	10
ethyl methacrylate	5	5
1,2,3-trichloropropane	5	5
dichloromethane	5	5
iodomethane	10	10
trichlorofluoromethane	5	5

TABLE B.5 REQUIRED QUANTITATION LIMITS FOR EXPLOSIVES IN SOIL AND
WATER BY METHOD 8330*

PARAMETER	WATER ($\mu\text{g/l}$)	LOW-LEVEL SOIL/SEDIMENT ($\mu\text{g/g}$)
HMX	0.50	2.2
RDX	0.85	1.0
1,3,5-TNB	0.55	0.25
1,3-DNB	0.25	0.25
Tetryl	0.70	0.65
NB	0.80	0.26
2,4,6-TNT	0.55	0.25
4-Am-DNT	--	--
2-Am-DNT	--	--
2,6-DNT	0.45	0.26
2,4-DNT	0.55	0.25
2-NT	0.70	0.25
4-NT	0.50	0.25
3-NT	0.50	0.25

* Quantitation limits revised from those shown in Method 8330.

TABLE B.6

QUANTITATION LIMITS FOR OTHER ANALYSES IN SOIL AND WATER

PARAMETER	WATER (mg/l)	LOW-LEVEL SOIL/SEDIMENT (mg/kg)
METALS		
antimony	0.03	1.0
arsenic	0.01	1.0
barium	0.02	10.0
cadmium	0.005	1.0
chromium	0.01	1.0
lead	0.002	1.0
mercury	0.002	0.1
nickel	0.05	1.0
selenium	0.01	1.0
silver	0.07	1.0
thallium	0.01	1.0
COMMON ANIONS		
nitrate	0.1	0.1
chloride	2.0	1.0
sulfate	2.0	1.0

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 accompanied 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	

value_cas	The Chemical Abstract Services 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	

011802

TABLE/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

method	A code identifying the method 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	

011805

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 YYYYMMDD.	YYYYMMDD	
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	

lot_control	The batch designator of an 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	

TULSA DISTRICT DATA DICTIONARY
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
lrsequence	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	

011007

TULSA DISTRICT DATA DICTIONARY
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

011808

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.	YMMDD	
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

011809

surface_elevation	Elevation of ground surface 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

011810

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	

071811

TULSA DISTRICT DATA DICTIONARY
ERMA D BASE

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	

011812

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

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

011813

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

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	

011814

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

011815

TULSA DISTRICT DATA DICTIONARY
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	

011816

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

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

011817

TULSA DISTRICT DATA DICTIONARY
ERMA DATABASE

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 retrieved 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	

011818

011819

APPENDIX C

INVESTIGATION DERIVED WASTE MANAGEMENT PLAN

011820

LONGHORN ARMY AMMUNITION PLANT

RI/FS WORKPLAN

INVESTIGATION-DERIVED WASTE

MANAGEMENT PLAN

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

JUNE 1992

PREPARED FOR:

Longhorn Army Ammunition Plant
Karnack, Texas

TABLE OF CONTENTS

1. Introduction.	C-1
1.1. Purpose of Management Plan.	C-1
1.2. IDW Management Approach.	C-1
1.3. Facility Description Summary.	C-2
1.3.1. Climate.	C-2
1.3.2. Terrain.	C-2
1.3.3. Regional Groundwater.	C-2
1.4. Current Sites To Be Investigated.	C-3
1.5. Past investigations.	C-3
1.6. Site Descriptions.	C-8
1.6.1. (11) Suspected TNT Burial Site at Ave.'s P & Q.	C-8
1.6.2. (13) Suspected TNT Burial Site Between Old & Active Landfills/Acid Dump.	C-8
1.6.3. (14) Area 54 Burial Ground.	C-9
1.6.4. (16) Old Landfill.	C-9
1.6.5. (17) Burning Ground No. 2 /Flashing Area.	C-10
1.6.6. (18 & 24) Burning Ground No. 3 & Unlined Evaporations Pond/Rocket Motor Washout Lagoon.	C-11
1.6.7. (29) Former TNT Production Area.	C-12
1.6.8. (12) Active Landfill.	C-13
1.6.9. (32) Former TNT Disposal Plant.	C-14
1.6.10. (1) Inert Burning Grounds.	C-15
1.6.11. (xx) Ground Signal Test Area.	C-16
1.6.12. (27) South Test Area.	C-16
1.7. Investigation Summary.	C-17
1.8. Methods of Waste Quantity Minimization.	C-18
2. Waste Description.	C-21
2.1. Types and Estimated Quantities of IDW.	C-21
2.1.1. Drill Cuttings.	C-21
2.1.2. Purge and Development Water.	C-21
2.1.3. Decontamination Fluids.	C-21
2.1.4. Personnel Protective Equipment (PPE).	C-22
2.2. IDW Applicable of Relevant and Appropriate Requirements (ARARs).	C-22
2.3. Methods for Characterizing RCRA Hazardous/Non-hazardous IDW.	C-22
3. Area of Contamination Description.	C-23
3.1. AOC-A.	C-23
3.2. AOC-B. C-TOC-1	C-23

3.3.	AOC-C.	C-23
3.4.	AOC-D.	C-23
3.5.	AOC-E.	C-23
3.6.	AOC-F.	C-23
3.7.	AOC-G.	C-23
4.	Waste Management Plan (WMP).	C-37
4.1.	Drill Cuttings WMP.	C-37
4.1.1.	Containerization.	C-37
4.1.2.	Sampling.	C-37
4.1.3.	Storage.	C-38
4.1.4.	Disposal.	C-38
4.2.	Development, Purge, and Decontamination Water WMP.	C-39
4.2.1.	Containerization.	C-39
4.2.2.	Sampling.	C-40
4.2.3.	Storage.	C-40
4.2.4.	Disposal.	C-40
4.3.	Personnel Protective Equipment (PPE) and Disposable Equipment (DE)	
	WMP.	C-40
4.3.1.	Containerization.	C-40
4.3.2.	Sampling.	C-41
4.3.3.	Storage.	C-41
4.3.4.	Disposal.	C-41
4.5.	Documentation/Notification.	C-41
5.	References.	C-43

FIGURES

Figure C-1.	C-4
Figure C-2.	C-24
Figure C-3.	C-25
Figure C-4.	C-26
Figure C-5.	C-27
Figure C-6.	C-28
Figure C-7.	C-29
Figure C-8.	C-30
Figure C-9.	C-31
Figure C-10.	C-32
Figure C-11.	C-33
Figure C-12.	C-34
Figure C-13.	C-35
Figure C-14.	C-36

TABLES

Table C-1	C-5
Table C-2	C-19

1. Introduction. Longhorn Army Ammunitions Plant (LHAAP) was placed on the National Priority List (NPL) in August 1990. This document will serve as an Investigations-Derived Waste (IDW) management plan for the investigations to be performed per the Remedial Investigations/Feasibility Study (RI/FS) Workplan under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Twelve locations have been identified as having 13 sites within the installation.

1.1. Purpose of Management Plan. The purpose of this plan is to describe the anticipated approach and procedures for IDW management. During the investigations, waste will be generated that may contain hazardous substances as defined by CERCLA, be characteristically hazardous under the Resource Conservation and Recovery Act (RCRA), listed hazardous waste under RCRA, or industrial solid waste. The intent of the IDW management is to leave the site in no worse condition after the investigation than existed prior to the investigation and to comply with ARARS to the extent practicable. In accordance with the guidance this document will be written as a stand-alone plan but will only provide the briefest details other than those specific to waste management. Detailed information about facility, the sites, and the investigations is provided in the Volume 1 of the RI/FS Workplan.

1.2. IDW Management Approach. The approach will be to utilize the Area of Contamination (AOC) unit concept as outlined in the EPA guidance document, Superfund Management of Investigation-Derived Wastes During Site Inspections, May 1991, (Appendix C-1). The most important elements of the IDW management approach as listed in the above referenced guidance are as follows:"

- Leaving a site in no worse condition than existed prior to the investigations.
- Removing those waste that pose an immediate threat to human health or the environment.

- Leaving on-site wastes that do not require off-site disposal or extended above-ground containerization.
- Storing on site waste that is contaminated but is not hazardous for treatment during the remedial action.
- Complying with federal ARARs, to the extent practicable.
- Complying with state ARARs, to the extent practicable.
- Careful planning and coordination for IDW management.
- Minimizing the quantity of generated wastes."

1.3. Facility Description Summary. LHAAP is a US Army facility with restricted access. It is located in the northeast corner of Harrison County of east Texas. The facility consists of 8,493 acres located between State Highway and the western shore of Caddo Lake. It's primary mission is to load, assemble, and packout pyrotechnic and illuminating/signal ammunition and solid propellant rocket motors. The facility was established in 1942 and has a long history of producing high explosives (HE), pyrotechnic and illuminating ammunition by various contractors.

1.3.1. Climate. LHAAP is located in a moist, humid, mild climate and receives an average rainfall of 46 inches.

1.3.2. Terrain. It is situated on gently rolling land with an average slope of 3 percent. All surface water drains into Caddo Lake via four drainage systems across the facility.

1.3.3. Regional Groundwater. Groundwater is generally unconfined, it can vary in depth beneath land surface (BLS) from 1 to 20 feet and is approximately 120 to 130 feet thick.

Investigated. There are thirteen separate sites included in this investigation. The provided as Figure C-1. The LHAAP

the thirteen sites are:

1. Site at Avenues P & Q

2. Site between the Old and Active

and

3. Flashing Area

4. and Unlined Evaporation

5. Washout Lagoon (same site as LHAAP 18)

6. ion Area

7. Plant

8.

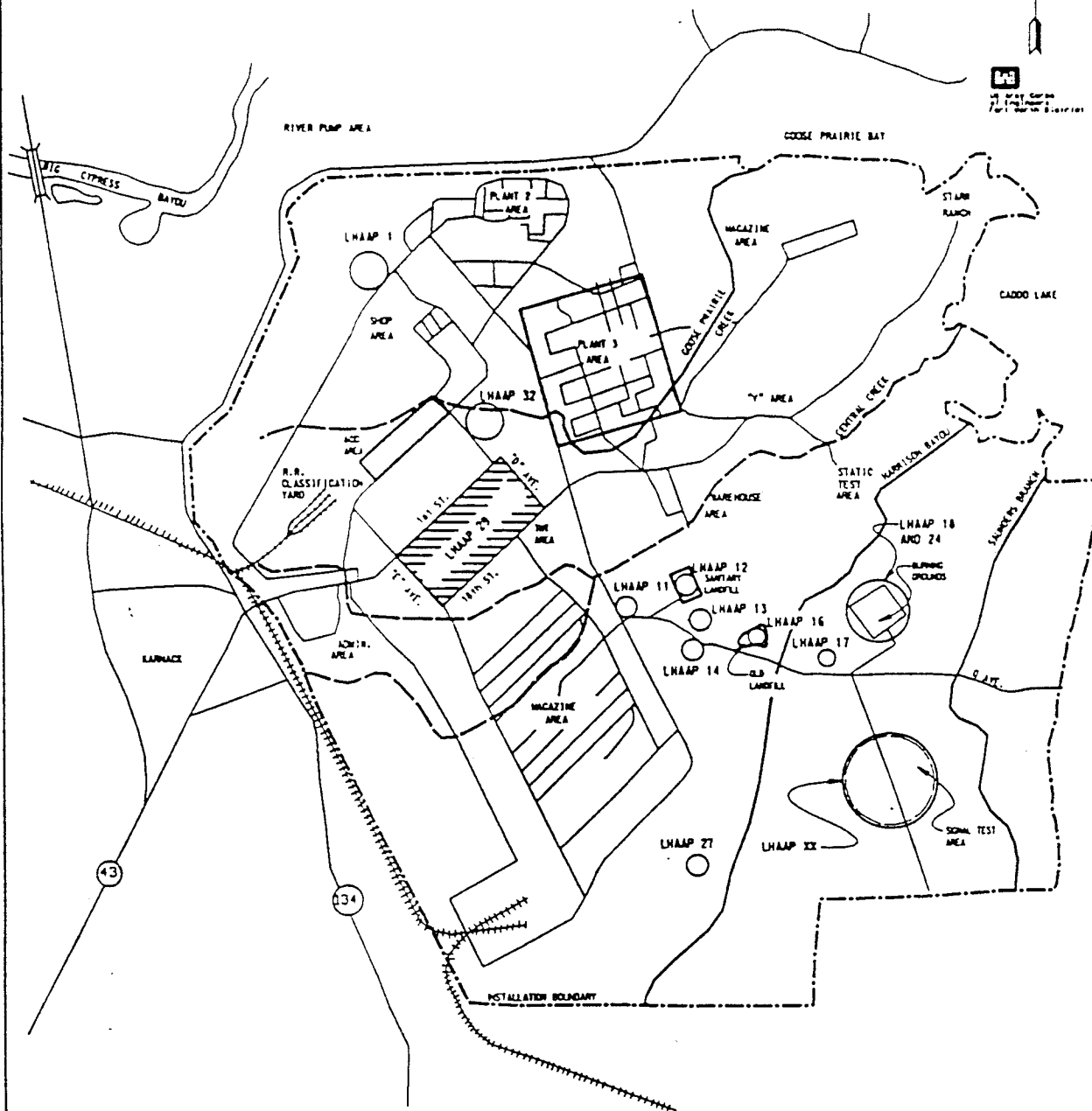
9. Area

The facility has been shown by past mapped surface soils, sediment, vadose zone water to varying degrees at the different sites. Figure C-1 provides a brief summary of the highest concentrations at the individual sites from past investigations.

011827



US Army Corps of Engineers
Fort Worth District
Karnack, Texas



4000 2000 C 4000 8000

SCALE IN FEET

CORPS OF ENGINEERS
FORT WORTH DISTRICT
LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

RI/FS WORK PLAN

LOCATION MAP FOR PROJECT AREAS

DATE: JUNE 1992

FIGURE C - 1

Table C-1
SITE PAST CONTAMINATION SUMMARY
LONGHORN RI IDW MANAGEMENT INFORMATION

LHAAP UNIT NO.	SITE NAME	SOIL CONTAMINATION TYPE (depth)	SOIL MAXIMUM CONC. (mg/Kg)	DEPTH TO GROUND WATER	GROUND WATER CONTAMINATION TYPE	GROUND WATER MAXIMU M CONC. (ug/l)
11	Suspected TNT Burial Site at Ave.'s P & Q	2,4,6,-TNT (2.5') 1,3,5-TNB (1.5')	1.86 117.0	3.0'	NO INFORMATION (NI)	NI
13	Suspected TNT Burial Site Between Old & Active Landfills/Acid Dump	(Suspected) 2,4,6,-TNT Acidic waste	NI	25.0'	NI	NI
14	Area 54 Burial Ground	Suspected Demolition Debris Explosives/Acidic waste	NI	24.0'	1,3,5-TNB (BH-12)	6.1
16	Old Landfill	1,3-DNB (sed./O17) 2,6-DNT (sed./O17) 2,4,6-TNT(sed./O17) 1,3,5-TNB(SS/Q-II) 2,4,6-TNT(SS/704T) 2,4-DNT (15'/Q-IV) 2,6-DNT (10'/Q-IV) TCE (15'/Q-I) DCE (10'/Q-I) VCI (10'/Q-I) 1,1-DCA (15'/Q-IV)	12.2 15.0 3.9 0.153 13.6 73.0* 173.0 1.0 1.9 2.1 2.6	8.5'	Strontium (SW-017) Sulphate (SW-017) 2,6-DNT (MW-122) VCI (MW-122) Cadmium (MW-122) Chromium(MW-122) Barium (MW-122) Nitrate (BH-12) Phosphates (BH-13) Sulphate (BH-13) Stronium (BH-16)	80.0 8,170.0 8.6 10.5 6.84 55.8 217.0 1213.0 3930.0 122,000.0 1,790.0
17	Burning Ground No. 2 /Flashing Area	1,3,5-TNB /SS 2,4,6-TNT /SS 1,3-DNB /SS MEC /SS TCE /SS 1,4-DCB /SS 1,3-DNB (5') 2,4,6-TNT (5') 1,3,5-TNB (5') 2,4-DNT (5') 2,6-DNT (5') MEC (5') TCE (5') 1,4-DCB (5')	.127 .153 .180 .26 .53* .21 .470 .040 .060 .14* .053 .13 .56* .86	5.0'	Phenol (sw-O16) Chromium (sw-O16) Nitrate (sw-O16) Sulphate (sw-O16) Chloride (sw-O16) MEC (mw130) Tetrahydrofuran (mw130) Chloride (BG-2) Strontium (BG-2) Chloroform (mw130)	14.0 34.5 940.0 10,500.0 4,000.0 153.0 46.0 2,348,000.0 1,116.0 16.0

Table C-1
SITE PAST CONTAMINATION SUMMARY
LONGHORN RI IDW MANAGEMENT INFORMATION

LHAAP UNIT NO.	SITE NAME	SOIL CONTAMINATION TYPE (depth)	SOIL MAXIMUM CONC. (mg/Kg)	DEPTH TO GROUND WATER	GROUND WATER CONTAMINATION TYPE	GROUND WATER MAXIMU M CONC. (ug/l)
18 & 24	Burning Ground No. 3 & Unlined Evaporations Pond/ Rocket Motor Washout Lagoon	Tetryl (8A-902, 14') TNT (8A-905, 8') MEC (8A-940, 10') TCE (8A-940, 4') 1,2-DCE (8A-902, 14') Toluene (8A-940, 4')	26.6 9.5 420.0 430.0* 153.3 34.0	22'	MEC (120) Acetone 1,2-DCE 1,2-DCA TCE (120) PCA Barium (MW-2) Chloride (MW-2) TOX (MW-2) Nitrates (123)	17,000,000.0 810.0 120.0 52.0 1,400,000.* 17,000.0 3,600.0 890,000.0 3,644,000.0 6,300.0
29	Former TNT Production Area	2,4,6-TNT (sediment) 1,3-DNB (SS) 2,4,6-TNT (SS) 1,3,5-TNB (SS) 2,4-DNT (SS) 2,6-DNT (SS) 1,3-DNB (1'-3.5') 2,4,6-TNT (2.5') 1,3,5-TNB (3.5') 2,4-DNT (1.5') 2,6-DNT (1-3.5')	0.78 0.52 7645.68 64.65 16.8* <0.61 <.01 .73 0.63 0.093 <.01	20'	2,4,6-TNT (SW) 2,4-DNT (SW) 2,6-DNT (SW) 1,3,5-TNB (MW-114 & 118) (All other groundwater samples below detection limit.)	206.9 23.4 13.6 1.4
12	Active Landfill	Sediment samples taken in 1991 investigations - no results over detection limits for explosives, VOC, and SVO.		12'-19'	1,3-DNB (BH-18) Aluminum (MW-103) Manganese (BH-17) Strontium BH-19) Chloride (BH-19) Sulphate (BH-18) Nitrate (BH-17) MEC (BH-17)	2.25 361.0 1,990.0 1,160.0 2,725,000.0 285,000.0 1,120.0 48.0
32	Former TNT Disposal Plant	Soil samples taken indicate no results over detection limits for explosives.		10'	2,4,6-TNT (SW)	7.6

Table C-1
SITE PAST CONTAMINATION SUMMARY
LONGHORN RI IDW MANAGEMENT INFORMATION

LHAAP UNIT NO.	SITE NAME	SOIL CONTAMINATION TYPE (depth)	SOIL MAXIMUM CONC. (mg/Kg)	DEPTH TO GROUND WATER	GROUND WATER CONTAMINATION TYPE	GROUND WATER MAXIMU M CONC. (ug/l)
1	Inert Burning Grounds	Soil samples taken indicate no results over detection limits for explosives and anions. No high samples were reported for metals. Nitrate (103) Sulphate (103)	 8.33 40.48	5'	1,3,5-TNB (104) Nitrobenzene (104) Strontium (104) Chloride (104) Nitrate (104) Sulphate (104) No VOC's or SVO detected.	9.74 1.82 96.0 8,000.0 3,500.0 5,710.0
xx	Ground Signal Test Area	Soil samples taken indicate no results over detection limits for explosives and anions. No high results were reported for metals. Aluminum (0102)	 1,435.0	10'-15'	Manganese (127) Strontium (104) Chloride (104) Sulphate (104) No Explosives, VOC's or SVO detected.	1,860.0 4,120.0 1,000,000.0 1,622,000.0
27	South Test Area	2,4,6-TNT (0401)	10.15	4'	Aluminum (MW-132) Manganese (MW-132) Strontium (MW-132) Chloride (MW-131) Sulphate (MW-132)	232.0 1,448.0 2,640.0 50,000.0 387,000.0

DCA = dichloroethane
DCB = dichlorobenzene
DCE = dichloroethene
DNB = dinitrobenzene
DNT = dinitrotoluene
MEC = methylene chloride
PCA = tetrachlorethane
TCE = trichloroethylene
TNB = trinitrobenzene
TNT = trinitrotoluene

VCl = vinyl chloride
VOC = volatile organic carbons
SVO = semivolatile organic carbon
TOX = total organic halides
MW = monitoring well
SB = soil boring
NI = no information available
* = concentration greater then the TCLP regulatory limits

1.6. Site Descriptions.

1.6.1. (11) Suspected TNT Burial Site at Ave.'s P & Q. This site consists of a cleared, grassy area at the intersection of two roads. The site was reported by USATHAMA as a possible burial site used to dispose of TNT in the 1940's. A borrow pit was later created in the central part to the wooded area north of the site, leaving a depression approximately 5 feet deep. This depression is apparent in aerial photographs taken in 1963, is inactive at present, and is not a candidate for the investigation. There is no operational activity presently scheduled at the suspected burial site.

The explosive compounds 2,4,6-TNT and 1,3,5-TNB have been found in soils at this site down to at least 5-foot depths, the maximum depth sampled. Maximum concentrations were 1.86 ug/g of TNT and 117 ug/kg of TNB.

1.6.2. (13) Suspected TNT Burial Site Between Old & Active Landfills/Acid Dump. This site is located in a clearing in a heavily wooded area immediately south of a power line easement. Based on conversations with employees at LHAAP, there was a suspected one-time disposal of TNT and/or acid at this site. No other known or suspected disposals have occurred.

The site contains a number of bare patches that support little or no vegetation. The patches vary in size from 1 to 10 feet in diameter. The three larger bare patches stand out very well in the surrounding grass which is 1 to 2 feet tall. Based on the presence of the bare patches it appears reasonable to suspect something may have been disposed of at these locations which is preventing the native grasses from re-establishing themselves.

The site has not been previously investigated. Based on the statements of plant employees and the continued presence of bare spots at the site, it is reasonable to investigate the site for possible soil and groundwater contamination due to the suspected burial of explosives and associated wastes, or the possible dumping of pesticides, herbicides, or acids.

1.6.3. (14) Area 54 Burial Ground. This site is approximately 150 feet in size and contains a small 25 by 30 foot asphalt parking lot. It was reportedly used during the 1940's and early 1950's for the disposal of demolition debris, explosives, and acids. The parking lot may cap the burial pit.

The site has not been previously investigated. Based on the statements of plant employees and the presence of contaminants which have been found near the site, possible soil and groundwater contamination will be investigated for explosives, demolition debris, and acids.

1.6.4. (16) Old Landfill. This site is defined as an open area bounded along the western and northern edges by a gravel road and along the eastern and southern edges by a wooded area. A large rectangular paved area that is designated as the Retail Sales Area for LHAAP is located on the western edge of the site. In the past, equipment auctions were held at this location. A tributary of Harrison Bayou runs closely along the eastern edge of the site.

The Old Landfill area was used for the disposal of inert materials and mission related hazardous wastes. The area was used to dispose of TNT redwater ash material from 1942 to 1944. In the mid to late 1950's, three rocket motor casings were burned and possibly buried on the eastern side of this landfill. A large bermed depression, once located near the center of the Old Landfill, served as an all-purpose junkyard for the disposal of such materials as substandard TNT, barrels of chemicals, oil, paint, scrap iron and wood. This area was filled in and the pond no longer exists. The landfill operation started at original ground level at the north-south mid-line of the site and ended 15 feet above original grade at the eastern edge of the site. Currently, all inert solid wastes are disposed of in the Active Landfill located elsewhere on the installation. The Old Landfill site is now used for the deposition of inert rubble only.

Soil contamination due to explosives has been verified at the site to depths of at least 15 feet. Sediments in the adjacent tributary to Harrison

Bayou also are contaminated with explosive compounds. No explosives have been detected in groundwater downgradient of the site, and none have been found in surface waters. The only contaminant exceeding TDH drinking water standards identified in the groundwater downgradient of the landfill is cadmium. Major contaminants and their maximum concentrations are presented in Table C-1. Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1, February 1992.

1.6.5. (17) Burning Ground No. 2 /Flashing Area. This site is situated within a heavily wooded section of LHAAP. It consists of two 185 by 305 foot cleared areas separated by a gravel entrance road. The east area of the entrance road was once fenced, and the area west of the road is open. Harrison Bayou flows approximately 1200 feet northwest of the site.

Burning Ground No. 2 was used for burning bulk TNT, photo flash powder, and reject material when LHAAP was operated by Universal Match Corporation. Although it has been reported that bulk TNT was uncovered at the site in 1954, there is no documentation to support bulk TNT burial at the site. In 1959, all of the materials removed from the TNT Production Area (LHAAP 29) during razing were burned or flashed at this site. A 1958 aerial photograph shows a possible man-made pond on the western side of the road entering the site. This depression does not appear in 1954 or 1963 photos. There are no records of the pond's existence or the nature of its use over this 9 year period other than the 1958 photo. It is suspected that this was a burn pit or trenching operation. The site was used until 1980 as a flashing area to decontaminate recoverable metal by products. Burning trenches were located around the inside perimeter of the fenced area. As each trench filled with ash, the trench was covered and a new trench was dug. The waste residues were reportedly removed in 1984 and the site was allowed to revegetate. The site is presently inactive.

Soils at the location of the suspected pond have been identified as being contaminated with explosives, metals, and trace amounts of volatile organic compounds to a depth of at least 5 feet, the maximum sampling depth. Although a

monitoring well exists downgradient of the previously fenced flashing area, it is inconclusive whether groundwater has been impacted. It is possible that explosive residues and other contaminants may be present in the surface soils of old burn trenches that have not been investigated. Some of the significant contaminant maximum concentrations found at the site are presented in Table C-1. Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1, February 1992

1.6.6. (18 & 24) Burning Ground No. 3 & Unlined Evaporations

Pond/Rocket Motor Washout Lagoon. Burning Ground No. 3 is a fenced 34.5 acre secured area currently used for the disposal of explosives and explosive-contaminated wastes through open burning. It is a cleared area within a heavily wooded section of LHAAP. The UEP, now closed and capped, is located in the northern corner of Burning Ground No. 3. Harrison Bayou flows within 1,000 feet of the western edge and within 500 feet of the northern edge of the burning grounds site.

Burning Ground No. 3 has been in operation since 1955. The area has been used for the treatment, storage, and disposal of solid and liquid explosive, pyrotechnic, and combustible solvent wastes by open burning, incineration, evaporation, and burial. Historical waste management units include open burning pits, an unlined evaporation pond (UEP), stockpiles of solvent soaked sawdust, and suspected waste burial pits. The UEP was constructed at the burning grounds in 1963 as a holding pond to store explosive wastes resulting from the washout of rocket motor casings, which was performed at the northern corner of the pond. In 1973, the pond also began receiving wash water containing solvent residues and solids collected from LHAAP operations involving pyrotechnic material preparation and mixing. Sawdust soaked with methylene chloride and other solvents that were used to clean and scour mixers used for mixing illuminants were stockpiled along the southern berm of the pond as well as burned in trenches in the western portion of the burning ground. An air curtain destructor (ACD) was built in 1979 in the western corner of the burning grounds

for the purpose of disposing of explosive and explosive-contaminated wastes by burning. Use of burn pits and trenches was reportedly discontinued in 1984. Use of the UEP was discontinued in 1984 when it was discovered that the pond was contaminating groundwater beneath the site. The UEP was closed as a RCRA interim status surface impoundment in 1986 by removing all waste and capping the impoundment. As part of the INF Treaty activities being conducted at LHAAP, a burn cage was added in 1989 for the open burning of Pershing II missile motors. Current operations include disposal of explosive and explosive-contaminated wastes by burning in the ACD, three open burning cages, and two open burning pans, as well as a burn cage for Pershing II motor elimination.

A summary of the major contaminants detected in groundwater and their maximum concentrations is provided in Table C-1. Contaminants found in shallow soils include tetryl (26.6 ug/g), TNT (5.7 ug/g), and reportedly high concentrations of unspecified volatile compounds.

Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1, February 1992.

1.6.7. (29) Former TNT Production Area. The Former TNT Production Area is an 85-acre site located in the west central portion of LHAAP. With the exception of the former Bulk Toluene Storage Area, the site is bounded by Avenue E on the southwest, 1st Street on the northwest, 18th Street on the southeast and Avenue D on the northeast. The Former Bulk Toluene Storage Area, once a part of the TNT production area, is a 500 by 500 foot area located across Avenue D from the production area. It is a wooded area bounded by 33rd Street on the north and Avenue D on the west.

The Former TNT Production Area operated from April 1943 until August 1945 as a six line plant with a supporting acid plant which produced over 180 million kg of TNT. All six production lines, lines A through F, operated throughout this period with line F used as a reserve line for production when other lines were inactive. Redwater from the wash houses associated with each of these lines flowed via underground wood stave pipelines to a pumphouse located on the

northern end of the site adjacent to 16th Street, and then on to the TNT Waste Disposal Plant. Cooling water (blue water) drain lines from the former production lines flow to the northeast and empty into an open ditch alongside 16th Street approximately 550 feet from Avenue D. A toluene bulk storage facility, servicing the TNT production operation, was located across Avenue D from the production area. The TNT production plant was not operated after World War II and was razed, except for foundations, in 1959. There are presently no industrial activities conducted in these two areas.

The site contains high levels of TNT in the surface soil. Explosives were also found in sediments and surface water drainage from the production area site. The abandoned Bulk Toluene Storage Area has not been investigated. Explosives have been identified in soils down to at least 42 inches at random locations across the production area site. Pieces of crystallized DNT have been found in the abandoned cooling water drain line and where the line discharges into an open ditch. Two locations have been identified where sediments are contaminated with 2,4,6-TNT. One of these locations also had surface water contaminated with low levels of various explosive compounds. Groundwater has apparently not been impacted by soil contamination at the production area site. It is not known if contamination from the bulk storage of toluene at the storage area exists. Major contaminants and their maximum concentrations are provided in Table C-1.

Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1, February, 1992.

1.6.8. (12) Active Landfill. The Active Landfill is located in the central portion of LHAAP. The center of the site is about 1,700 feet east-northeast of the intersection of Avenue P and Avenue Q. The entrance to the site's graveled access road is on Avenue Q about 0.2 mile east of Avenue P.

Aerial photography taken in 1954 reveals the construction of a diversion ditch between Central Creek and one of its principal tributaries which collects surface runoff from the southern part of the Magazine Area. The apparent

purpose of the ditch was to divert flow in the area where a railroad crossed the tributary system, eliminating the need for a bridge. The diversion ditch remained functional until 1963 when aerial photography shows waste material disposed in the ditch system. 1970 photographs show that enough waste material had been disposed to block the flow of the system, but the site appeared to be inactive. Sometime between 1970 and 1978, the site was reactivated for waste disposal. By 1978 the entire ditch system had been filled with waste material and an adjacent undisturbed hillside had also been used for disposal. Since 1978, the site has been in continuous use for disposal of industrial solid wastes generated at LHAAP. An area southeast of the original ditch system has been cleared and is now used for the disposal of non-hazardous combustible and non-combustible wastes. The types of waste disposed of at this site since 1963 are largely unknown. It is possible that the Active Landfill site has been used for the disposal of similar wastes which were disposed of at the Old Landfill which include substandard TNT, barrels of chemicals, oils, paints, scrap iron, and wood.

The site contains elevated concentrations of metals in the soil and groundwater along with trace amounts of 1,3-DNB at one monitoring well location and volatile organics at three locations. Major contaminants and their maximum Reference: LHAAP RI/FS Workplan, Volume 1, February 1992.

1.6.9. (32) Former TNT Disposal Plant. The site is situated in the west central portion of LHAAP and is located approximately 400 feet northwest of Avenue C and 600 feet southeast of 6th Street.

The Former TNT Waste Disposal Plant was constructed in 1942 to treat and dispose of wastewaters generated at the nearby Former TNT Production Area (LHAAP 29). The disposal plant was operated by Monsanto Chemical Co. from April 1943 until August 1945 and disposed of wastewaters resulting from the production of over 397 million pounds of 2,4,6-TNT. The plant was not operated after August 1945. In 1959, most of the buildings and tanks used in the disposal process were removed, leaving only the concrete foundations, access roads, underground

utilities, and constructed surface water drainage. The disposal process involved neutralization and storage of the waste until it could be burned by incineration.

Explosive compounds were not detected at the site with the exception of 7.6 ug/l of 2,4,6-TNT found in surface water adjacent to the former Neutralized Wastes Storage Tank. Concentrations of aluminum, chromium, lead, manganese, and nickel are also present in surface water above local background levels. Major contaminants and their maximum concentrations are provided in Table C-1.

Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1, February 1992.

1.6.10. (1) Inert Burning Grounds. This site is situated in the extreme northwestern portion of LHAAP. The center of the site is at least 2,000 feet from the LHAAP boundary and approximately 400 feet west of the intersection of Avenue P and 32nd Street.

The Inert Burning Grounds was 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 1950's until most burning operations were transferred to the Burning Ground No. 2/Flash Area (LHAAP 17). Intermittent, small-scale burning may have continued into the early 1960s. 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.

Previous investigations indicate elevated levels of metals in the soil and groundwater. Explosives nitrobenzene and 1,3,5-TNB exceed background levels in the groundwater at concentrations of 1.82 and 9.74 ug/l respectively. Major contaminants and their maximum concentrations are provided in Table C-1.

Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1,

February 1992.

1.6.11. (xx) Ground Signal Test Area. This site is located in the southeastern portion of LHAAP. 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 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 Pershing missile rocket motors 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 1963 the site was used intermittently for testing and burn-out of rocket motors from Nike-Hercules, Pershing, and Sargent missiles. In 1970 a rocket motor was inadvertently destroyed when it exploded in the center of the site. Debris from the explosion was placed in the crater and backfilled.

Previous investigations indicate elevated levels of metals in the soil and groundwater. No detectable levels of explosives or organics were found at the site. Major contaminants and their maximum concentrations are provided in Table C-1.

Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1,
February 1992.

1.6.12. (27) South Test Area. This site is located in the south central portion of LHAAP. The earthen test pad is approximately 2,000 feet southeast of Avenue P and the Magazine Area. A deteriorated asphalt and gravel road runs from the entrance to the Test Pad. The concrete bunkers and Observation Building 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 is now overgrown with brush and small trees.

The South Test Area was constructed in 1954 and was used by Universal Match Corporation for testing photo flash bombs that they produced at LHAAP until about 1956. The bombs were tested by exploding them in the air over an elevated, semi-elliptical earthen Test Pad with the floodplain of Harrison Bayou. During the late 1950s, illuminating devices were demilitarized within pits excavated in the vicinity of the Test Pad. During the early 1960s, leaking 3 to 4 pound canisters of white phosphorus were possibly demilitarized in the vicinity of the Test Pad. In the early 1980s photo flash cartridges were demilitarized in an area just east of the Observation Building.

Aerial photographs taken in 1954 when the area was under construction indicate an area of apparent vegetation distress. This area may have been used for toxic waste disposal during early stages in construction. The vegetation distress has persisted for over 37 years.

Previous investigations indicate elevated levels of metals in the soil along with low levels of 2,4,6-TNT. Elevated levels of metals are also present in the groundwater along with trace amounts of semivolatile organic compounds. Major contaminants and their maximum concentrations are provided in Table C-1. Reference: Longhorn Army Ammunition Plant RI/FS Workplan, Volume 1, February 1992.

1.7. Investigation Summary. This IDW Management Plan pertains to the following investigations:

- Soil sampling from bore holes at 76 locations
- Soil sampling from monitoring well bore holes at 21 locations
- Groundwater sampling from the 68 soil borings
- Groundwater sampling from the 21 new wells and the 56 existing monitoring wells for a total of 77 samples
- Surface water sampling from 63 locations

- Sediment sampling from 63 locations
- Shallow soil/waste sampling from 18 locations

Detailed information about the investigations is provided in Volume 1 and Volume 2, Chemical Data Acquisition Plan (CDAP38) of which this plan is an Appendix. Information about the investigations on an individual site basis is provided in Table C-2.

1.8. Methods of Waste Quantity Minimization. There are many ways in which waste generation will be kept to a minimum. During the investigations personnel are directed to:

- Avoid walking through areas of obvious or known contamination
- Avoid handling or touching materials directly
- Take care to limit the amount of contamination that comes in contact with equipment
- If contaminated tools are to be placed on non-contaminated equipment for transport use plastic to keep non-contaminated surfaces clean to limit decontamination waste

TABLE C-2
INVESTIGATION DERIVED WASTE SUMMARY
LONGHORN ARMY AMMUNITION PLANT
GROUP 2 SITES
PHASE 2 REMEDIAL INVESTIGATION

PHASE 2 REMEDIAL INVESTIGATION

LHAAP Unit No.	Site Name	Summary of Investigations										Estimated Waste Quantities (Drums)			
		Monitoring Wells/ Piezometers (depth)	Soil Borings (depth)	Geoprobe Borings (depth)	Abandoned Wells (depth)	Chemical Samples			Physical Samples		Soil Cuttings	Decon Water	Purge Water	PPE & Disp. Equipment	
						Sediment	Soil	Surface Water	Groundwater	Soil Borings					
12	Active Landfill	3 (30') 1 (150') 2 (20')	1 (200')	18 (25')	5 (30')	11	0	11	13 (Well) 18 (Geoprobe)	90	140	30	115	5	
16	Old Landfill	3 (20') 1 (150')	1 (200')	15 (15')	0	15	0	15	16 (Well) 15 (Geoprobe)	71	100	25	130	5	
17	Burning Ground No. 2/ Flashing Area	3 (20') 1 (150')	1 (200')	16 (15')	0	6	20	6	6 (Well) 16 (Geoprobe)	72	100	25	80	5	
18/24	Burning Ground No. 3/ Unlined Evaporation Pond	8 (20') 6 (60') 5 (150')	5 (200')	30 (15')	0	18	25	18	19 (Well) 30 (Geoprobe)	362	520	95	365	20	
29	Former TNT Production Area	6 (40') 2 (150')	2 (200')	39 (20')	0	3	48	3	11 (Well) 39 (Geoprobe)	199	220	55	150	10	
32	Former TNT Waste Disposal Area	0	0	0	0	9	0	9	0	0	0	5	0	0	
TOTALS		41	10	108	5	62	93	62	183	794	1080	125	420	45	

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2. Waste Description.

2.1. Types and Estimated Quantities of IDW. Table C-2 provides a listing of the estimated waste quantities for each site and the sections below provide a description and total amount for each type.

2.1.1. Drill Cuttings. The drill cutting will consists of soil removed from borings and monitoring well installations. All of the bore holes will be drilled at least 2 feet into the saturated groundwater zone. To prevent spread of contamination the bore holes will be grouted after soil and bore hole water sampling. All borings and monitoring wells will be drilled in the AOC's with the exception of the background investigations that by nature is not expected to be contaminated. No borings or monitoring wells are planned for outside the facility. A total of 30.44 cubic yards of drill cuttings are expected to be generated.

2.1.2. Purge and Development Water. The new monitoring wells will be purged of at least 5 volumes of water during development and an additional five volumes of water prior to sampling new and existing monitoring wells as described in the CDAP, section 4.5. The soil borings will not be purged for water sampling. This water will be taken directly from the saturated groundwater zone. A total of 40,120 gallons of purge and development water is expected to be generated.

2.1.3. Decontamination Fluids. The drilling equipment will be decontaminated between each hole as described on page 23 of the CDAP.

Purging equipment will be scrubbed and rinsed with Type II reagent grade water each it is used.

Sampling equipment will be washed with a non-phosphate detergent, tap water, distilled water, and hexane, in that order, allowed to air dry, and sealed back in clean containers prior to use.

Personnel decontamination will be minimal with the use of disposable suits, gloves, and boot covers. A boot wash will be utilized, if chemically resistant boots (rather than covers) are used. If PPE Level C or higher is implemented additional decontamination washes will be utilized.

A total of 6,493 gallons of purge and development water is expected to be generated.

2.1.4. Personnel Protective Equipment (PPE). A modified Level D PPE will initially apply for all intrusive investigations. This is described in detail in the Site Safety and Health Plan in Volume III of this workplan. Disposable items will include the following items:

- Tyvek full body coveralls
- Chemically resistant surgical type gloves (inner)
- Cotton work gloves (outer)
- Chemical resistant boot covers
- Respiratory dual cartridge filters for air purifying and a combination organic vapor/HEPA filter (respirators will be added if needed based upon the air monitoring action levels)

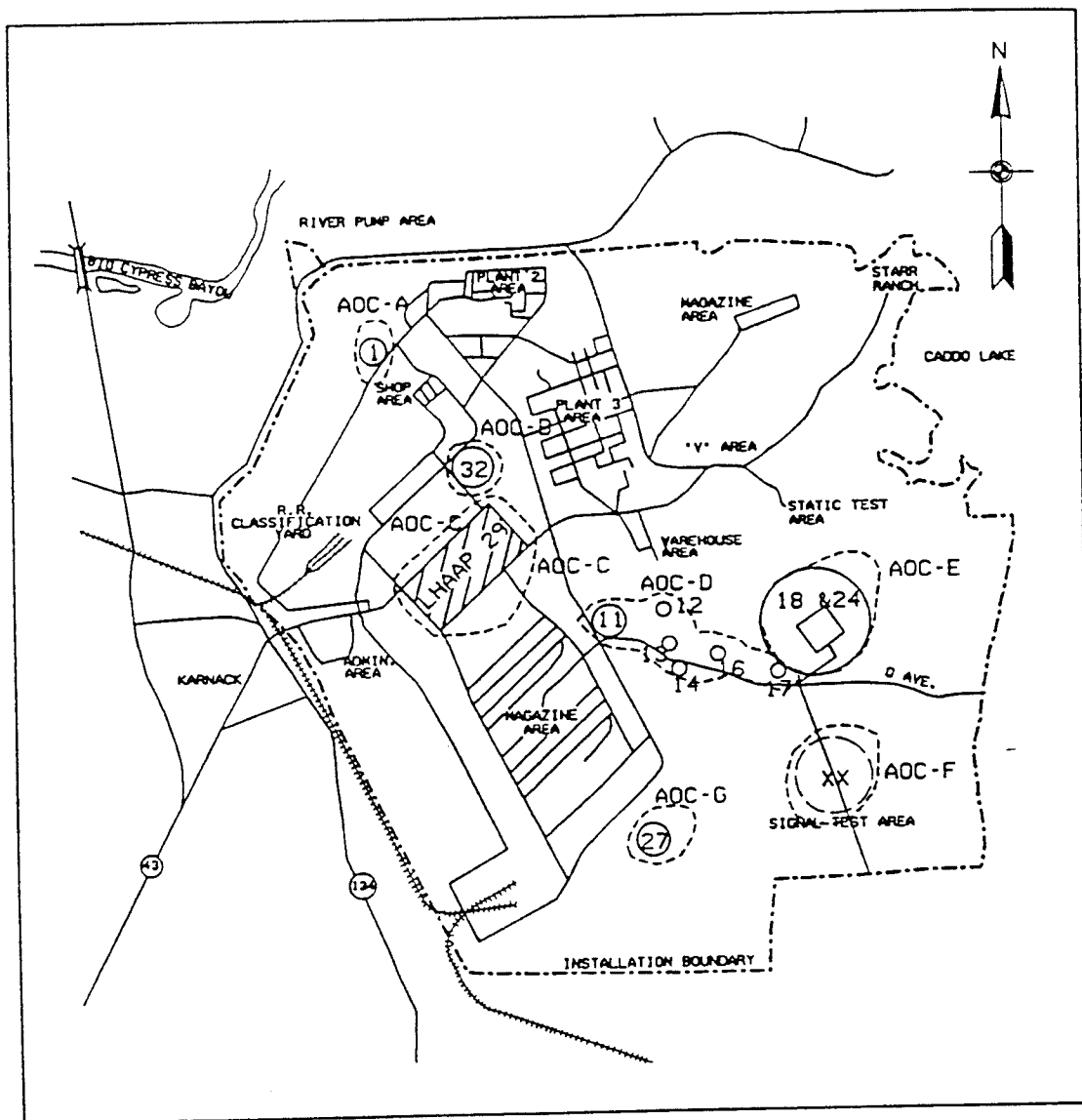
A total of 446 20 gallon plastic bags are expected to be generated.

2.2. IDW Applicable of Relevant and Appropriate Requirements (ARARs). A comprehensive list of ARARs is presented in Section 7 of the Workplan.

2.3. Methods for Characterizing RCRA Hazardous/Non-hazardous IDW. The primary method for characterizing the IDW has been review of historical use of the sites and past investigation results. For LHAAP 13 that has no past investigation the assumption was made that the waste would be similar to LHAAP 11 and 14. Past experience and professional judgement was also utilized. All liquid waste will be tested for TCLP parameters to determine if it is characteristically hazardous.

3. Area of Contamination Description. The Area of Contamination (AOC) Unit is a boundary to the waste unit and the surrounding contamination present in the soil, groundwater, sediment, and surface water. This provides a conceptual area in which investigations activities, storage and storage of IDW will not degrade the site so as to increase the hazard to human health and the environment. This provides a mechanism for practical and efficient investigation without negative impact to the environment. Figure C-2 shows the entire facility with the site locations and the seven AOC's.

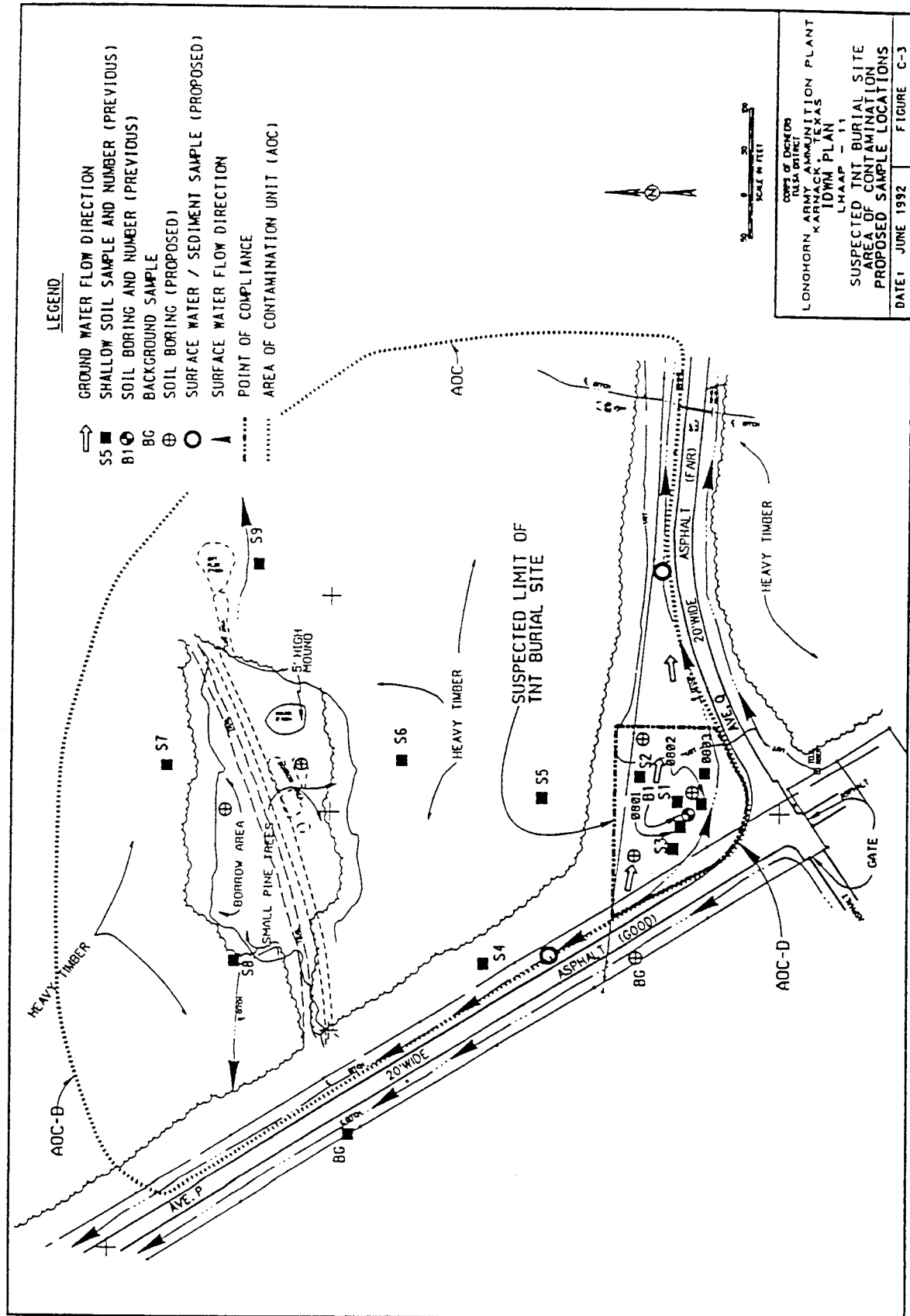
- 3.1. AOC-A. Figure C-3 shows the AOC-A with the LHAAP 1 investigations.
- 3.2. AOC-B. Figure C-4 shows the AOC-B with the LHAAP 32 investigations.
- 3.3. AOC-C. Figure C-5 shows the AOC-C with the LHAAP 29 investigations.
- 3.4. AOC-D. Because LHAAP 11, 12, 13, 14, 16, and 17 are so physically close together and extent of spread of contamination is unknown, these 6 sites were included in one AOC unit. Figure C-6 shows the AOC-D with the LHAAP 11 investigations. Figure C-7 shows the AOC-D with the LHAAP 12 investigations. Figure C-8 shows the AOC-D with the LHAAP 13 investigations. Figure C-9 shows the AOC-D with the LHAAP 14 investigations. Figure C-10 shows the AOC-D with the LHAAP 16 investigations. Figure C-11 shows the AOC-D with the LHAAP 17 investigations.
- 3.5. AOC-E. Figure C-12 shows the AOC-E with the LHAAP 18 & 24 investigations.
- 3.6. AOC-F. Figure C-13 shows the AOC-F with the LHAAP XX investigations.
- 3.7. AOC-G. Figure C-14 shows the AOC-G with the LHAAP 27 investigations.

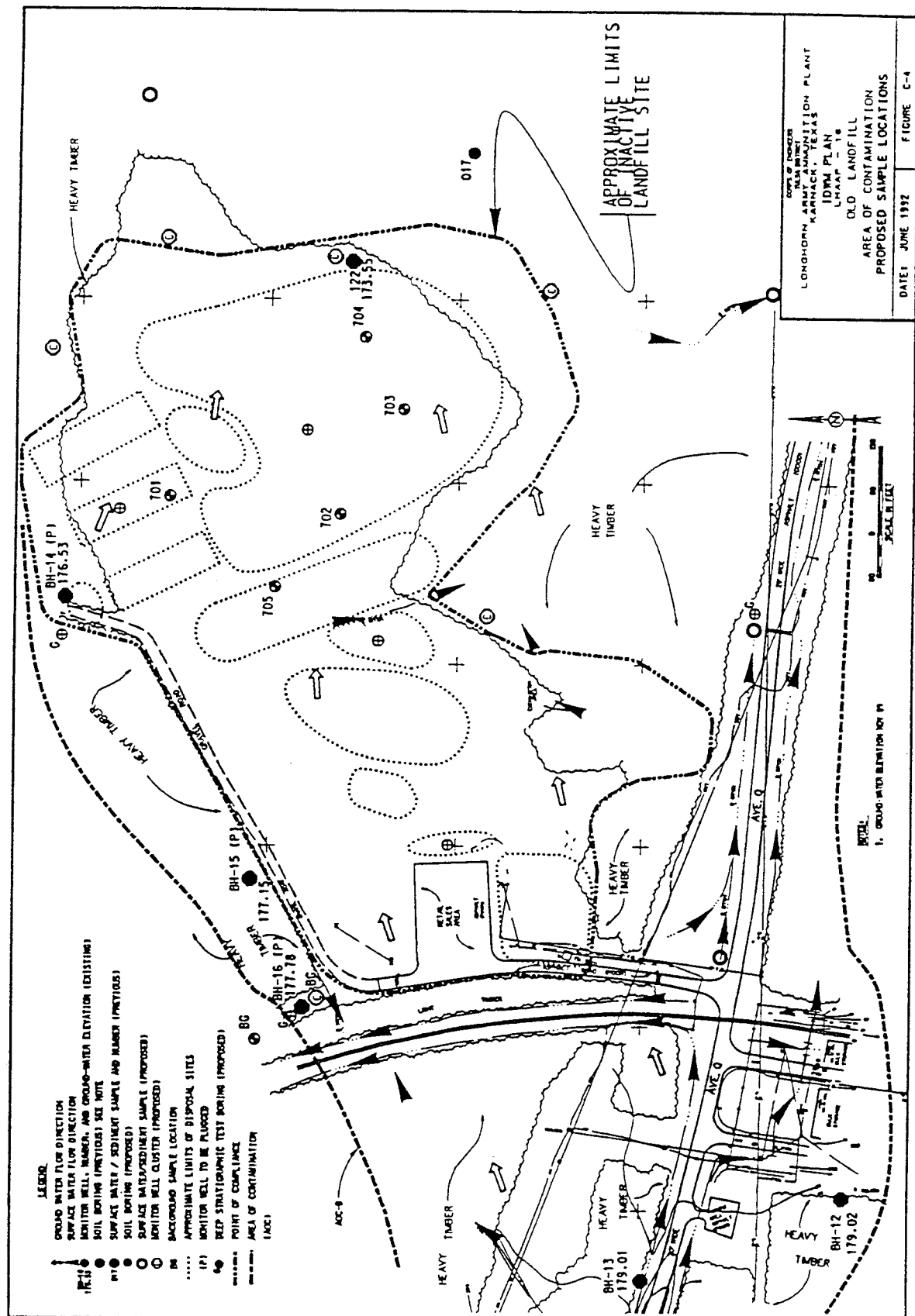


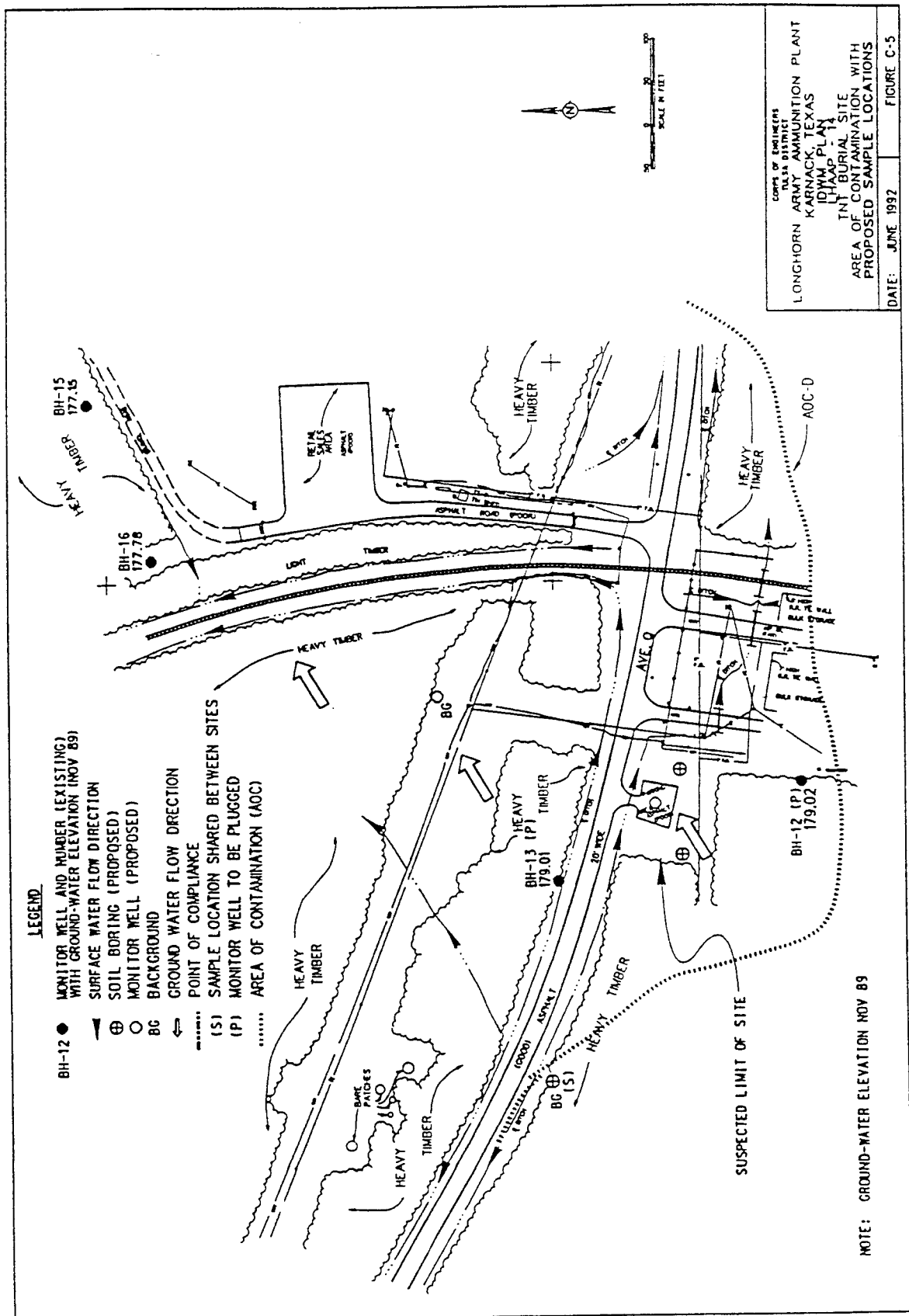
0 2000 4000
APPROX. SCALE IN FEET

LONGHORN ARMY AMMUNITION PLANT
RI/FS WORK PLAN
LOCATION MAP FOR AREA OF CONTAMINATION UNITS
WITH LHAAP CERCLA SITES
IDW MANAGEMENT PLAN

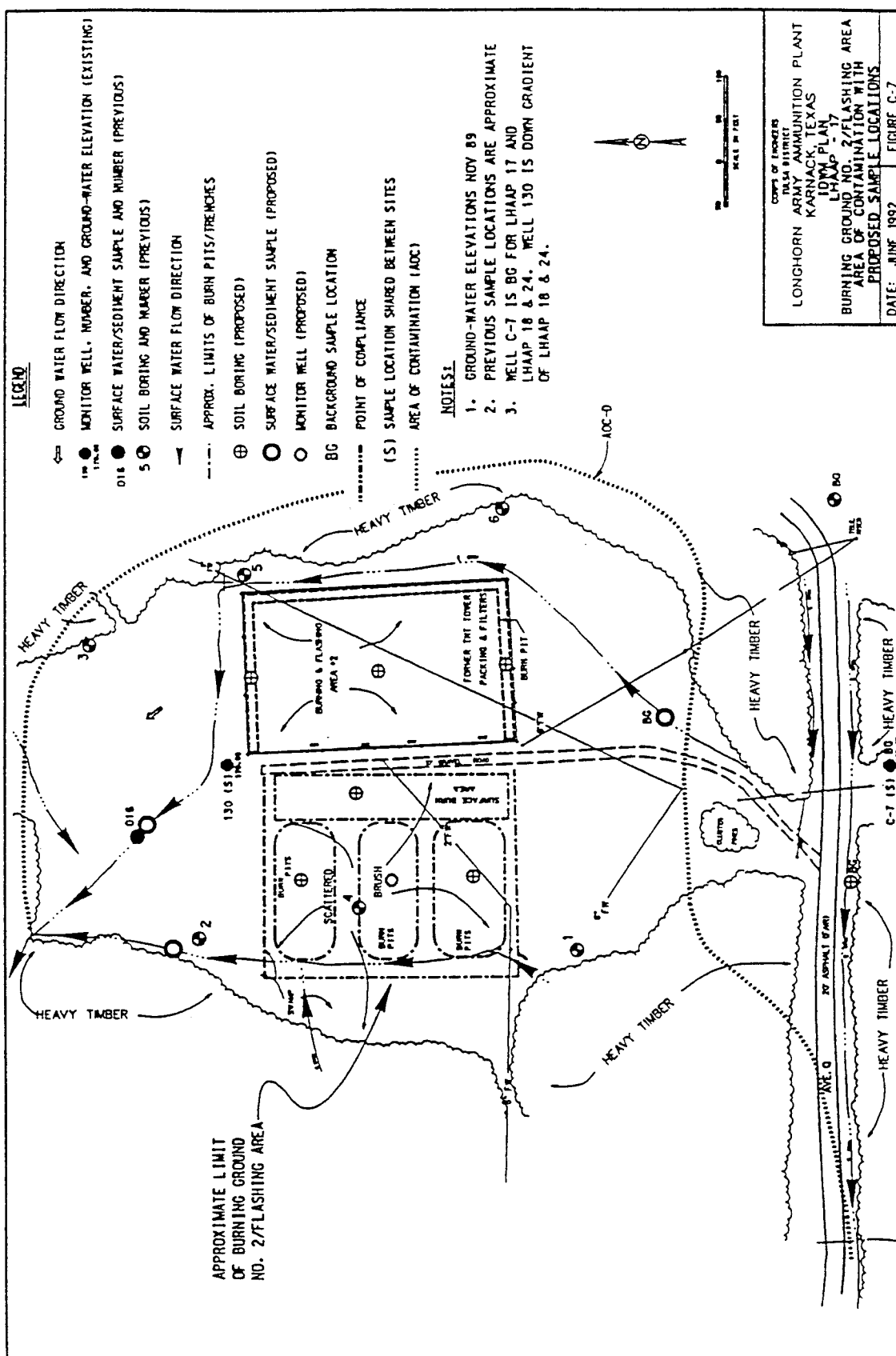
FIGURE C-2

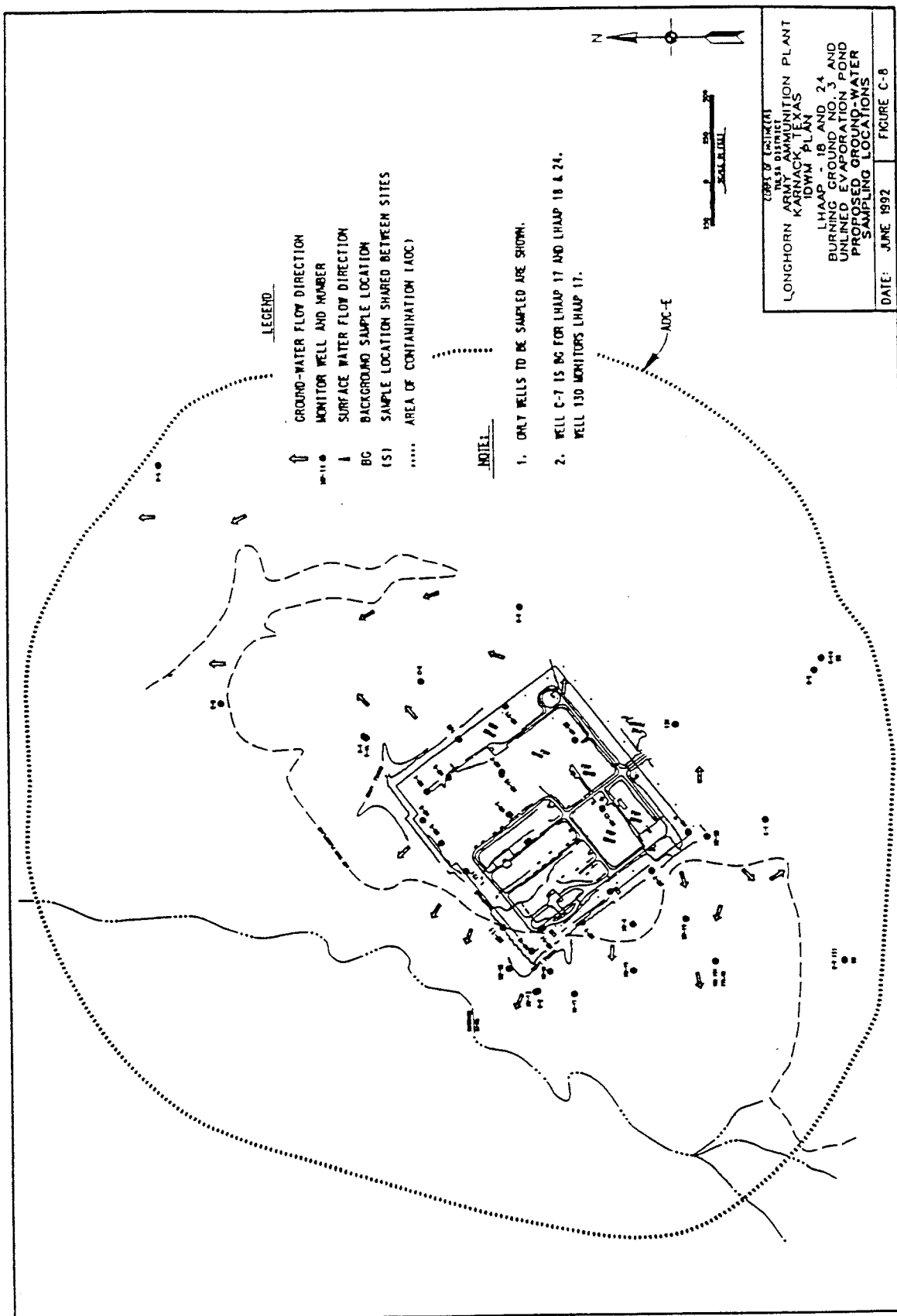


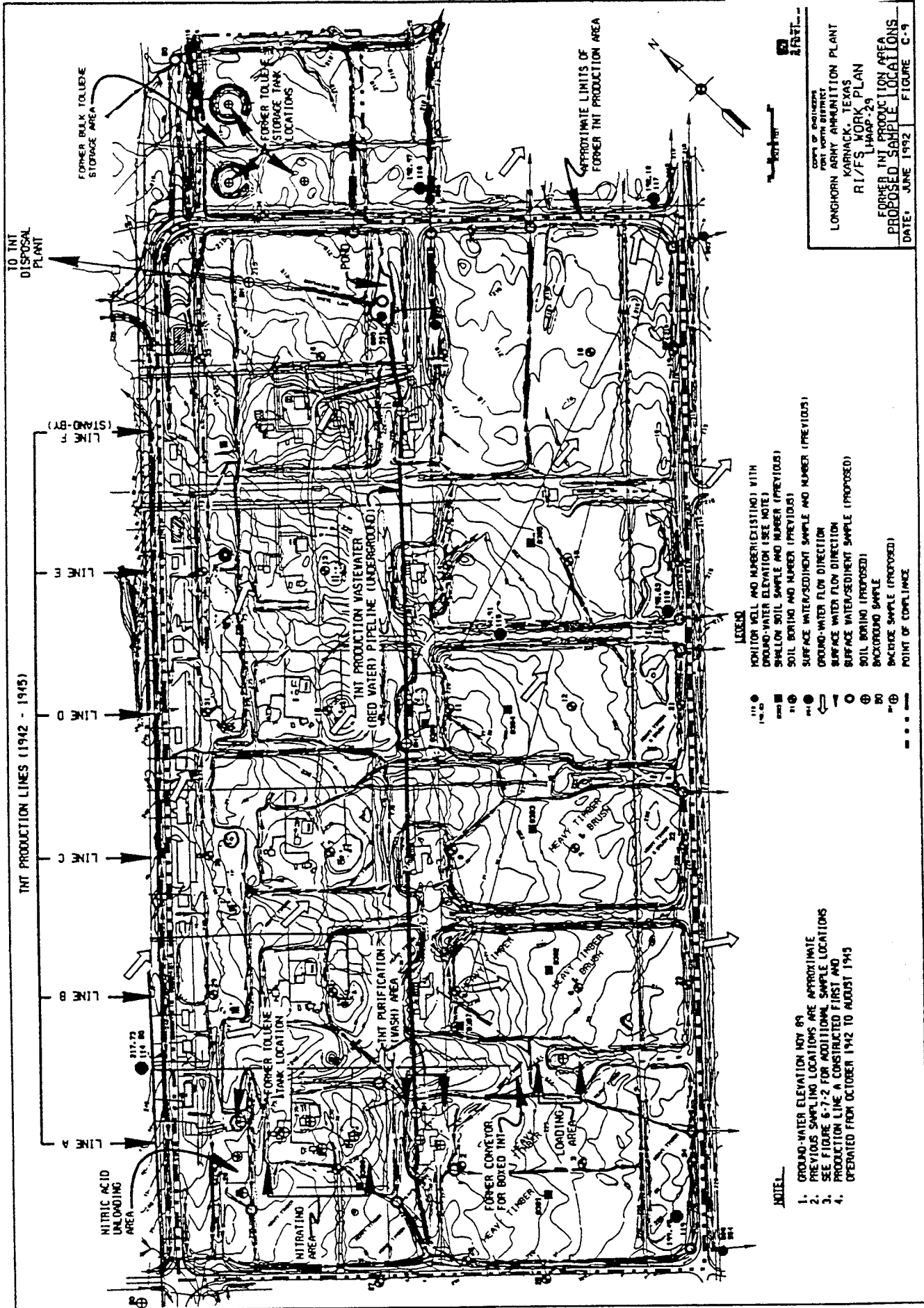










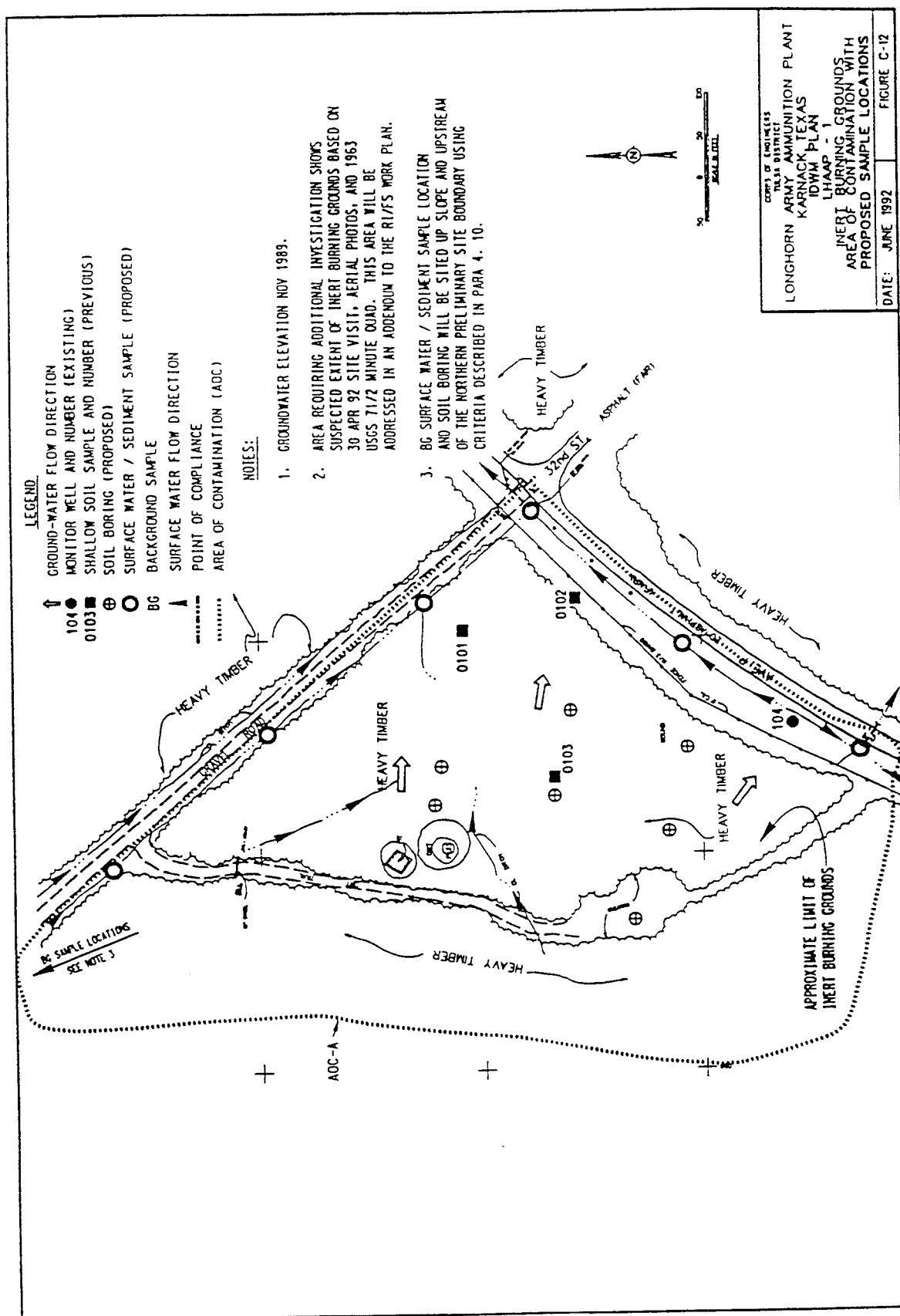


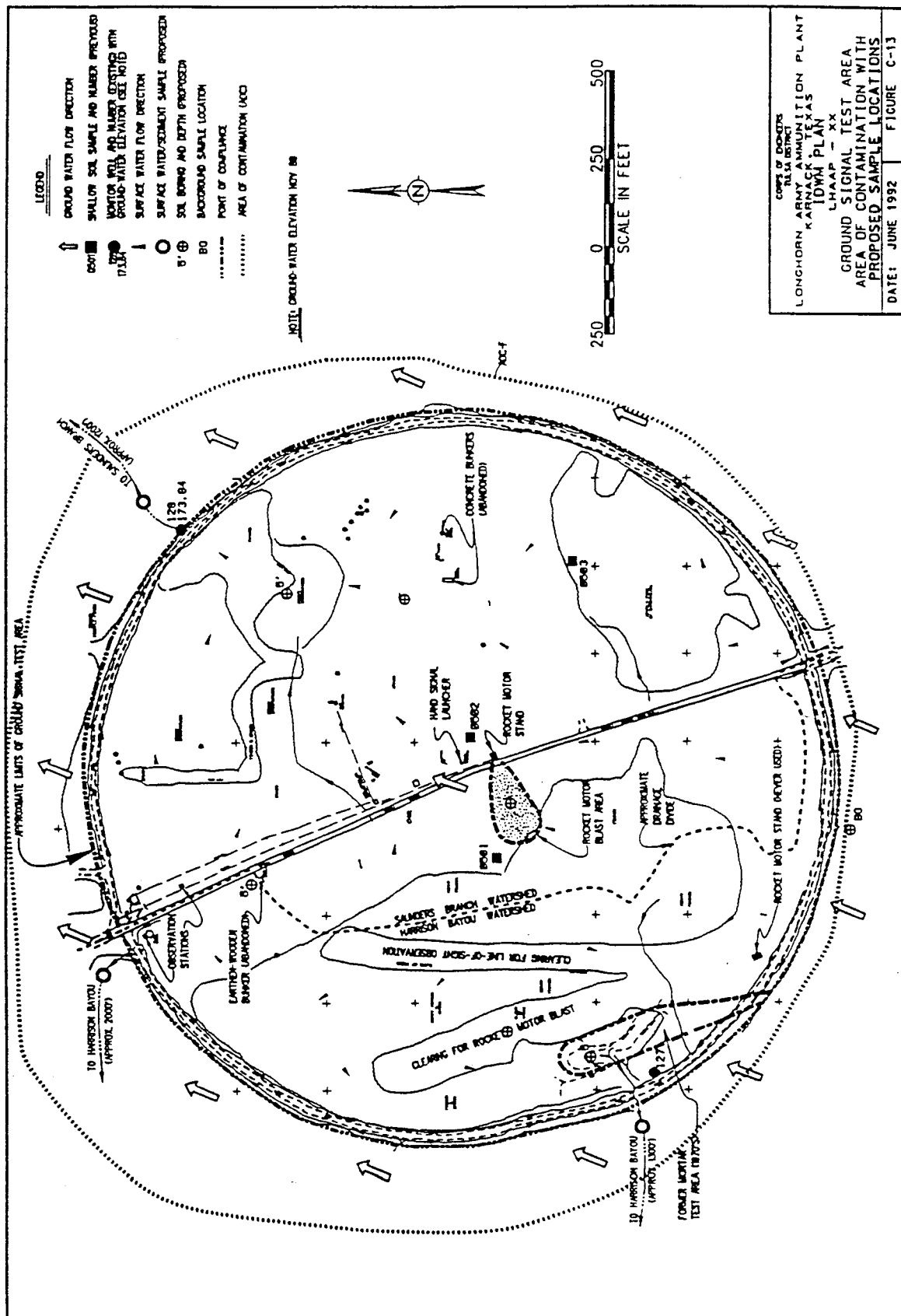
LONGHORN ARMY AMMUNITION PLANT
 KARNACK, TEXAS
 R1/FS WORK PLAN
 LHAAP-29
 FORMER TNT PRODUCTION AREA
 PROPOSED SAMPLE LOCATIONS
 DATE: JUNE 1992 FIGURE C-9

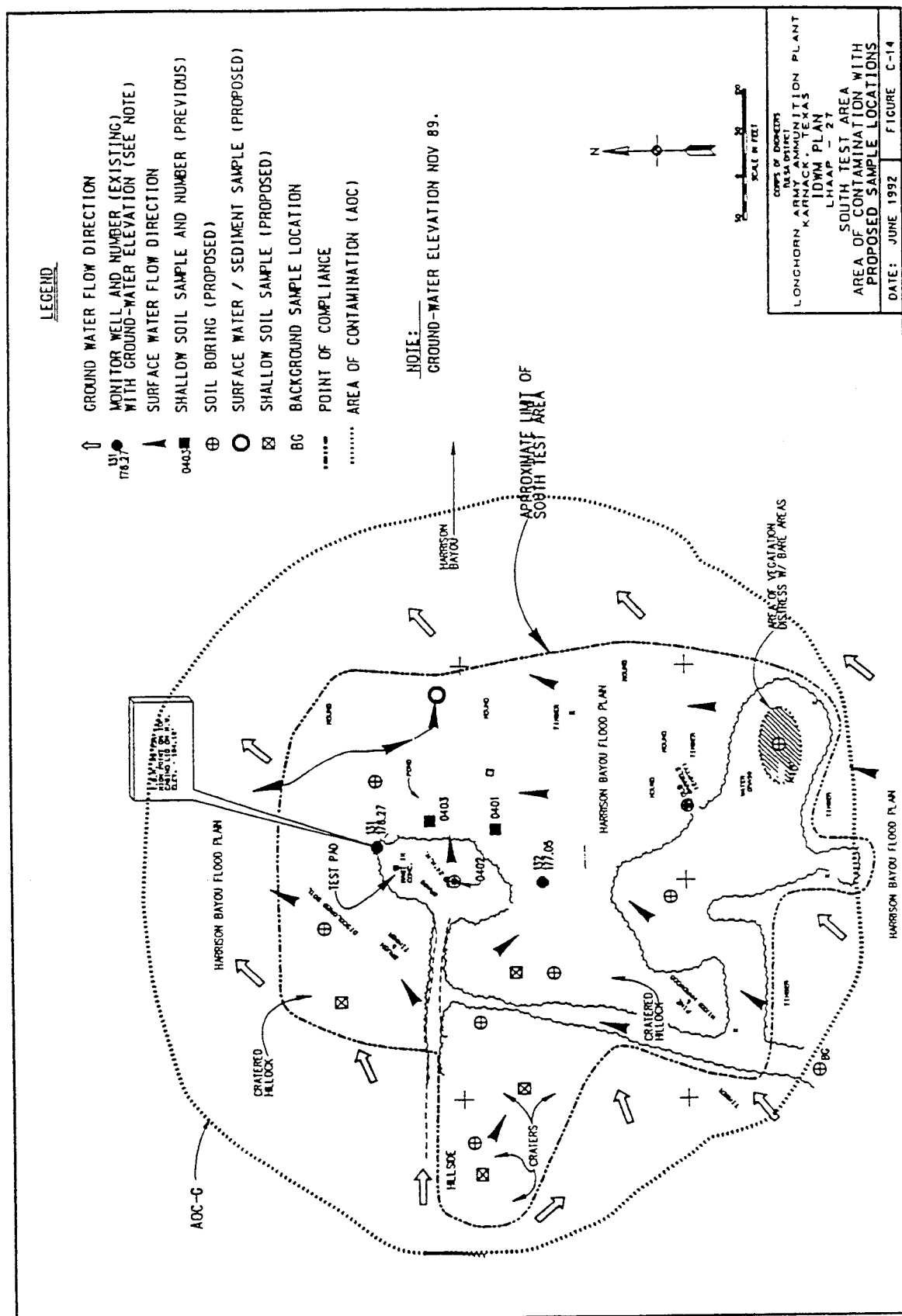
- LEGEND**
- MONITOR WELL AND NUMBER (EXISTING) WITH GROUND-WATER ELEVATION (SEE NOTE)
 - SHALLOW SOIL SAMPLE AND NUMBER (PREVIOUS)
 - SOIL BORING AND NUMBER (PREVIOUS)
 - SURFACE WATER/SEDIMENT SAMPLE AND NUMBER (PREVIOUS)
 - GROUND-WATER FLOW DIRECTION
 - SURFACE WATER/SEDIMENT SAMPLE (PROPOSED)
 - SOIL BORING (PROPOSED)
 - BACKGROUNDS SAMPLE
 - POINT OF COMPLIANCE

- NOTE:**
1. GROUND-WATER ELEVATION MAY BE
 2. PREVIOUS SAMPLING LOCATIONS ARE APPROXIMATE
 3. SEE FIGURE 6-7-2 FOR ADDITIONAL SAMPLE LOCATIONS
 4. PRODUCTION LINE A CONSTRUCTED FIRST AND OPERATED FROM OCTOBER 1942 TO AUGUST 1945









4. Waste Management Plan (WMP).

4.1. Drill Cuttings WMP. On site disposal immediately upon generation is planned at background investigations. On-site disposal of containerized soil cuttings will occur after test results from site characterization soil samples indicate that hazardous constituents are all below regulatory limits at sites LHAAP 11, 13, 14, 16, 17, 29, 12, 32, 1, xx, and 27, where the borings and monitoring wells will be installed within the AOC's and there is no evidence indicating that the disposal of drill cuttings on-site will in any way degrade the surface conditions at the site or cause harm to human health or the environment beyond what is presently existing at these sites. No cuttings will be generated from LHAAP 18 & 24. If borings are performed at LHAAP 18 & 24 during the second phase of investigations, the cuttings will be managed as RCRA hazardous waste.

4.1.1. Containerization. The cuttings from all investigations except background investigations will be containerized within D.O.T. approved drums, containers, roll-off bins, dumpsters, or vessels and properly labeled stored. The containers will be made of material that is non-reactive with the waste constituents present at the site. The labels will include the type of material contained, (soil, water, etc.) site name, boring or well number, accumulation start date, EPA waste number (obtained from the EPA) and telephone number(s) for the site manager and/or installation site coordinator. The containers will be labeled using a permanent, non-soluble substance or devise. Containers will be labeled on the side not on the top, or lid. Cuttings from different borings will not be mixed.

4.1.2. Sampling. The IDW cutting samples will be collected in accordance with the CDAP and TCLP testing will be performed to determine if cuttings are characteristically hazardous waste. TCLP testing will include inorganic and organic species identification and quantification by the method described in the CDAP under procedures set forth in 40 CFR 260.20 and 260.21.

° LHAAP 11, 13, 14, 17, 29, 12, 32, 1, xx, and 27 - only required if site characterization samples indicate that TCLP constituents are present within

regulatory limits (samples will be taken every five feet as part of the site characterization)

° Background sites - not required (these sites are by definition in non-contaminated areas)

° LHAAP 16 (and 18 & 24 if later borings) - required

4.1.3. Storage. After filling or when the boring is completed the containers will be stored, on a location within the AOC that is outside the floodplain limits, until test results are received. If no storage area outside of the floodplain is available at an AOC the waste will be stored at an adjacent AOC storage area. If metal drums are utilized, they will be stored on pallets and covered with a plastic tarp. After test results are received if any of the waste are determined to be above the TCLP regulatory limits, that container will be taken to the LHAAP 90 day RCRA storage facility to await TCLP results and disposal. Waste that is determined to be contaminated but not characteristically hazardous will be stored on site until the remedial activity is constructed. If remedial construction is expected to take over 1 year to begin, a more permanent storage facility will be required. IDW cuttings from LHAAP 16 (and 18 & 24, if later borings are required) will be stored as hazardous waste at the LHAAP 90 day RCRA storage-facility.

4.1.4. Disposal.

° LHAAP 11, 13, 14, 17, 29, 12, 32, 1, xx, 27, and background - On-Site if not contaminated - Off-Site if characteristically hazardous

° LHAAP 16 (and 18 & 24 if later borings) - Off-Site

4.1.4.1. On-Site. If the cuttings are not contaminated disposal will be on site. The cuttings will be spread around the bore hole and monitoring well locations in such a manner to minimize wind or surface water erosion. This will be accomplished by spreading the soil out over a minimum area at least 10 feet from the well in a downgradient area within the AOC. If the cuttings are spread thicker than 4 inches then, grass seed suitable for the area will be spread over the cuttings and raked in.

4.1.4.2. RCRA Hazardous Waste. If the test results (or for LHAAP 18 & 24 there is listed RCRA hazardous waste) indicate that cuttings are

characteristically hazardous, the waste will be disposed of at a fully permitted RCRA Subtitle C facility that is permitted to receive CERCLA waste. The facility must meet the requirements of Land Disposal Restrictions (LDR) (waste may require pretreatment for constituents listed in the LDR before disposal) and the CERCLA section 121(d)(3) and the Off-Site Policy.

4.1.4.3. Contaminated Non-Hazardous. If the test results indicate that cuttings are not characteristically hazardous but do contain hazardous constituents, the waste will be stored and treated on-site during remediation at the site.

4.1.4.4. Stored Off-Site Non-Contaminated. If the test results do not indicate the presence of any contamination, the cuttings will be disposed on the LHAAP facility as inert materials.

4.2. Development, Purge, and Decontamination Water WMP. On site storage of water is planned at 11 of the sites (LHAAP 11, 13, 14, 16, 17, 29, 12, 32, 1, xx, and 27) and at background investigations outside of the AOC's in accordance with Reference 1. On site disposal will occur at the sites where the water is determined to be non-contaminated. Contaminated non-hazardous IDW water will be stored on site and processed during the remedial action. Off-site disposal is anticipated at one site (LHAAP 18 & 24) in accordance with the EPA guidance document, Superfund Management of Investigation-Derived Wastes During Site Inspections, May 1991. Review of past investigations and site history indicate that the IDW water at this site will be classified as hazardous waste after the test results are in.

4.2.1. Containerization. The IDW water will be containerized within D.O.T. approved drums, containers, roll-off bins, dumpsters, or vessels and properly labeled. The labels will include the type of material contained, (soil, water, etc.) site name, boring or well number, accumulation start date, EPA waste number (obtained from the EPA) and telephone(s) for the site manager and/or installation site coordinator. The containers will be labeled using a permanent, non-soluble substance or devise. Containers will be labeled on the side not on the top, or lid.

4.2.2. Sampling. The IDW samples will be collected in accordance with the CDAP. TCLP testing will be performed to determine if the IDW waters are characteristically hazardous waste. TCLP testing will include inorganic and organic species identification and quantification by the method described in the CDAP under procedures set forth in 40 CFR 260.20 and 260.21.

If contaminated, IDW water from LHAAP 18 & 24 will be classified as listed hazardous waste due to the contained in rule from the F listed waste code present in the soil and groundwater.

4.2.3. Storage. On site storage of IDW water is planned at 11 of the sites (LHAAP 11, 13, 14, 16, 17, 29, 12, 32, 1, xx, and 27) and at background investigations outside of the AOC's. After filling or when the purging of site wells are completed the containers from LHAAP 18 & 24 will be taken to the LHAAP 90 day RCRA storage facility to await test results.

4.2.4. Disposal.

4.2.4.1. RCRA Hazardous Waste. If the test results (or for LHAAP 18 & 24 there is listed RCRA hazardous waste) indicate that cuttings are characteristically hazardous, the waste will be disposed of at a fully permitted RCRA Subtitle C facility that is permitted to receive CERCLA waste. The facility must meet the requirements of Land Disposal Restrictions and the CERCLA section 121(d)(3) and the Off-Site Policy.

4.2.4.2. Contaminated Non-Hazardous. If the test results indicate that the water is not characteristically hazardous but is contaminated with hazardous constituents, the water will be classified according to TWC rules, and then treated along with the other water present at the site during remedial action.

4.2.4.3. Non-Contaminated. If the test results indicate that the water is not contaminated, it will be placed in the on-site waste water treatment plant facility.

4.3. Personnel Protective Equipment (PPE) and Disposable Equipment (DE) WMP.

4.3.1. Containerization. At sites LHAAP 11, 13, 14, 16, 17, 29, 12,

32, 1, xx, and 27 the PPE and DE from each site will be contained in double, ultraviolet degradation resistant, 20 gallon plastic bags. The bags will be tagged with a label that gives date, sample location, and site name. Review of the past investigations results does not indicate that this IDW will be hazardous. PPE and DE from LHAAP will be bagged as above and placed in a dumpster (or other suitable container).

4.3.2. Sampling. No sampling of this IDW is required.

4.3.3. Storage. At sites LHAAP 11, 13, 14, 16, 17, 29, 12, 32, 1, xx, and 27 the PPE and DE from each site will be stored in a dumpster on site. PPE and DE from LHAAP 18 & 24 will be stored at the LHAAP RCRA 90-day storage facility.

4.3.4. Disposal. At sites LHAAP 11, 13, 14, 16, 17, 29, 12, 32, 1, xx, and 27 the PPE and DE from each site will be disposed in the LHAAP active landfill. PPE and DE from LHAAP 18 & 24 will be disposed of at a fully permitted RCRA Subtitle C facility that is permitted to receive CERCLA waste. The facility must meet the requirements of Land Disposal Restrictions and the CERCLA section 121(d)(3) and the Off-Site Policy.

4.5. Documentation/Notification. The information contained in this section applies to all IDW managed during these investigations. Field records will be kept of all disposal activities the logs will contain the following information:

- 1) Description Generating Activities
- 2) Location of Generation (including depth if applicable)
- 3) Type of Waste
- 4) Date and Time of Generation
- 5) Date and Time of Disposal of each Type
- 6) Disposal Location of each Type
- 7) Disposal Method
- 8) Description of any waste sampling including:

type of test

laboratory sample to be sent to

sampling method

name of sampler

- 9) Name of person recording information
- 10) Name of Field Manager at time of Generation and at time of Disposal
- 11) The test results must also be provided

4.5.1. RCRA Hazardous Waste. All hazardous waste must be accompanied by a Hazardous Waste Manifest (and other forms required by Texas Law). The treatment, disposal (not restricted waste), storage (TDS) facility must be notified prior to sending the IDW. The following items must accompany the Notification:

- 1) EPA hazardous waste codes
- 2) Manifest number
- 3) Wasted analysis data
- 4) If the waste is also restricted, corresponding concentration-based or technology-based treatment standards, or prohibition

4.5.2. Contaminated Non-Hazardous. If it is transported off-site the IDW must have a Bill of Lading.

4.5.3. Non-Contaminated. No notification or other documentation is required.

5. References.

1. USEPA/540/G-91/009, Superfund Management of Investigation-Derived Wastes During Site Inspections, May 1991.
2. USEPA, OSWER 9934.0-1A, Land Disposal Restrictions, Summary of Requirements, February 1991.
3. USACE, Longhorn Army Ammunitions Plant RI/FS Work Plan Volume 1, General, February 1992.

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APPENDIX C-1

EPA/540/G-91/009, Superfund Management of Investigation-Derived Wastes During Site
Inspections, May 1991

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Superfund



Management of Investigation-Derived Wastes During Site Inspections



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Management of Investigation-Derived Wastes During Site Inspections

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
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NOTICE

The policies and procedures set forth here are intended as guidance to Agency and other government employees. They do not constitute rulemaking by the Agency, and may not be relied on to create a substantive or procedural right enforceable by any other person. EPA officials may decide to follow the guidance provided in this directive, or to act at variance with the guidance, based on analysis of specific site circumstances. The Agency also reserves the right to change this guidance at any time without public notice.

EXECUTIVE SUMMARY

INTRODUCTION	1
1.1 Purpose	1
1.2 Organization of the Guidance	1
2.0 REGULATORY REQUIREMENTS AND POLICY CONCERNS	3
2.1 Requirements of CERCLA and the NCP	4
2.2 Off-Site Response Actions Policy	5
2.3 Applicable or Relevant and Appropriate Requirements	5
2.4 Resource Conservation and Recovery Act	6
2.4.1 Land Disposal Restrictions	6
2.4.2 Area of Contamination Concept and Its Implications	8
2.4.3 Requirements for RCRA Subtitle C Treatment, Storage, and Disposal Facilities	9
2.4.4 Applications of RCRA Requirements to IDW Management	9
2.4.5 Criteria for RCRA Subtitle D Waste Disposal Facilities	10
2.5 Toxic Substances Control Act	10
2.6 Clean Water Act	11
2.7 State Requirements	11
3.0 IDENTIFICATION OF INVESTIGATION-DERIVED WASTES	13
3.1 Extent of Efforts to Characterize Wastes	13
3.2 RCRA Hazardous Wastes and CERCLA Hazardous Substances	14
3.2.1 RCRA Characteristic Wastes	15
3.2.2 RCRA Listed Hazardous Wastes	19
4.0 PLANNING FOR IDW GENERATION AND MANAGEMENT	19
4.1 Liability Limits of IDW Management	20
4.2 Waste Minimization	20
4.3 Types, Hazards, and Quantities of IDW	21
4.4 Decision Tree	21
4.5 On-Site IDW Handling and Management Options	25
4.6 Off-Site Disposal of IDW and Management Options	25
5.0 IMPLEMENTING THE IDW MANAGEMENT PLAN	31
5.1 On-Site IDW Management	31
5.2 Off-Site IDW Management	31
6.0 IDW HANDLING COSTS	31
6.1 On-Site IDW Management	31
6.2 Off-Site Disposal of IDW	31
6.3 Subcontracting	31
8.0 REFERENCES	3

TABLE OF CONTENTS (continued)

APPENDIX A: Relevant Parts of the NCP	A-1
APPENDIX B: OSWER Directive 9347.3-05 FS - Superfund LDR Guide #5	B-1
APPENDIX C: OSWER Directive 9330.2-04 - Discharge of Wastewater from CERCLA Sites into POTWs	C-1
APPENDIX D: TCLP Constituents	D-1
APPENDIX E: Glossary of Terms	E-1

LIST OF FIGURES

1. "Plan for IDW Handling"	22
2. "On-Site Handling"	23
3. "Off-Site Disposal"	24

011872

This guidance presents a general regulatory background and options for management of investigation-derived wastes (IDW) generated during Superfund site inspections (SIs). These wastes include soil cuttings, drilling muds, purged ground water, decontamination fluids (water and other fluids), disposable sampling equipment (DE), and disposable personal protective equipment (PPE). The National Contingency Plan (NCP) requires that management of IDW generated during SIs complies with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable. In addition, other legal and practical considerations may affect the handling of IDW. Therefore, site inspection managers and other involved parties should be familiar with this guidance, as well as the requirements of the NCP, ARARs, and EPA's interpretation of these requirements.

IDW from SIs may contain hazardous substances as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Some CERCLA hazardous substances are hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act (RCRA), while other substances are regulated by other federal laws such as the Safe Drinking Water Act (SDWA), Clean Air Act (CAA), Toxic Substances Control Act (TSCA), and the Clean Water Act (CWA). EPA estimates that RCRA hazardous IDW have been generated at fewer than 15 percent of CERCLA sites. However, RCRA regulations, and in particular the RCRA Land Disposal Restrictions (LDRs), are very important as potential ARARs since they regulate treatment, storage, and disposal of many of the most toxic and hazardous materials.

EPA's strategy for managing RCRA hazardous IDW presented in this guidance is based on:

- The NCP directive that SIs comply with ARARs to the extent practicable.
- The Area of Contamination (AOC) unit concept.

The most important elements of the IDW management approach are as follows:

- Leaving a site in no worse condition than existed prior to the investigation.
- Removing those wastes that pose an immediate threat to human health or the environment.
- Leaving on-site wastes that do not require off-site disposal or extended above-ground containerization.
- Complying with federal ARARs, to the extent practicable.
- Complying with state ARARs, as practicable.
- Careful planning and coordination for IDW management.
- Minimizing the quantity of generated wastes.

The specific elements of the approach are as follows:

- Characterizing IDW through the use of existing information (manifests, Material Safety Data Sheets, previous test results, knowledge of the waste generation process, and other relevant records) and best professional judgment.
- Delineating an AOC unit for leaving RCRA hazardous soil cuttings within the unit.

- Containerizing and disposing of RCRA hazardous ground water, decontamination fluids, and PPE and DE (if generated in excess of 100 kg/month) at RCRA Subtitle C facilities.
- Leaving on-site RCRA nonhazardous soil cuttings, ground water, and decontamination fluids preferably without containerization and testing.

EPA does not recommend removal of wastes from all sites and, in particular, from those sites where IDW do not pose any immediate threat to human health or the environment. Removing wastes from all sites would not benefit human health and the environment and would result in spending a significant portion of the total funds available for the site assessment program, thus impairing EPA's ability to successfully meet the goals of the program.

1.0 INTRODUCTION

In the process of collecting environmental samples during Superfund site inspections (SIs), site investigators generate many different types of potentially contaminated investigation-derived wastes (IDW) that include soil, ground water, used personal protective equipment (PPE), decontamination fluids, and disposable sampling equipment (DE). The National Contingency Plan (NCP)⁽¹⁾ requires that managing (handling) of IDW attains all applicable or relevant and appropriate requirements (ARARs) to the extent practicable considering the exigencies of the situation. To comply with ARARs, site managers need to be familiar with these requirements and how the Environmental Protection Agency interprets them.

1.1 PURPOSE

This document provides guidance on determining and interpreting ARARs, and highlights EPA's recommended approach to handling IDW in compliance with these requirements. The guidance is intended to assist site inspection managers (SM), EPA regional project officers (RPOs), EPA Site Assessment Managers (SAMs), state environmental agencies, potentially responsible parties (PRPs), and others involved in Superfund site assessment work. The approach presented reflects EPA's goal to protect human health and the environment, addresses the most typical scenarios that the SM may encounter, and describes cost-efficient methods of handling both hazardous and non-hazardous IDW.

1.2 ORGANIZATION OF THE GUIDANCE

This guidance consists of seven sections:

- Section 1 - Introduction.
- Section 2 describes regulatory requirements and policy concerns, with emphasis on Resource Conservation and Recovery Act (RCRA)⁽²⁾ regulations.
- Section 3 discusses the distinction between IDW containing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances and RCRA hazardous wastes based on their regulatory definitions.
- Section 4 stresses planning for IDW generation and management as the most important factor of the comprehensive approach to handling IDW. This section also presents the IDW disposal decision tree intended as a quick reference for site inspection managers.
- Section 5 describes the implementation of the IDW management plan.
- Section 6 discusses costs involved in both on-site and off-site IDW handling.
- Section 7 briefly describes available subcontracting procedures for IDW transportation and disposal.

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2.0 REGULATORY REQUIREMENTS AND POLICY CONCERNS

A variety of IDW are generated during CERCLA SIs. Many of these wastes contain substances considered hazardous under CERCLA or regulated under various federal statutes such as the Toxic Substances Control Act (TSCA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), and RCRA. Even though all of these statutes can be ARARs for CERCLA actions, the application of these laws to handling IDW generated during the SI can be difficult and confusing, since none specifically addresses the management of IDW generated during the SI.

The National Contingency Plan (NCP)⁽¹⁾ and the proposed amendment to the NCP⁽²⁾ ("Procedures for Planning and Implementing Off-Site Response Actions") codifying the CERCLA off-site policy⁽³⁾, present EPA's interpretation of how these laws apply to response action investigations such as SIs.

2.1 REQUIREMENTS OF CERCLA AND THE NCP

CERCLA authorizes EPA to respond to releases or threats of releases of hazardous substances into the environment. CERCLA response actions include removal actions, remedial investigations, and other response actions financed by Superfund. CERCLA Section 101 (23) defines "removal" to include actions that may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances. Thus, CERCLA studies, site assessments, and field investigations are considered removal actions. The NCP directs that removal actions attain ARARs "to the extent practicable considering the exigencies of the situation" (unless the ARAR is waived) (see Section 300.415 (i) of the NCP). Practicability is assessed by examining factors such as the urgency of the situation and the scope of the removal action to be conducted. Section 2.2 of this guidance discusses procedures for CERCLA off-site actions.

The preamble to the NCP clarifies the extent to which ARARs apply to removal actions:

"[Because] the purpose of removal actions generally is to respond to a release or threat of release of hazardous substances, pollutants, or contaminants so as to prevent, minimize, or mitigate harm to human health and the environment... [and] removals are distinct from remedial actions in that they may mitigate or stabilize the threat rather than comprehensively address all threats at a site... removal actions cannot be expected to attain all ARARs... Indeed, the imposition by Congress of limits on the amount of time and Fund money that may be spent conducting a removal action often precludes comprehensive remedies by removal actions alone" (55 FR 8695, March 8, 1990) (emphasis added).

Because investigative activities are categorized as removal actions, the preamble to the NCP sets out the following IDW management approach:

"... the field investigation team should, when handling, treating or disposing of investigation-derived waste on-site, conduct such activities in compliance with ARARs to the extent practicable, considering the exigencies of the situation. Investigation-derived waste that is transported off-site (e.g., for treatability studies or disposal) must comply with applicable requirements of the CERCLA off-site policy" (55 FR 8756, March 8, 1990) (emphasis added).

In determining what is "practicable" in the context of an SI, the Agency may take into account the very limited scope and purpose of the activity, and in particular the fact that it is not intended to address contamination at the site (other than to gather information about it). This means that, as a general matter, actions taken at the SI that leave conditions essentially unchanged (such as returning soil cuttings to the location from which they were taken) should not require a detailed analysis of ARARs or assurance that conditions at the site after the action is taken will comply with ARARs. At the same time, site personnel should ensure that their handling of IDW does not create

additional hazards at the site. (For example, leaving highly contaminated soil cuttings on the surface could create an additional risk of direct exposure.)

Potential ARARs include (but are not limited to) RCRA⁽²⁾, TSCA, CWA, CAA, and state legally enforceable regulations. The most important ARARs for managing IDW are RCRA and TSCA (addressed in Sections 2.4 and 2.5 of this guidance). The preamble to the NCP discusses when CERCLA actions (including activities during SIs) constitute "land disposal," which triggers several significant requirements, including RCRA land disposal restrictions (LDRs)⁽³⁾ (55 FR 8759-8762).

Section 300.400(g)(4) of the NCP defines state ARARs as "those state standards that are promulgated, are identified by the state in a timely manner, and are more stringent than federal requirements." Section 2.7 of this guidance discusses the issue of state ARARs.

Before ARARs can be determined, it is necessary to determine what contaminants, if any, are present in the IDW. Section 3.0 of this guidance discusses the process of identifying contaminants. In general, such identification should be done based on available information about the site and professional judgment rather than testing.

In brief, compliance with the NCP can generally be assured by:

- (1) Identifying contaminants, if any, present in IDW based on existing information and best professional judgment; testing is not required in most circumstances.
- (2) Determining ARARs (particularly RCRA and state laws), and the extent to which it is practicable to comply with them.
- (3) Delineating an area of contamination (AOC) unit based on existing information and visual observation if soil cuttings are RCRA hazardous (see Section 2.4.2).
- (4) Burying RCRA hazardous soil cuttings within the AOC unit, so long as no increased hazard to human health and the environment will be created. Containerization and testing are not required.
- (5) Containerizing RCRA hazardous ground water and other RCRA hazardous IDW such as PPE, DE, and decontamination fluids for off-site disposal.

The following sections of this guidance provide guidelines for determining ARARs and identifying IDW.

2.2 OFF-SITE RESPONSE ACTIONS POLICY

CERCLA Section 121 (d) (3) requires that hazardous substances, pollutants, or contaminants that are transferred off-site for treatment, storage, or disposal during CERCLA response actions must be sent to facilities operating in compliance with RCRA and other applicable laws or regulations. In 1987, EPA issued a more detailed policy (the "off-site policy" - OSWER Directive No. 9834.11, November 13, 1987⁽⁴⁾) that describes procedures that must be followed when a response action under CERCLA involves off-site management of CERCLA wastes. This policy applies to all IDW that are transported to an off-site disposal facility, but does not itself require that all RCRA hazardous wastes and CERCLA hazardous substances be disposed off-site. Sections 2.4.3, 2.4.4, 2.5 and 2.6 of this guidance present the criteria that RCRA Subtitle C facilities, RCRA Subtitle D facilities, TSCA and CWA-regulated facilities must meet. The off-site policy is complex, and questions that arise should be referred to the appropriate EPA Office of Regional Counsel.

The off-site policy provides acceptability criteria for facilities that receive wastes from CERCLA-authorized or -funded response actions, including RCRA land disposal, treatment, storage, and permit-by-rule facilities, and for

non-RCRA Subtitle C facilities (such as facilities permitted to receive waste under TSCA) that receive non-RCRA wastes. Section 2.4.3 of this guidance discusses requirements for RCRA facilities that receive such wastes. In addition, the off-site policy lists procedures for implementing off-site response actions, incorporates the SARA requirements, and provides detailed procedures for issuing and reviewing unacceptability determinations. Off-site actions must comply with applicable requirements of this policy.

The off-site policy also establishes criteria for selecting an appropriate disposal facility. The policy requires that all RCRA hazardous wastes and CERCLA hazardous substances (which include RCRA hazardous wastes as a subset) generated during CERCLA response actions that are transferred off-site be managed in facilities that are not only in compliance with RCRA and other federal and state requirements, but also meet the compliance and release criteria outlined in the policy.

EPA has proposed an off-site rule (Part 300.440 of the NCP) that would codify the requirements of CERCLA Sections 121 (d) (3) and the off-site policy, and prevent CERCLA response actions from contributing to present or future environmental problems "by directing these wastes to management units determined to be environmentally sound" (53 FR 48218, November 29, 1988⁰⁰). Once the rule is issued in final form, it will supersede the policy. Note that the proposed off-site rule contains provisions regarding materials sent to laboratories for testing and analysis. These provisions do not relate to the types of IDW discussed in this guidance.

2.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARARs must be identified on a site-specific basis, and the site manager must determine whether a requirement is applicable and, if not, whether the requirement is relevant and appropriate. A requirement under environmental laws may be either "applicable" or "relevant and appropriate," but not both.

For dealing with IDW, the most important federal ARAR is RCRA because it specifically regulates all aspects of transportation, treatment, storage, and disposal of hazardous wastes. Other major federal ARARs of concern include CWA, CAA, SDWA, and TSCA. State ARARs should be attained where they are promulgated and legally enforceable (see Section 2.7 of this guidance).

Much of what is discussed in this guidance is directly applicable; however, there are instances where requirements may not be legally applicable, but are nevertheless relevant (addressing a similar situation or problem) and appropriate (being well-suited to a particular site). Relevant and appropriate requirements should be considered in the same way as those that are directly applicable. For instance, such situations might include circumstances where a highly toxic waste constituent is suspected, a large volume of waste may be generated or the nature of the property (e.g. residential or proximity to public facilities) is of concern. Section 4.6 of this guidance discusses factors identified for off-site disposal of IDW and management options when an ARAR has been determined.

2.4 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

The Resource Conservation and Recovery Act (RCRA) of 1976, an amendment to the Solid Waste Disposal Act (SWDA) of 1965, was passed to protect human health and the environment, to conserve energy and natural resources, and to quickly reduce or eliminate the generation of hazardous wastes. RCRA currently has 10 discrete sections (Subtitles) that address specific waste management activities. Two of these Subtitles, and their implementing regulations, may be ARARs for IDW handling: Subtitle C (Hazardous Waste Management) and Subtitle D (Solid Waste Management).

The RCRA Hazardous and Solid Waste Amendments (HSWA) of 1984 established land disposal restrictions (LDRs) for RCRA hazardous wastes and mixtures of RCRA hazardous wastes with other substances, including those regulated under TSCA. Under RCRA regulations, restricted RCRA wastes may only be land disposed after treatment to specified levels. RCRA may be an ARAR for IDW handling if the IDW generated during the SI contain RCRA hazardous wastes. In that case, the SM should evaluate compliance (to the extent practicable) with LDRs.

2.4.1 LAND DISPOSAL RESTRICTIONS

Land disposal, as defined by RCRA Section 3004 (k), includes any placement of RCRA hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome or salt bed formation, or underground mine or cave. For LDR purposes, the Agency commonly uses "land disposal" and "placement" as synonymous terms.

For the purpose of the LDRs, HSWA divides RCRA hazardous wastes into several groups (e.g., First Third, Second Third, California list wastes) and specifies dates, referred to as the statutory deadlines, by which treatment standards for each group must be established. The final statutory deadline for wastes listed or identified before November 8, 1984 was May 8, 1990. For wastes identified after November 8, 1984, EPA must determine whether these wastes will be prohibited from land disposal within 6 months of listing or identification. If EPA fails to promulgate treatment standards within 6 months for newly identified wastes, the wastes can be land disposed without restriction until the appropriate treatment standards are promulgated. After the statutory deadline for wastes identified before November 8, 1984, the wastes are "restricted" or "prohibited" and cannot be disposed in land unless:

- The wastes are treated to meet promulgated treatment standards.
- It can be demonstrated that hazardous constituents will not migrate from the land disposal unit as long as the wastes remain hazardous.
- The wastes are subject to treatment standard variances.
- The specific waste has received a national capacity variance.

It should be noted that the NCP establishes a presumption that treatment to best demonstrated available technology (BDAT) standards is inappropriate as a standard for soil removed from CERCLA sites, and that a treatability variance is appropriate in such circumstances (see 55 FR 8760-8762).

To determine if LDRs are applicable to IDW management, the SM must evaluate whether:

- (1) The IDW are RCRA hazardous waste.
- (2) The RCRA hazardous waste is regulated under the LDRs.
- (3) The anticipated approach to IDW management constitutes "placement" (land disposal) of the generated wastes. (For the purpose of the LDRs, EPA considers itself a waste generator when the response action involves treatment, storage, or disposal of RCRA hazardous wastes. If the SI does not involve RCRA hazardous IDW disposal, RCRA regulations are not triggered.)

LDRs apply only if the answer to all three questions is "yes." In some cases, as discussed in section 2.3, LDRs may be "relevant and appropriate" even if not strictly applicable.

2.4.2 AREA OF CONTAMINATION CONCEPT AND ITS IMPLICATIONS

An important consideration in determining whether LDRs apply is whether land disposal of IDW has occurred. If IDW are merely being moved within the same "area of contamination" (AOC), EPA does not consider "land disposal" to have occurred, so that LDRs are not triggered, even if IDW contain RCRA hazardous material. Therefore, if IDW are being moved only within an AOC, it is unnecessary to determine whether they are subject to LDRs.

EPA has not promulgated a regulatory definition of an AOC. However, the preamble to the NCP (55 FR 8760) states that "EPA generally equates the CERCLA area of contamination with a single RCRA land-based unit, usually a landfill." EPA noted that under RCRA, the term "landfill" could include a non-discrete land area on or in which there is generally dispersed contamination." The contamination in an AOC may vary in concentration and type of contaminant. Further guidance on the AOC concept is provided in 55 FR 8760 (March 8, 1990), 53 FR 51444 (December 21, 1988), and in Superfund LDR Guide #5 (OSWER Directive 9347.3-05, July 1989).

The AOC concept applies only to contaminated soil (and sediments) from the inspected site. The AOC concept does not affect the approach for managing IDW that did not come from the AOC, such as PPE, DE, decontamination fluids, and ground water. The latter materials, if RCRA hazardous, must be containerized and disposed off-site.

Examples of AOCs include: a waste source such as waste pit, landfill, waste pile along with the surrounding contaminated soil, or the sediments in a contaminated stream. Depending on site characteristics, one or more AOCs may be delineated. CERCLA sites often consist of several AOCs. To determine if separate AOCs can be delineated within the site, and if RCRA regulated wastes are present within the AOCs, the site manager should collect sufficient information about the site as early as possible, preferably prior to starting field work. Determining AOCs may prove difficult if there is little available information or no visual contamination. In such cases, site managers may use their best professional judgment to delineate AOCs (e.g., a small area immediately adjacent to a borehole may be part of an AOC if the area is covered with surface soil similar to soil from the borehole).

Once the AOC units are determined, the site manager must evaluate whether an anticipated IDW handling approach constitutes land disposal. In general, land disposal does not occur when wastes are:

- Moved within the unit.
- Capped in place.
- Treated in situ (without placing the waste in another unit for treatment).
- Processed within the AOC to improve structural stability (without placing the waste into another unit for processing).

Superfund LDR Guide #5, "Determining when Land Disposal Restrictions (LDRs) are Applicable to CERCLA Response Actions,"⁽⁵⁾ states that land disposal occurs when:

- Wastes from different AOCs are consolidated into one AOC.
- Wastes are moved outside of an AOC (for treatment and storage) and returned to the same or a different AOC.
- Wastes are excavated from an AOC, transferred to a separate unit such as a tank, surface impoundment, or incinerator that is within the AOC, and then redeposited into the AOC.

In addition, land disposal occurs if wastes removed from an AOC are stored (e.g., placed in drums outside the AOC) prior to being returned to the AOC.

Thus, under the NCP, the AOC unit concept means that:

- Land disposal does not occur when wastes are left in place, or moved or stored within a single AOC unit.
- Leaving RCRA hazardous soil on-site within the AOC unit does not constitute disposal and does not

trigger RCRA regulations, unless the SM determines that the wastes would significantly increase risks to human health and the environment (e.g., fire or explosion) and must be disposed of off-site.

- RCRA hazardous ground water, decontamination fluids, PPE, and DE should be containerized and disposed off-site.
- Moving RCRA hazardous soil cuttings from one AOC to another AOC triggers the LDRs.

If IDW cannot be deposited within the delineated AOC, the site manager must comply with all LDRs to the extent practicable. This means that the IDW should be transferred to an off-site RCRA Subtitle C hazardous waste treatment, storage, or disposal facility that complies with the off-site policy.

2.4.3 REQUIREMENTS FOR RCRA SUBTITLE C TREATMENT, STORAGE, AND DISPOSAL FACILITIES

The RCRA Subtitle C standards⁽²⁾ cover hazardous waste treatment, storage, and disposal (TSD) facilities. The specific standards govern installation, operation, inspection, and closure of containers, tanks, surface impoundments, waste piles, land treatment units, landfills, incinerators, and other units.

Off-site TSD facilities receiving IDW must have RCRA permits to operate. Facilities that are permitted under another statute to receive hazardous wastes are eligible for RCRA permits without filing RCRA permit applications. These facilities, referred to as "permit-by-rule," include ocean disposal barges or vessels, injection wells, and publicly-owned treatment works (POTWs). The NCP exempts EPA from the RCRA permitting requirement while conducting CERCLA actions on-site. However, EPA should attempt to consider RCRA storage regulations as relevant and appropriate when containerizing and storing wastes on-site, even though a permit application will not be filed.

Generally, the RCRA storage regulations require a generator to: (1) place the waste in containers or tanks; (2) satisfy the standards for containers or tanks; (3) clearly indicate the waste accumulation date on the containers; (4) mark the containers and tanks as "hazardous waste"; and (5) comply with the requirements for owners and operators of hazardous waste TSD facilities. In addition, LDRs prohibit the storage of RCRA restricted waste unless the storage is to accumulate sufficient quantities of the waste to promote proper disposal, treatment, or recovery. When storing hazardous waste for more than 90 days, the SM should consider the storage requirements of 40 CFR Parts 262 and 264 as relevant and appropriate and comply with them to the extent practicable unless the site falls within one of the following categories of waste generators:

1. Conditionally exempt small quantity generators (producing no more than 100 kilograms of hazardous waste in a calendar month), and
2. Small quantity generators producing between 100 kg and 1,000 kg of hazardous waste in a calendar month.

In the cases listed above, the SM will have to comply with the guidelines provided in 40 CFR Part 261.5(g)(2) and 40 CFR Part 262.34.

Any facility receiving IDW containing hazardous wastes must comply with all RCRA Subtitle C design, operation, and closure requirements. In addition, the off-site policy presents additional criteria for selecting an appropriate disposal facility. The most important criteria⁽⁴⁾ that a RCRA Subtitle C facility must meet if it receives RCRA hazardous IDW are:

- There must be no record of any relevant violations at or affecting the receiving unit.
- There must be no releases at receiving units of land disposal, treatment, or storage facilities. Note that

011882

a land disposal facility may consist of one or more land disposal units, including landfills, surface impoundments, land treatment units, and piles.

- There must be no significant releases (as determined by EPA) from non-receiving units at treatment and storage facilities that are not controlled by corrective action.
- Waste cannot be disposed of at any unit of a land disposal facility, if any one unit at the facility has releases that are not controlled by corrective action.
- The land disposal facility must demonstrate compliance with the minimum technology requirements of RCRA Section 3004 (o).

The off-site policy also applies to RCRA permit-by-rule facilities receiving RCRA hazardous waste. These facilities are subject to the same requirements as other RCRA Subtitle C facilities and must be inspected for compliance with the applicable RCRA requirements, as well as be inspected by the appropriate authorities for compliance with other applicable laws. Permit-by-rule facilities that receive only nonhazardous materials do not need RCRA permits but must be inspected by local agencies for compliance with applicable laws.

2.4.4 APPLICATION OF RCRA REQUIREMENTS TO IDW MANAGEMENT

RCRA requirements apply to management of IDW during SIs in the following manner: if IDW is stored or disposed off-site, then the SM must comply with all RCRA and ARAR storage requirements; if IDW are stored on-site, then the SM must comply with RCRA to the extent practicable.

Off-site management of RCRA hazardous IDW may also involve treatment, storage, and disposal of RCRA hazardous wastes in accordance with all applicable guidelines. For TSD facilities constructed solely as part of a CERCLA response action, RCRA operating permits are not required.

IDW generated during the SI may require on-site storage in containers while awaiting off-site disposal. Although CERCLA exempts response actions conducted entirely on-site from permit requirements (see CERCLA Section 121 (e) (1)), EPA's policy is to follow the storage regulation practices required for RCRA generators who wish to avoid obtaining permits (40 CFR Parts 240-280). These requirements are applicable if the site manager determines that the containerized IDW are RCRA hazardous waste. RCRA hazardous IDW containerized and stored on-site must be properly disposed within a regulatory timeframe. There are cases where this may not be possible and storage does not require a permit, although EPA should try to expedite removal as much as possible. Note that accumulation of IDW, even on-site, in units other than containers or tanks may result in creation of RCRA units that are subject to various RCRA requirements such as closure, permitting, and ground water monitoring.

2.4.5 CRITERIA FOR RCRA SUBTITLE D FACILITIES

RCRA Subtitle D²⁰ regulates disposal of nonhazardous wastes in facilities such as municipal landfills. RCRA nonhazardous IDW, such as personal protection equipment (PPE) and disposable equipment (DE), may be disposed of in a Subtitle D facility. Other RCRA nonhazardous IDW (e.g., soil cuttings or ground water) should go to a Subtitle D facility only in very rare circumstances (these wastes should be disposed on-site). The off-site policy establishes requirements for selecting an appropriate RCRA Subtitle D facility for IDW disposal:

- The facility must have a compliance inspection prior to receiving CERCLA IDW and this inspection must not identify any noncompliance with relevant federal and state regulations at or affecting the receiving unit.
- Environmentally significant releases (as determined by EPA) of hazardous substances must be controlled by corrective action.

2.5 TOXIC SUBSTANCES CONTROL ACT

RCRA nonhazardous IDW containing PCBs or asbestos must, in certain circumstances, be disposed of at facilities regulated under the Toxic Substances Control Act (TSCA). While asbestos is not a common contaminant at CERCLA sites, PCBs can be found at about 17 percent of CERCLA sites. Regulations governing the management of IDW containing PCBs, which are generally based on PCB concentrations in waste, are found at 40 CFR 761.60.

TSCA requirements for handling PCBs⁽⁹⁾ call for incineration of PCB-contaminated liquid material with concentrations greater than 500 ppm. For liquid material with PCB concentrations between 50 and 500 ppm, the principal alternative to incineration is disposal in a TSCA chemical waste landfill. Any receiving unit must meet the compliance and release criteria for non-RCRA units as set out in the off-site policy, in order to be acceptable. These PCBs may also be destroyed by using a TSCA-approved method that provides a level of performance equivalent to incineration. Nonliquid PCBs at concentrations greater than or equal to 50 ppm may be incinerated, treated by a equivalent TSCA-approved method, or disposed in a TSCA chemical landfill. PCB-contaminated material with concentrations less than 50 ppm are generally not regulated under TSCA, and may be disposed in acceptable Subtitle D facilities.

Even though IDW containing PCBs alone are not RCRA hazardous wastes, IDW containing PCBs mixed with RCRA hazardous wastes are regulated under RCRA LDRs as part of the California list wastes⁽¹⁰⁾. Since PCBs can be governed by RCRA and TSCA, the SM must determine whether RCRA (in the case of PCBs mixed with RCRA wastes) or TSCA regulations, or both, are applicable.

2.6 CLEAN WATER ACT

The Clean Water Act (CWA) addresses site-specific pollutant discharge limitations and performance standards for specified industries to protect surface water quality. At the SI, the most likely situation involves indirect discharge of IDW water, regulated under CWA, to POTWs for treatment and disposal. A less likely situation may involve direct discharge, either on-site or off-site, to surface water.

RCRA hazardous wastewater can be disposed of at POTWs that have a RCRA permit-by-rule and that meet the off-site policy criteria for a facility receiving RCRA hazardous waste. Disposal at a POTW of nonhazardous wastewaters from CERCLA sites is an option⁽¹¹⁾ if the POTW is acceptable under the off-site policy (Appendix C). EPA regulations cover general and specific prohibitions on discharges⁽¹²⁾ to POTWs.

The following criteria⁽¹³⁾ should be used in selecting an appropriate POTW facility:

- Compliance with all applicable laws.
- The quantity and quality of the CERCLA IDW must be compatible with the POTW.
- The POTW must have no unpermitted "releases."
- The concentration of any hazardous substance must meet applicable pretreatment standards (CERCLA IDW cannot upset the facility's operation and violate the permit).
- The POTW must be in compliance with its National Pollutant Discharge Elimination System (NPDES) permit.
- The transport of IDW to the POTW and its placement in an impoundment must not create a potential for ground water contamination.

2.7 STATE REQUIREMENTS

State ARARs present an array of specific problems for CERCLA sites because their goals and methods often differ from federal environmental laws. CERCLA Section 121 and Section 300.400 (g) of the NCP provide that only those state standards that are promulgated, identified by the state in a timely manner, and more stringent than federal requirements may generally be ARARs. To be considered "promulgated," a standard must be legally enforceable and of general applicability. A waiver is available if the state standard is applied only to CERCLA sites¹¹. When dealing with IDW, SMs must comply (to the extent practicable) with state promulgated and enforceable requirements that are more stringent than federal requirements.

State hazardous waste regulations are among the most important environmental laws that may differ, in some states, from federal law. EPA has authorized some states to administer and enforce RCRA hazardous waste management programs. Regulations in these states may be more stringent or have a greater scope of coverage than the federal RCRA requirements. If the CERCLA site is in a state with an authorized RCRA program, the RCRA requirements promulgated by the state will replace the federal requirements as potential ARARs.

In addition to state RCRA regulations, other state legally enforceable standards may govern the handling of wastes. However, the SM should be aware that ARAR waivers are generally available for state requirements specifically aimed at CERCLA sites (see CERCLA section 121(d)(4)(E); 40 CFR 300.430(f)(1)(ii)(C)(5)).

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3.0 IDENTIFICATION OF INVESTIGATION-DERIVED WASTES

To properly deal with IDW from SIs, the SM must know whether IDW contain CERCLA hazardous substances, and whether these hazardous substances constitute either RCRA hazardous wastes or contaminants regulated under other statutes. This section is intended to help the SM ascertain the types of IDW generated during the SI and, in particular, to determine whether IDW are either RCRA listed or characteristic hazardous waste.

There are several types of IDW generated during the SI. Examples include the following: (1) soil cuttings and drill mud from soil boring or monitoring well installations; (2) purge water removed from wells before ground water samples are collected; (3) water, solvents, or other fluids used to decontaminate field equipment and PPE; and, (4) PPE and DE. These IDW can be contaminated with various CERCLA hazardous substances. To handle IDW in compliance with regulations, reasonable efforts should be made to characterize the wastes.

3.1 EXTENT OF EFFORTS TO CHARACTERIZE WASTES

The efforts made to characterize IDW should be consistent with the limited scope and purpose of the SI. In most cases, the limited scope of an SI makes it impracticable to characterize wastes to the same extent that might be done in a remedial investigation/feasibility study (RI/FS). In particular, Contract Laboratory Program (CLP) testing would not be warranted in most cases; instead, the nature of the wastes should be assessed by applying best professional judgment, using readily available information about the site (such as manifests, storage records, preliminary assessments, and results of earlier studies that may have been conducted and are available to the Agency, as well as direct observation of the IDW for discoloration, odor, or other indicators of contamination).

The Agency has specifically indicated that IDW may be assumed not to be "listed" wastes under RCRA unless available information about the site suggests otherwise (53 FR 51444, December 21, 1988). Similarly, RCRA procedures for determining whether a waste exhibits RCRA hazardous characteristics do not require testing if the decision can be made by "applying knowledge of the hazard characteristic in light of the materials or process used" (40 CFR 262.11(c)). The level of such knowledge required to make a determination with respect to IDW may take into account considerations of practicability and should reflect the limited scope of the activity. In most instances, a determination may be possible based on available information and professional judgment.

The fact that extensive resources need not be used in characterizing IDW does not mean that IDW can be assumed to be nonhazardous unless clearly proven otherwise. Rather, the question is whether, given the limited information that is likely to be available, the SM considers it more likely than not that the wastes are hazardous.

It should be noted that characterizing IDW is only the first step. For example, once it has been determined that a RCRA hazardous waste is involved, the guidelines discussed in Section 2.4 for determining the extent to which RCRA requirements must be complied with should be considered. Furthermore, the degree of certainty with which IDW are characterized during site inspections will be less than during remedial actions. Therefore, even if the waste is deemed not to be RCRA hazardous, RCRA requirements may be considered relevant and appropriate under the specific circumstances at the site (see section 3.2.1).

3.2 RCRA HAZARDOUS WASTES AND CERCLA HAZARDOUS SUBSTANCES

Some CERCLA hazardous substances are RCRA hazardous wastes. Another category of CERCLA hazardous substances are PCBs, which are fairly common at CERCLA sites. Identification of RCRA hazardous wastes and PCB-contaminated IDW is important for making appropriate management decisions (see Sections 2.5, 3.2.1, and 3.2.2 of this guidance). The SM must know the difference between RCRA hazardous wastes and other CERCLA hazardous substances because the presence of RCRA hazardous IDW invokes special technical considerations and

management decisions due to RCRA regulations (particularly the LDRs). EPA recommends using knowledge of IDW rather than testing the wastes to characterize them.

The SM should not assume that all IDW contaminated with CERCLA hazardous substances are RCRA hazardous wastes, in the absence of positive evidence (e.g., manifests, records, knowledge of generation processes) to support such an assumption. At the same time, however, the SM should determine whether IDW are RCRA hazardous wastes, to the extent practicable, as discussed above.

The most important characterization decision is whether IDW contain "hazardous waste" under RCRA. This is relevant to the ARAR status of LDRs and other RCRA requirements, and whether waste disposed of off-site must be disposed of in a Subtitle C or Subtitle D facility. A solid waste is a RCRA hazardous waste⁽¹⁾ if it contains a listed waste or exhibits any of the hazardous characteristics and is not excluded from regulation as a hazardous waste. (For purposes of the RCRA Subtitle C regulations, a solid waste is any discarded material (solid, sludge, liquid, and compressed gas) that is not excluded under SWDA.) IDW generated during the SI may either exhibit a RCRA characteristic or contain RCRA listed waste.

Under EPA regulations, soil and ground water may be considered contaminated environmental media. If they contain listed hazardous waste, they must be managed as RCRA hazardous wastes as long as they "contain" the listed waste. If IDW exhibit RCRA characteristics, they also have to be managed as RCRA hazardous wastes.

To properly handle IDW, the SM must make a reasonable effort to ascertain if they are RCRA hazardous. When the SM determines that IDW do not fall in any listed waste category and does not display RCRA characteristics, the wastes are not RCRA hazardous. Sections 3.2.1 and 3.2.2 help determine if IDW are RCRA characteristic wastes or if they contain RCRA hazardous listed wastes.

Even if the IDW do not contain RCRA "hazardous waste," the SM should determine whether they contain other CERCLA hazardous substances. CERCLA hazardous substances include, in addition to RCRA hazardous wastes, substances, elements, compounds, solutions, or mixtures designated as hazardous or toxic under CERCLA itself or under the authority of other laws such as TSCA, CWA, CAA, and SDWA. Therefore, even where RCRA is not applicable, one of these statutes may be an ARAR. EPA presents a list of these hazardous substances in 40 CFR Part 302.4, Table 302.4.

3.2.1 RCRA CHARACTERISTIC WASTES

A solid waste is a RCRA characteristic hazardous waste if it exhibits the characteristic of ignitability, corrosivity, reactivity (as defined in 40 CFR Part 261, Subpart C), or toxicity (toxicity characteristic leaching procedure, TCLP, as described in 55 FR 11796-11877, March 29, 1990⁽¹¹⁾).

IDW exhibit ignitability if:

- They are a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, and have a flash point lower than 60°C (140°F).
- They are not a liquid and are capable, under standard temperature and pressure, of causing fire and, when ignited, create a hazard.
- They are an ignitable compressed gas as defined in 49 CFR 173.300.
- They are an oxidizer as defined in 49 CFR 173.151.

IDW exhibit corrosivity if:

- They are aqueous and have a pH less than or equal to 2 or greater than or equal to 12.5.
- They are a liquid and corrode steel at a rate greater than 6.35 mm (0.25 inch) per year at a test temperature of 55°C (130°F).

IDW exhibit reactivity if:

- They are normally unstable and readily undergo violent change without detonating.
- They react violently with water.
- They form potentially explosive mixtures with water.
- When mixed with water, they generate toxic gases, vapors or fumes that pose a danger to human health or the environment.
- They are a cyanide- or sulfide-bearing waste capable of (at the pH range of 2 to 12.5) generating toxic gases that can present a danger to human health or the environment.
- They are capable of detonation or explosive decomposition.
- They are a forbidden explosive as defined in 49 CFR 173.51.

IDW exhibit TCLP-toxicity when its leachate contains certain contaminants at levels exceeding their regulatory thresholds⁽¹⁰⁾. The TCLP has replaced the EP-toxicity test for identifying RCRA characteristic wastes. The new procedure expands the number of chemicals regulated as hazardous wastes by adding 25 organic constituents to the previous RCRA list of toxic chemicals, and by establishing regulatory levels for these chemicals (Appendix C). The TCLP is designed to determine the mobility of both organic and inorganic contaminants present in liquid, solid, and multiphasic wastes. A water containing less than 0.5 percent dry solid material, filtered through a 0.6 to 0.8-um glass fiber filter, is defined as the TCLP extract. If this extract contains a regulated compound above its threshold level, then the water is hazardous by TCLP characteristic. If the filtered extract from the solid phase contains a regulated compound above its threshold level, then the solid material is RCRA hazardous.

To identify RCRA characteristic waste⁽¹¹⁾, the SM may rely on knowledge of the properties of the substances from, for example, the Material Safety Data Sheets (MSDS) prepared by manufacturers, or on the results of tests described in 40 CFR 261.21 - 261.24. EPA recommends using knowledge of the properties of materials instead of testing since most CERCLA wastes do not exhibit these RCRA characteristics. Therefore, the SM should not test IDW, particularly if they are a soil of known RCRA characteristics, the AOC concept is applicable, and the wastes will be buried on-site.

3.2.2 RCRA LISTED HAZARDOUS WASTES

Any type of IDW that contains listed hazardous wastes should be considered a RCRA hazardous waste. EPA has developed four lists of RCRA hazardous wastes according to the sources of their origin and toxicity (40 CFR Part 261, Subpart D). These lists contain:

- Wastes from nonspecific sources (F wastes). Examples include spent halogenated solvents (tetrachloroethylene, methylene chloride), nonhalogenated solvents (xylene, acetone, ethyl ether), still bottoms from the recovery of these spent solvents, and some wastewater treatment sludges.
- Wastes from specific sources (K wastes). Examples include wastewater treatment sludges from the production of zinc yellow and chrome green pigments, and still bottoms from the distillation of benzyl chloride.
- Discarded commercial chemical products, manufacturing intermediates, off-specification (off-spec) chemicals (which, if they met specifications, would be listed), and container and spill residues that are "acutely hazardous" (P-wastes). Examples include aldrin and phosgene.
- Discarded commercial chemical products, manufacturing chemical intermediates, or off-spec commercial chemical products that are "toxic" (U-wastes). Examples include chlorobenzene and mercury.

To ascertain whether IDW constitute RCRA listed hazardous waste, the SM must first determine if the IDW contain a component that may be a listed hazardous waste, and then decide whether that component meets the regulatory description of that listed waste.

For example, to determine if solvents contaminating IDW are RCRA spent solvent F001-F005 wastes, the SM must know if:

- The solvents are spent and cannot be reused without reclamation or cleaning.
- The solvents were used exclusively for their solvent properties.
- The solvents are spent mixtures and blends that contained, before use, a total of 10 percent or more (by volume) of the solvents listed in F001, F002, F004, and F005.

If the solvents contained in the IDW are RCRA listed wastes, the IDW are RCRA hazardous waste. When the SM does not have guidance information on the use of the solvents and their characteristics before use, the IDW cannot be classified as containing a listed spent solvent. (When the solvents are not listed and IDW are not a characteristic waste, the IDW should be declared nonhazardous.

For other F and K wastes, the SM must know the generation process information (about each waste contained in the RCRA waste) described in the listing. For example, for IDW to be identified as containing K001 wastes that are described as "bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol," the SM must know the manufacturing process that generated the wastes (treatment of wastewaters from wood preserving process), feedstocks used in the process (creosote and pentachlorophenol), and the process identification of the wastes (bottom sediment sludge).

P and U wastes cover only unused and unmixed commercial chemical products, particularly spilled or off-spec products. Not every waste containing a P or U chemical is a hazardous waste. To determine whether a CERCLA IDW contains a P or U waste, the SM must have direct evidence of product use. In particular, the SM should ascertain, if possible, whether the chemicals are:

- Discarded (as described in 40 CFR 261.2(a) (2)).
- Either off-spec commercial products or a commercially sold grade.
- Not used (soil contaminated with spilled unused wastes is a P or U waste).

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- The sole active ingredient in a formulation.

Identification of a listed waste requires a great deal of care on the part of the SM, particularly if the IDW have to be disposed off-site. For instance, depending on its source and prior use benzene may be an F waste, U waste, or not a RCRA hazardous waste at all. The waste identification process requires access to manifests, storage records, records of waste sources and their prior use, and other information that is reasonably ascertainable during the SI. Visual inspection of the site or the waste generating process will sometimes be sufficient.

IDW from many SIs will not fit the definition of RCRA hazardous listed waste due to limited information. If there is a probability that investigation-derived soil cuttings contain a RCRA listed waste, and a site manager intends to leave them on-site within the AOC unit, a thorough evaluation of the waste is not necessary.

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4.0 PLANNING FOR IDW GENERATION AND MANAGEMENT

The most important phase of IDW management is planning for waste generation and handling before field activity starts. In the planning phase of work, the SM must decide if IDW can be left on-site or must be disposed off-site. Since some sites may have both RCRA hazardous and RCRA nonhazardous IDW, the SM must be familiar with the NCP, and appropriate sections of RCRA, TSCA, CWA, and other relevant statutes.

Handling of RCRA hazardous IDW and IDW with high PCB concentrations (greater than 50 ppm) may involve either moving the IDW within an AOC unit, or containerization, storage, testing, treatment, and off-site disposal. Handling of RCRA nonhazardous IDW usually involves various methods of on-site disposal. EPA prefers to leave both RCRA hazardous and nonhazardous IDW on-site whenever it complies with regulations and does not pose any immediate threat to human health and the environment. This approach speeds up the site assessment process while avoiding high costs of off-site disposal, particularly when off-site disposal does not result in any benefits to human health and the environment.

The approach to IDW generating and handling must be described in the SI work plan which is subject to EPA approval. The SM must base the approach on available information and best professional judgment. The work plan should describe the logic behind the proposed approach to IDW handling, and in particular:

- Methods of waste quantity minimization.
- Types of waste.
- Quantity of waste.
- ARARs of concern, and limits of practicability in light of the scope of the SI.
- On-site and off-site handling methods, where necessary.
- Delineated AOCs for RCRA waste to be handled on-site.
- Containerization, storage, testing, and pick-up methods for wastes to be disposed off-site.

The description of the approach to IDW handling must be as detailed as possible, so the inspection team can execute the work plan without any major problems in the field. If the SI results in generating any IDW off-site, they should be handled the same way as if they were generated on-site.

4.1 AUTHORITY TO MANAGE IDW

EPA views IDW management as an inherent part of the site investigation process authorized under CERCLA Section 104 (e) (4). Should a site owner refuse to provide access, EPA has the authority to issue an administrative order, or seek a court order, to gain site access for environmental sampling. Non-compliance with such an order may result in imposing the sanctions authorized under CERCLA Section 104 (e) (5), including penalties.

EPA believes the approach contained in this guidance to be reasonable and protective of human health and the environment. The limited scope and purpose of the SI activity is not intended to address contamination at a particular site (other than to gather information about it). Generally, SI activities that leave conditions essentially unchanged (e.g., returning soil cuttings to the location from which they were taken) will comply with ARARs. The SM should seek to obtain the appropriate management approach for IDW outlined in this guidance when negotiating site access agreements.

Note, however, that some site circumstances may warrant exceptions to the IDW management approach outlined in this guidance. The SM should use professional judgment in recognizing situations where special steps are required to avoid creating additional threats to human health and the environment. When substantial doubt exists regarding the scope of EPA's authority to carry out the proposed plan for IDW management, the SM should consult legal counsel.

4.2 WASTE MINIMIZATION

The SM should select investigation methods that minimize the generation of IDW, particularly RCRA hazardous wastes. The SI team should limit contact with contaminants, and use drilling and decontamination methods (such as steam cleaning) that minimize PPE, DE, decontamination fluids, and soil cuttings. In particular, the inspection team should minimize the amounts of solvents used for decontamination or eliminate solvents. Minimizing the amount of wastes generated reduces the number of IDW handling problems and costs of disposal. The waste minimization approach should be addressed in the SI workplan.

4.3 TYPES, HAZARDS, AND QUANTITIES OF IDW

To handle IDW properly, the SM must determine the types (such as soil cuttings, ground water, decon fluids, PPE or DE), characteristics (whether RCRA hazardous or containing other CERCLA hazardous substances), and quantities of anticipated wastes. As discussed in Section 3.1, testing will generally not be required to characterize waste to the extent appropriate for an SI. In addition to direct observation of the IDW for evidence of contamination, the SM should review and analyze all available information about the site such as:

- Results of previous EPA preliminary assessments or site investigations.
- Environmental permits.
- Results of inspections by state, local, or federal agencies, or private parties.
- Records from community relations interviews.
- Any other helpful data such as tax records or aerial photography.

Upon ascertaining the types of anticipated IDW, the SM should determine IDW characteristics, in particular whether the anticipated waste is RCRA hazardous (see Section 3.2 of this guidance) or contains high concentrations of PCBs. For RCRA hazardous IDW, the SM should determine whether the IDW pose an increased hazard to human health and the environment relative to conditions that existed prior to the SI. Whenever field analytical screening instruments are used during the SI, the SM may plan to evaluate the analytical results as helpful indicators of IDW characteristics. However, the SM must remember that most of these tests are not RCRA tests, and that the test results usually do not identify RCRA hazardous wastes. The SM must also determine the exact properties of RCRA nonhazardous IDW to select an appropriate disposal facility (e.g., POTW) when the circumstances require off-site disposal.

Upon determining the types and characteristics of IDW to be generated, the SM must assess the anticipated quantities which vary depending on the size of a site and the scope of the SI. As a point of reference, a typical SI may result in generating a range of 1 to 3 drums of PPE and DE, 50 to 1,500 gallons of decontamination water, 1 to 3 pints of other decontamination fluids (e.g., organic solvents) and, depending on the number of wells installed or sampled, 0 to 13 drums of soil cuttings and 0 to 200 gallons of well purge water. The SM should calculate the quantity of the anticipated soil cuttings and ground water from the dimensions of wells and the depth to the ground water table. The SM should use experience to assess the amount of decontamination fluids (decontamination water and organics), PPE, and DE.

4.4 DECISION TREE

Upon designating IDW either RCRA hazardous or RCRA nonhazardous, the SM should determine the appropriate handling approach. The SM should use the decision tree (Figures 1, 2, and 3) which, combined with the SM's best professional judgment, will help select the best approach for IDW management and the steps that are involved in executing the approach. The decision tree indicates when and how IDW should be handled on-site or disposed off-site.

The decision tree summarizes basic elements of planning for IDW handling such as waste minimization, characterization, and management. It shows the steps that must be followed in the process. For example, the "Plan for Waste Management According to IDW Characteristic" branch (Figure 1) indicates that the SM has two options: either to handle IDW on-site or to dispose of it off-site. If the SM's decision is to leave IDW on-site, then the "On-Site Handling" branch (Figure 2) indicates what choices and steps can be involved in this approach depending on the type of IDW. The "Off-Site Disposal" branch (Figure 3) of the decision tree presents options available for handling IDW off-site and steps involved in executing these options. The SM should select one of the available options for a given type of IDW.

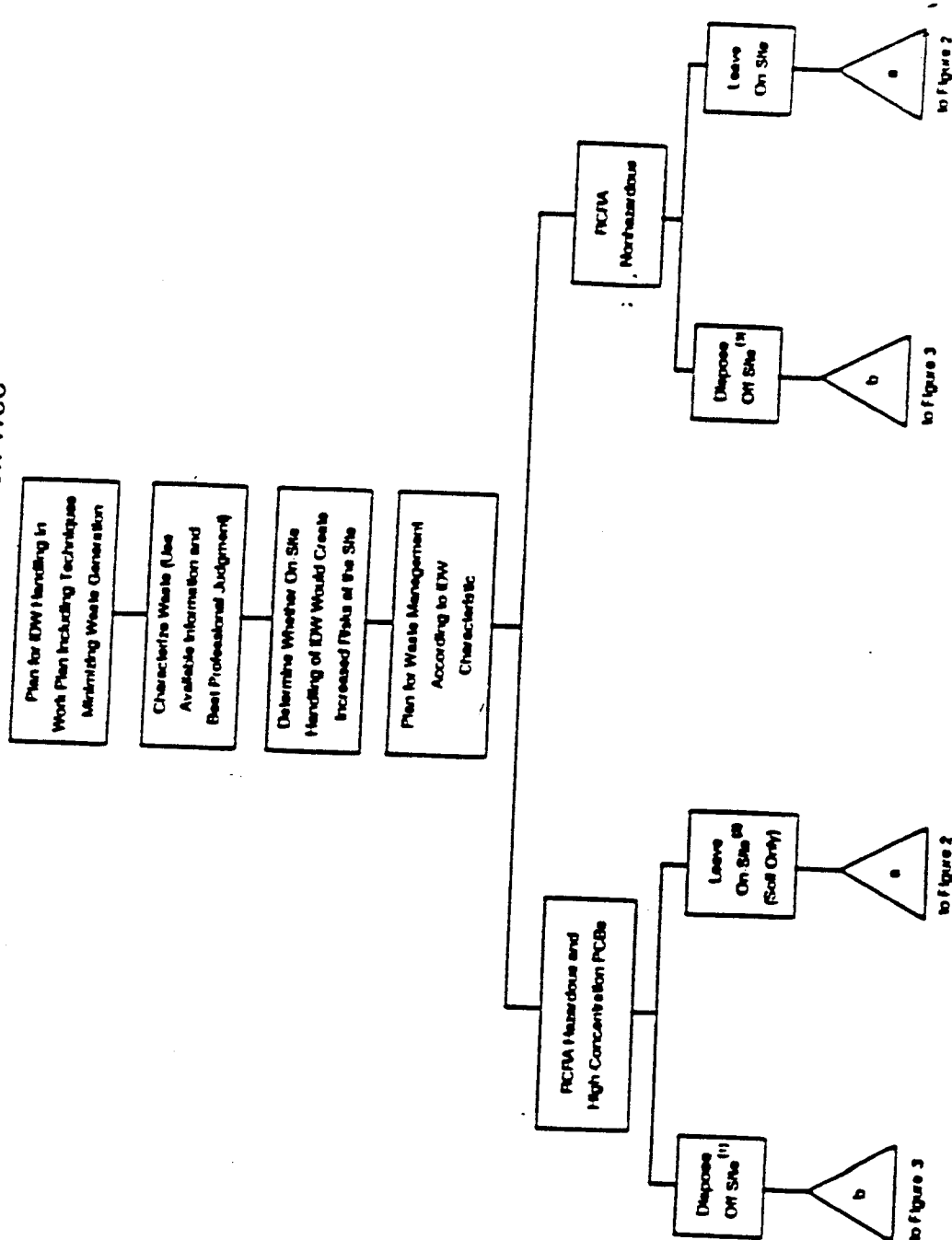
For example, when IDW from the same site are expected to encompass ground water, PPE, DE, decontamination fluids, and soil cuttings that are RCRA hazardous (or contaminated with PCBs) wastes, the decision tree (Figures 1, 2) calls for either handling the cuttings on-site in an AOC unit, or in the site's existing treatment or disposal unit (TDU), or disposing of them off-site. EPA prefers to handle most IDW on-site, but if circumstances require, the off-site option is also available. If PPE and DE can be decontaminated and, according to the SM's best professional judgment, rendered nonhazardous, the decision tree indicates (Figure 3) that these wastes should be double-bagged, and deposited either in an industrial dumpster (on-site or at the EPA warehouse), or in a municipal landfill (RCRA Subtitle D facility). If the SM anticipates that PPE and DE cannot be rendered RCRA nonhazardous after decontamination and the total quantity of IDW generated exceeds 100 kg at an individual site, the decision tree indicates (Figures 1,2) that the wastes should be drummed and disposed off-site at an appropriate facility by a subcontractor, and the SM should start the subcontracting process before field activity begins. If the total quantity of RCRA hazardous PPE and DE is less than 100 kg and this quantity represents the entire amount of IDW generated during the SI, the small quantity waste generator exemption applies and the wastes can be disposed of in a municipal landfill with state approval. However, EPA prefers to send even small quantities of RCRA hazardous PPE and DE to RCRA hazardous waste facilities.

The decision tree points out that when the ground water is RCRA nonhazardous (the most common situation), the water may be managed on-site (Figure 2) using one of a few simple techniques. If decontamination fluids are RCRA nonhazardous, they should be handled similarly. The decision tree indicates (Figure 3) that RCRA hazardous organic decontamination fluids should be handled off-site.

Sections 4.5 and 4.6 of this guidance present the details of EPA-preferred approaches to IDW management.

Figure 1

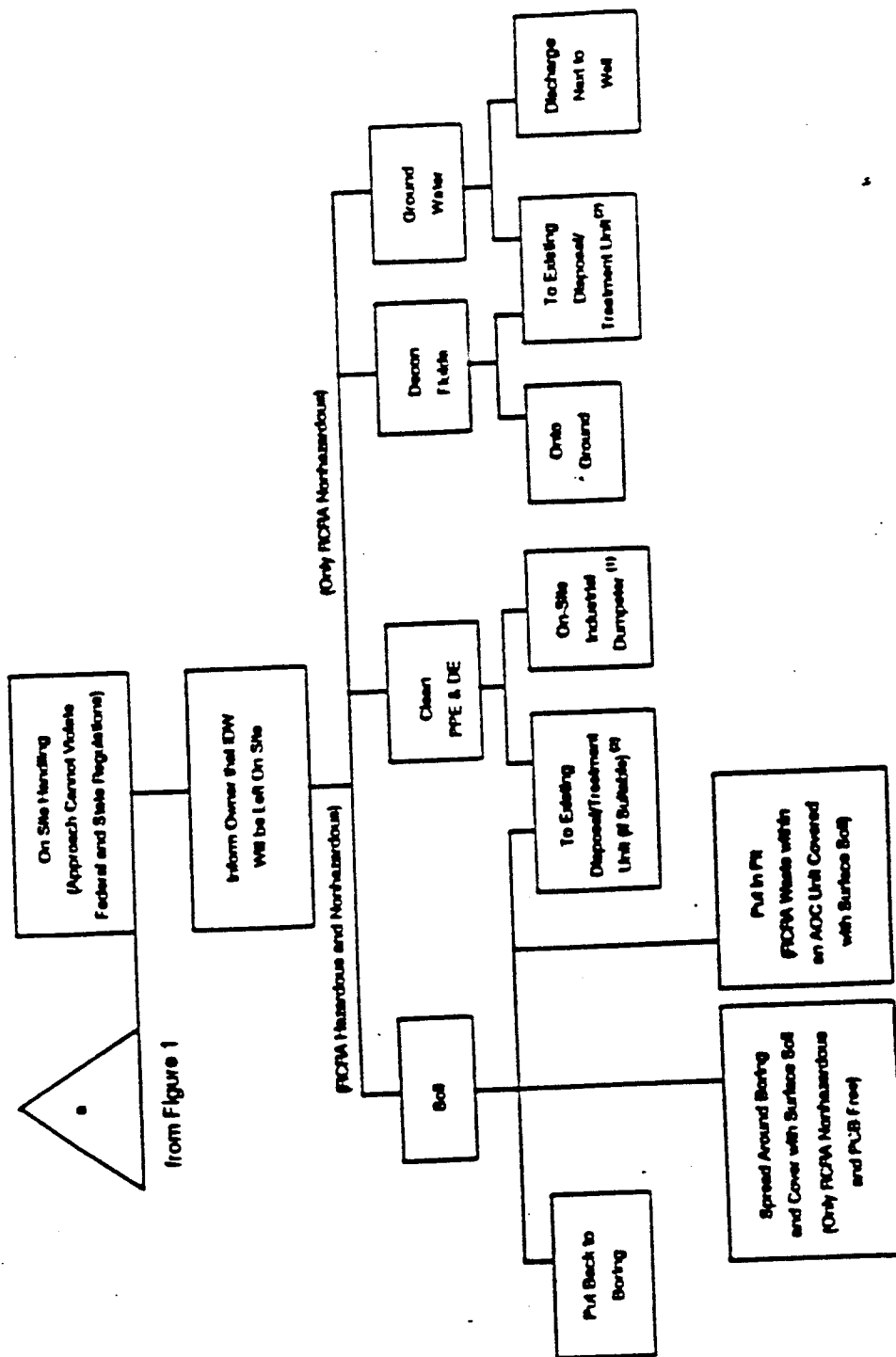
IDW Management Decision Tree



- (1) Soil cuttings, ground water, and decontamination fluids creating increased hazards at the site should be disposed off site. Before and after the SI, determine anticipated waste quantity and applicable regulations for waste generators.
- (2) If not prohibited by other legally enforceable requirements such as state ARAPs.
- (3) Justified only in rare circumstances when a RCRA nonhazardous waste is a state hazardous waste and state legally enforceable requirements call for waste removal, or if leaving the waste on site would significantly affect human health and the environment.

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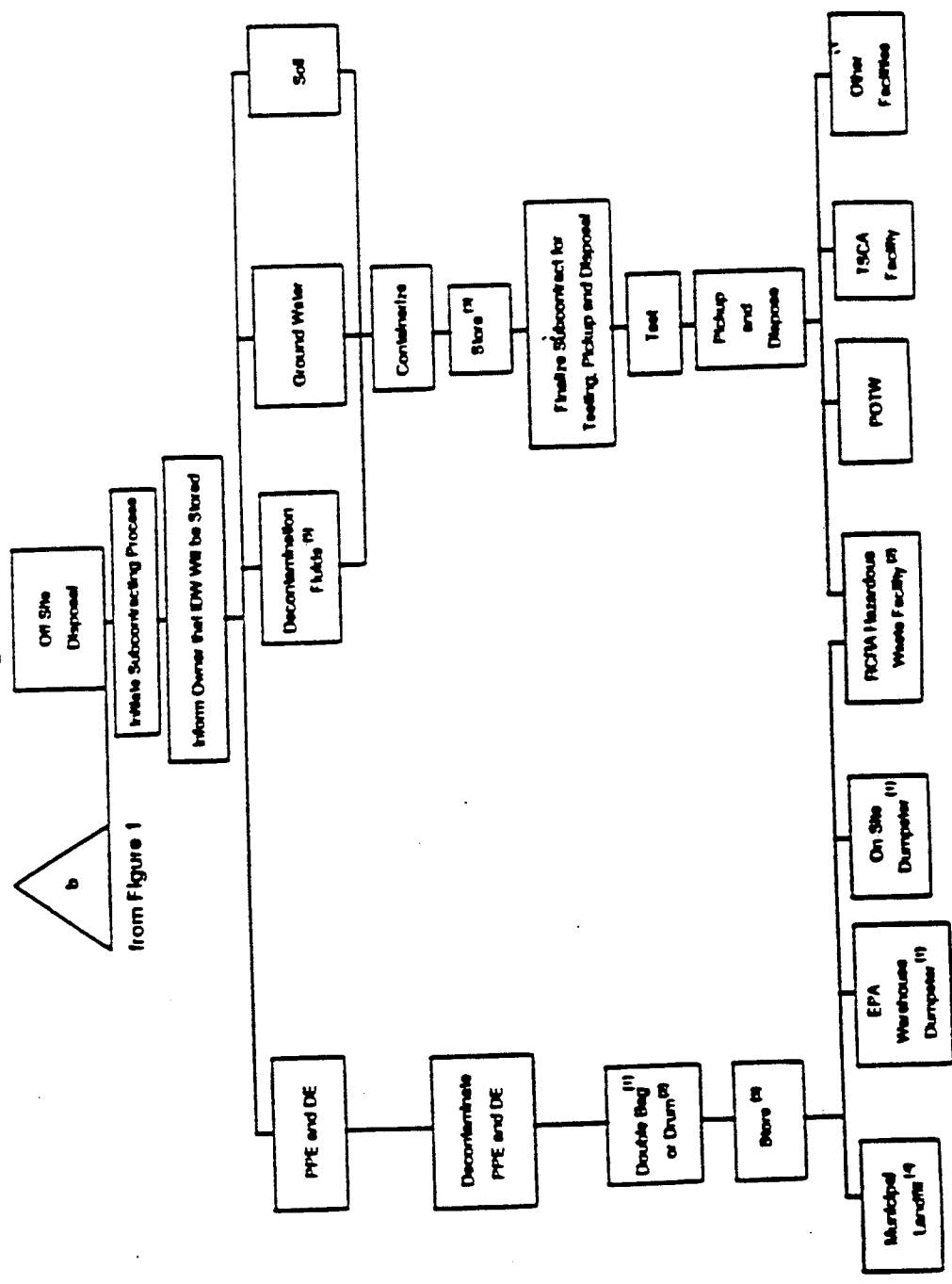
Figure 2
IDW Management Decision Tree



(1) Clean PPE and DE may also go to the nearest landfill or to an EPA warehouse dumpster.

(2) If the receiving unit meets the off-site policy acceptability criteria.

Figure 3
IDW Management Decision Tree



- (1) Only RCRA nonhazardous waste.
- (2) Only RCRA hazardous waste generated in quantities greater than 100 kg/month when sent off site.
- (3) In accordance with accumulation requirements for RCRA hazardous wastes.
- (4) Only if the conditionally exempt small quantity generator exception applies.
- (5) If the conditionally exempt small quantity generator exception applies, off site disposal of decon fluids may not require subcontracting

4.5 ON-SITE IDW HANDLING AND MANAGEMENT OPTIONS

If IDW are RCRA nonhazardous soil or water, they should be left on-site unless other circumstances, such as a state ARAR or a high probability of serious community concerns, require off-site disposal. RCRA hazardous soil also may be left on-site within an AOC unit. The SM must determine procedures for handling IDW on-site and notify the site owner in the site access agreement form that IDW such as soil cuttings and water will be left on-site. If the SM intends to leave IDW on-site, the waste should not be containerized and tested.

The on-site handling options available to the SM when IDW are RCRA nonhazardous are listed below.

- For soil cuttings:
 1. Spread around the well
 2. Put back to the boring
 3. Put into a pit within an AOC
 4. Dispose of at the site's operating TDU.
- For ground water:
 1. Pour onto ground next to the well to allow infiltration
 2. Dispose of at the site's TDU.
- For decontamination fluids:
 1. Pour onto ground (from containers) to allow infiltration
 2. Dispose of at the site's TDU.
- For decontaminated PPE and DE:
 1. Double bag and deposit in the site or EPA dumpster, or in any municipal landfill
 2. Dispose of at the site's TDU.

If IDW are considered RCRA nonhazardous due to lack of information on the waste hazard, the inspection team should have an alternative plan for handling IDW if field conditions indicate that these wastes are hazardous. In such a case, the minimum requirement is to have an adequate number of containers available for collecting ground water, decontamination water, or soil cuttings.

If IDW consist of RCRA hazardous soils that pose no immediate threat to human health and the environment, the SM should plan on leaving it on-site within a delineated AOC unit. However, before deciding to leave RCRA hazardous soil on-site, the SM must consider the proximity of residents and workers in the surrounding area. The SM must always use best professional judgment to make such decisions. Planning for leaving RCRA hazardous soil on-site involves:

- Delineating the AOC unit.
- Determining pit locations close to the borings within the AOC unit for waste burial.
- Covering hazardous IDW in the pits with surficial soil.
- Not containerizing and testing wastes designated to be left on-site.

Another alternative for handling RCRA hazardous soil is disposal in a TDU located on the same property as the AOC under investigation. If the TDU is outside the AOC, it must comply with the off-site policy. If any organic decon fluids are generated (which are RCRA hazardous wastes), they should be disposed of off-site in compliance with the off-site policy or in compliance with the conditionally exempt small quantity generator exemption. Small quantities (i.e., no more than 100 kg/month) of organic decon fluids may be containerized off-site prior to delivery to a hazardous waste facility.

4.6 OFF-SITE DISPOSAL OF IDW AND MANAGEMENT OPTIONS

IDW should be disposed off-site in the following situations:

- They are RCRA hazardous water.
- They are RCRA hazardous soil that may pose a substantial risk if left at the site.
- They are RCRA hazardous PPE and DE.
- If leaving them on-site would create increased risks at the site.

RCRA nonhazardous wastes could be disposed of off-site at appropriate RCRA nonhazardous facilities that are in compliance with CERCLA section 121(d)(3) and the off-site policy when it is necessary to comply with legally enforceable requirements such as state ARARs that preclude onsite disposal. IDW designated for off-site disposal must be properly containerized, tested, and stored before pick-up and disposal. Decontaminated PPE and DE should be double-bagged if sent to an off-site dumpster or a municipal landfill.

Planning for off-site disposal should include the following EPA guidelines:

- Incorporating a provision in the site access agreement form to inform the site owner that containerized IDW may be temporarily stored on-site while awaiting pickup for off-site disposal. The agreement should also request the owner's cooperation.
- Initiating the bidding process for IDW testing, pick-up, and disposal. If there are any subcontracting needs in planning for off-site disposal, EPA should specify what means of disposal will be needed (i.e. various types of treatment, landfilling, etc.). Since RCRA hazardous IDW must go to RCRA hazardous waste disposal facilities that comply with the off-site policy, the SM should obtain a list of available facilities from the RPO. Each EPA region maintains a list of RCRA hazardous TSD facilities that meet the conditions of the off-site policy. The recent addition of 25 new toxicity characteristic constituents to the list of toxic chemicals subject to RCRA hazardous waste regulations may result in fewer facilities available to handle IDW in the future. The SM must also check the selected facility's compliance before IDW pick-up. If IDW are RCRA nonhazardous, the SM must also check if the receiving RCRA nonhazardous waste facility complies with the off-site policy.
- Coordinating IDW generation with testing and pick-up. IDW samples should be collected in accordance with the "Test Methods for Evaluating Solid Waste" guidance manual (SW 846), and shipped for RCRA tests (and other tests, if necessary) as early as possible during the SI. This approach shortens the storage time and reduces the number of site visits to pick up waste. IDW need not be analyzed by a CLP laboratory. The SM should use the laboratory services of the pickup and disposal subcontractor, obtain an EPA ID number and manifest form for RCRA hazardous IDW, and a bill of lading for RCRA nonhazardous IDW.

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- Preparing adequate numbers and types of containers. Drums should be used for collecting small amounts of IDW. Larger amounts of soil and water can be contained in Baker tanks, poly tanks, and bins. PPE and DE should be double-bagged for disposal at a municipal landfill or collected in drums for disposal at a hazardous waste facility.
- Designating a storage area (either within the site's existing storage facility, existing fenced area, or within a temporary fence constructed for the SI). No humans, children in particular, may have access to the storage area. If a temporary storage facility is to be constructed, its location and size must be agreed upon with the site owner, and all construction materials should be delivered to the site before or on the first day of the SI.

EPA expects that complying with this guidance will limit on-site storage to, at most, the time required to complete any testing (usually less than 6 weeks) required by subcontractors in order to arrange for transportation. In most cases, this will not result in exceeding the regulatory 90 day storage time for quantities greater than 1,000 kg/month regardless of the quantity of IDW. In cases where the regulatory 90 day storage time for quantities greater than 1,000 kg/month is exceeded, the SM must initiate a subcontract bidding process to remove IDW wastes off-site and a permit is not required.

All IDW shipped off-site, whether RCRA hazardous or not, must go to facilities that comply with the off-site policy, and the SM must check that subcontractors operate in accordance with this policy.

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5.0 IMPLEMENTING THE IDW MANAGEMENT PLAN

The work plan describing the anticipated approach and procedures for IDW management should be clear, detailed, and concise to allow the field team to follow without problems. The plan should also be flexible enough to allow slight modifications due to unexpected and unforeseen field conditions. The SM should document implementation of the work plan in the field log book and describe the appearance of IDW as well as any modifications to the original handling approach. The SM must also ensure that IDW is handled in a fashion that does not generate public concerns.

5.1 ON-SITE IDW MANAGEMENT

If ground water or decontamination fluids are to be collected during the SI, adequate numbers and types of containers must be delivered to the site before the SI starts. The SM must check if the containers are clean and measure the pH of containerized waters even if these waters were originally determined to be RCRA nonhazardous. When the work plan calls for ground water to be poured onto the ground next to the well, then the SM must verify the original determination (e.g., pH testing) before allowing the water to infiltrate the ground.

If the SM, using best professional judgment, renders PPE and DE RCRA nonhazardous after decontamination, the materials are to be double-bagged and the SI team should take them to either the on-site or EPA warehouse dumpster, or to a municipal landfill. The location of PPE and DE disposal should be described in the field log book.

If the work plan calls for on-site management of RCRA hazardous soil cuttings, a shallow pit should be made close to the borings within a delineated AOC unit. IDW should then be buried in this pit and covered with surficial soil. The SM may decide to have more than one IDW burial pit within an AOC unit. The appearance of the generated IDW, and the size and location of the pit, must be described in the field log book.

If the work plan indicates that both RCRA hazardous and nonhazardous IDW are to be disposed in an operating treatment and disposal unit located on the same property as the IDW sources (but outside the AOC), then the SM must verify that the unit complies with the requirements of the off-site policy at the time of disposal.

5.2 OFF-SITE DISPOSAL OF IDW

Off-site disposal of RCRA hazardous and nonhazardous IDW involves the following common elements:

- Coordinating IDW handling.
- Identifying and verifying an acceptable disposal facility before the SI.
- Finalizing the subcontract.
- Containerizing IDW.
- Labeling containers.
- Storing containers.
- Sampling and testing of IDW.
- Transporting IDW off-site.

- Disposing at a disposal facility.
- Documenting the process.

Coordination of IDW handling is important because it affects the schedule and costs of the SI. Most coordination must be done before field activity starts. Before starting the field work, a subcontractor should be selected so the SM can coordinate field work and IDW generation with the subcontractor's sampling, testing, pick-up, and disposal activities. Before containerizing IDW, the SM should check the containers to ensure they are clean and do not contain any residues from past use. All filled containers should be dated and labeled as either RCRA hazardous or RCRA nonhazardous and stored in a safe manner in compliance with relevant regulations. The SM should also obtain an EPA ID number for a RCRA hazardous waste from the RPO.

If a temporary storage facility must be constructed, the SM should have all construction materials, such as chain-link fencing, posts, and other needed materials, delivered to a location agreed upon with the site owner before the SI. The SM should ensure that the storage time is short and never exceeds the regulatory 90 days for RCRA hazardous waste even if the small quantity generator exemption applies.

The SM should check that the subcontractor collects IDW analytical samples for the disposal facility "profile analysis" using EPA-recommended methods described in "Test Methods for Evaluating Solid Waste Physical/Chemical Methods" - SW 846. One composite sample should be collected from each large container or from a group of drums. Small samples of soil cuttings or drilling mud should be taken from several locations and depths of the handling containers, homogenized in a decontaminated bucket, and placed in sampling jars. Sampling of PPE and DE should be avoided. The SM should also ensure that the chain-of-custody form for shipping IDW samples is used. When the subcontractor's analysis confirms that IDW is a RCRA restricted hazardous waste, the SM should check that the subcontractor:

- Treats the IDW to meet the treatment standards (if needed) before land disposal.
- Complies with the LDR notification requirements of 40 CFR Part 268.

Containerized and tested RCRA hazardous IDW must be accompanied by a Hazardous Waste Manifest (and other forms required by state laws) if hauled off-site. RCRA nonhazardous IDW should have a bill of lading if transported off-site. The SM must obtain all required forms, fill them out clearly and completely, and have the forms signed by the RPO. The SM, if authorized, may sign the forms on behalf of EPA. Before transporting IDW to the selected facility, the SM must verify the facility's compliance with the off-site policy at the time of disposal. If the facility's status has changed since the award of the contract, (due to receiving citations or fines), the SM is responsible for finding a replacement facility without delay. The SM must receive a copy of the IDW analytical results and a confirmation of disposal from the subcontractor.

6.0 IDW HANDLING COSTS AND SUBCONTRACTING

This section presents and compares the costs of both on-site and off-site IDW management with emphasis on the costs of off-site disposal. The costs presented here are for general reference.

The costs of off-site IDW disposal have been increasing for several years and this trend is expected to continue in the future. Off-site IDW handling involves the use of a subcontractor to haul and dispose IDW in an appropriate facility that complies with the off-site policy. Most wastes generated during the SI and designated for off-site disposal are liquids, either RCRA hazardous or nonhazardous, which go to either RCRA wastewater treatment plants or POTWs. Solid IDW usually go to land disposal facilities.

On-site IDW handling, the EPA-preferred approach, involves the use of a variety of simple techniques for leaving the IDW in existing waste areas. These techniques include pouring RCRA nonhazardous decontamination fluids and ground water onto the ground, and burying soil cuttings in a shallow pit in the investigation area.

6.1 ON-SITE IDW MANAGEMENT

On-site IDW handling generally incurs no costs and does not delay the SI. Drums may be needed for collecting water. However, these drums will be recovered and reused on other SIs, so the cost of purchasing drums, distributed over several SIs, is negligible. The cost of digging shallow pits can be covered under the drilling subcontract. Spreading soil cuttings around the boring, or pouring ground water onto the ground, incurs no costs.

6.2 OFF-SITE DISPOSAL OF IDW

Handling IDW off-site involves hiring a subcontractor to provide transportation, testing, and disposal services. This approach allows the waste generator to select the most technically advanced and economically suitable disposal facility that complies with regulations. However, off-site management has several disadvantages including: (1) increasing costs of the services; (2) loss of control over the fate of IDW while still being liable for the waste; (3) potential for accidental spills during transportation; (4) difficulty in finding a suitable disposal facility; and (5) the reluctance of states to accept out-of-state wastes for disposal.

The costs of off-site IDW handling consist of the following elements: (1) containerization; (2) testing; (3) transportation; and (4) disposal. The costs of containers (usually 55-gallon drums) used to collect waste is about \$50/drum. These containers may be purchased by either EPA or the subcontractor. The cost of containers purchased by subcontractors is usually higher, therefore, the SM may decide to purchase all necessary containers.

The cost of the "profile analysis," performed by the subcontractor to verify the waste hazard prior to transport is between \$40 and \$300/sample. The total cost of the analysis depends on the number of samples and the parameters analyzed. The cost of transportation varies depending on factors such as the distance between the site and the disposal facility, the number of drums (the price per drum is lower when more drums are transported), and whether the pickup service is set for an individual generator or for several waste generators which is less expensive. In 1990, the estimated price range for waste transportation (regardless of whether IDW are hazardous) was between \$35 to \$600/drum.

The costs of disposal depend on the waste hazard, matrix, and amount. The ranges of costs per drum are presented below:

- RCRA nonhazardous liquid: \$12.50 - 345/drum
- RCRA hazardous liquid: \$155 - 550/drum
- RCRA nonhazardous solid: \$66 - 135/drum
- RCRA hazardous solid: \$145 - 615/drum

Additional costs of handling IDW off-site include:

- Storage.
- Field trips (to assist in waste sampling and pickup).
- Procurement expenses.

If IDW on-site storage is not available before pickup, a chain-link fence can be built at an average cost of \$600 (\$300 for the materials and \$300 for labor). The cost of procurement is estimated at about \$300 per site. The cost of the field trips depends on the coordination of waste generation, testing, and pickup.

The site manager must select a subcontractor before field work is completed, so the subcontractor can collect IDW samples for the "profile analysis" while the SM is still on-site. This approach requires only one more field trip to assist in the waste pickup. If two additional trips are needed (one for collecting IDW samples and one for IDW pickup), the costs of IDW disposal increase significantly. For example, if there are two drums to dispose of, the transportation, testing, and disposal cost is \$700, and one field trip costs \$500, the total cost of IDW handling is \$1,200. An additional field trip would result in a total cost of \$1,700, a 42 percent increase.

The approximate cost ranges of managing one drum of IDW off-site, depending on the waste hazard, are presented below:

WASTE	CONTAINER (\$)	TEST (\$)	TRANSPORTATION (\$)	DISPOSAL (\$)	STORAGE PROCUREMENT AND FIELD TRIPS (\$)	TOTAL* (\$)
RCRA Hazardous Solid	50	20-150	35-600	145-615	233	500-1650
RCRA Non-Hazardous Solid	50	20-150	35-600	66-135	233	400-1200
RCRA Hazardous Liquid	50	20-150	35-600	155-550	233	500-1600
RCRA Non-Hazardous Liquid	50	20-150	35-600	12.50-345	233	350-1400

* Based on the following assumptions: (1) 6 drums/site, (2) 1 sample/2 drums and, (3) only one field trip required for waste pickup at a cost of \$500/6 drums (\$83/drum).

The role of the SM in coordinating field activities, the subcontracting process, and IDW management is crucial to reducing the costs of IDW management. Disposing IDW off-site always results in high costs regardless of the waste hazard because there is no significant difference between the costs of disposal of hazardous and nonhazardous wastes. The SM should apply the most efficient management techniques to lower the costs of IDW handling whenever possible, and when such practices do not threaten human health and the environment.

6.3 SUBCONTRACTING

To implement subcontracting services for off-site disposal of IDW, the SM should refer to Federal guidelines. These guidelines are available from the Federal Acquisition Regulations (FAR). Federal Superfund contractors generally follow these guidelines.

Names of these subcontractors are available from either a local telephone directory, a state environmental agency list (in some states), or from the Hazardous Materials Control Directory (published annually by the Hazardous Materials Control Research Institute). Waste management facilities of all prospective bidders must be in compliance with the off-site policy during the bidding process and when the IDW are transported and disposed of. The SM and EPA are responsible for verifying the subcontractor's facility compliance with the policy. If the selected facility's status changes before the date of transport and disposal, the subcontract should be immediately awarded to the next lowest bidder if this bidder is able to meet the regulatory storage time limits.

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REFERENCES

1. 40 CFR Part 300, National Oil and Hazardous Substances Pollution Contingency Plan, Final Rule, 55 FR 8666-8865, March 8, 1990 (see Appendix A - Relevant Parts of the NCP).
2. 40 CFR Parts 240-280, Solid Waste Regulations, 1988.
3. 40 CFR Part 300.440, Amendment to the National Oil and Hazardous Substances Pollution Contingency Plan; Procedures for Planning and Implementing Off-Site Response Actions; Proposed Rule, 53 FR 48218-48234, November 29, 1988.
4. OSWER Directive 9834.11, November 13, 1987 - "EPA Off-Site Policy."
5. OSWER Directive 9347.3-05 FS, July 1989 - Superfund LDR Guide #5 (see Appendix B).
6. 40 CFR 761.60 - 761.79 - TSCA Regulations, 1988.
7. OSWER Directive 9330.2-4, April 15, 1986 - "Discharge of Wastewater from CERCLA Sites into POTWs" (see Appendix C).
8. "CERCLA Site Discharges to POTWs" - Guidance Manual (EPA/540/G-90/005, August 1990).
9. 40 CFR 403.5 CWA Regulations, 1988.
10. "CERCLA Compliance with Other Laws Manual" (Part I - EPA/540/G-89/006, Part II - EPA/540/G-89/009, 1989).
11. 40 CFR Part 261 et al., Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule 1990 (see Appendix D - TCLP Constituents Table).

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APPENDIX A to EPA/540/G-9/1009
RELEVANT PARTS OF THE NCP

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Thursday
March 8, 1990

Final Rule

Part II

Environmental Protection Agency

40 CFR Part 300

National Oil and Hazardous Substances
Pollution Contingency Plan; Final Rule



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300.420(c)(5) describes the information contained in a lead-agency report following completion of a remedial site investigation, including documentation as well as sampling data and potential risks to humans and the environment.

Response to comments: A commenter asked that the NCP state that reasonable efforts will be made during the site investigation phase to identify PRPs and provide them copies of the preliminary assessment/site investigation (PA/SI) report and an opportunity to comment.

The removal and remedial processes as currently outlined in the NCP provide PRPs with a reasonable opportunity to review and comment on lead agency actions at a site when the proposed plan is made available. Before this time, documents placed in the administrative record, including the PA/SI, are available for public inspection. In addition, PRPs that are interested in more extensive involvement in the investigation process may agree to undertake removal or remedial actions through a settlement agreement with EPA. They may be granted substantially more site involvement than non-settling PRPs.

Extending the formal review and comment period to PRPs as far back in the removal and remedial process as the PA/SI stage would unnecessarily slow down preliminary fact-gathering at a site. In cases where removal actions are considered emergency or time-critical, such review and comment time would unjustifiably delay response to a dangerous situation. Also, in most cases, the PRP search has not been completed or even started in a comprehensive manner at the time of the PA/SI. Accordingly, specifying formal procedures for PRP involvement at that time is not practical.

Final rule: EPA is promulgating §§ 300.410(c)(2) and 300.420(c)(5) as proposed.

Name: Section 300.410(g). Notification of natural resource trustee.

Final rule: Section 300.410(g) is revised as follows (see preamble discussion on § 300.615):

If natural resources are or may be injured by the release, the OSC or lead agency shall ensure that state and federal trustees of the affected natural resources are promptly notified in order that the trustees may initiate appropriate actions, including those identified in subpart G of this part. The OSC or lead agency shall seek to coordinate necessary assessments, evaluations, investigations, and planning with such state and federal trustees.

Name: Sections 300.415(b)(4) and 300.420(c)(4). Sampling and analysis plans.

Proposed rule: Proposed § 300.415 did not describe sampling requirements. Proposed § 300.420(c)(4) described the procedures necessary for preparing a site-specific sampling plan for a remedial site inspection.

Response to comments: One commenter stated that EPA should revise § 300.420(c)(4) to specify review of the sampling plan to ensure that appropriate sampling and quality control procedures are followed. In response, EPA is revising the description of the site-specific sampling plan in proposed § 300.420(c)(4) to conform with the purpose of the quality assurance project plan (QAPP) defined in § 300.5 and the QAPP and sampling and analysis plan described in

§ 300.430(b)(8), which states that such plans will be approved by EPA. This change emphasizes the similarity of these activities in the site evaluation and remedial investigation parts of the program. In addition, EPA believes that, when samples will be taken, it is appropriate to describe sampling requirements for non-time-critical removal actions to ensure that data of sufficient quality and quantity will be collected for this type of action.

EPA also notes that portions of the QAPP may incorporate by reference non-site-specific standardized portions of already-approved QAPPs, especially those portions addressing policy and organization, or describing general functional activities to be conducted at a site to ensure adequate data. This eliminates the necessity to reproduce non-site-specific quality assurance procedures for every site.

Final rule: Proposed §§ 300.415(b)(4) and 300.420(c)(4) are revised as follows:

1. In § 300.415(b)(4), a requirement has been added for developing a sampling and analysis plan, when samples will be taken.

2. Section 300.420(c)(4) is revised to better describe the required contents of the sampling and analysis plan.

Section 300.415. Removal Action.

Name: Section 300.415(b)(5)(ii).

Removal action statutory exemption.

Proposed rule: CERCLA section 104(c)(1)(C) provides a new exemption to the statutory limits on Fund-financed removal actions of \$2 million and 12 months. This exemption, stated in the NCP in § 300.415(b)(5)(ii), is applicable when continued response is otherwise appropriate and consistent with the remedial action to be taken. EPA expects to use the exemption primarily for proposed and final NPL sites, and only rarely for non-NPL sites (see 53 FR 51409).

Response to comments: One commenter supported EPA's proposal to allow waiver of the limits on Fund-financed removal payments if such an exemption is consistent with remedial actions.

One commenter stated that the decision to engage in a removal action should be based on site conditions and their impact on health and the environment, not cost or time; that once EPA concludes that a removal action is appropriate, the various alternatives should be analyzed at both likely NPL and non-NPL sites equally. The commenter felt that EPA should use the consistency exemption more liberally where time, rather than money, was the complicating factor.

In response, Congress has made the determination that cost and time are relevant factors in deciding how extensive a Fund-financed removal action may be; thus, contrary to the commenter's remark, EPA will continue to consider such factors. Further, Congress did not differentiate between time and dollar limits in setting the exemptions; EPA notes that exceeding the time limit will often also increase the cost of a removal action, even though it does not necessarily raise the cost to over \$2 million. Thus, EPA does not believe it should set different criteria for their use.

The new exemption from the time and dollar limits applies to any Fund-financed removal and thus encompasses state-lead as well as EPA-lead responses. Actions where EPA has the lead, but is to be reimbursed by private parties or other federal agencies, are still subject to the statutory limits and provisions for exemption.

Because the exemption requires consistency with the remedial action to be taken, its use is well suited to proposed or final NPL sites where remedial action is likely to be taken. It may also be appropriate to use this exemption at some non-NPL sites where justified on a case-by-case basis.

Final rule: EPA is promulgating the rule as proposed.

Name: Section 300.415(i). Removal action compliance with other laws.

Existing rule: The current NCP in § 300.65(f) requires that Fund-financed removal actions and removal actions pursuant to CERCLA section 106 attain or exceed, to the greatest extent practicable considering the exigencies of the circumstances, applicable or relevant and appropriate federal public health and environmental requirements. Other federal criteria, advisories, and guidance and state standards are to be

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responses and responses conducted by PRPs (emergency and time-critical removals are not covered by this policy). This notification should specify the type and quantity of waste involved, the name and location of the receiving facility and the expected schedule for the transfer of the CERCLA waste. Such notification will enable the recipient state to obtain from its permitted facilities any other information it may need in order to support the out-of-state action. Although this notification is neither mandated by CERCLA nor required by this regulation, EPA believes that adherence to this procedure will help to ensure that these waste transfers occur in a safe and expeditious manner. The policy is explained in more detail in OSWER Directive No. 8330.2-07 (September 14, 1989).

Because CERCLA actions may be carried out under a number of mechanisms and by a number of parties (e.g., lead state agencies, other federal agencies, PRPs), EPA plans to issue additional guidance or regulations, if appropriate, to implement this notification policy.

Final rule: There is no rule language on this issue.

Applicable or Relevant and Appropriate Requirements

Introduction. The November 20, 1985 revisions to the NCP required that, for all remedial actions, the selected remedy must attain or exceed the federal applicable or relevant and appropriate requirements (ARARs) in environmental and public health laws. It also required removal actions to attain ARARs to the greatest extent practicable, considering the exigencies of the circumstances. The preamble to the 1985 revisions to the NCP stated that ARARs could be determined only on a site-by-site basis, and it included from EPA's October 2, 1985 Compliance Policy a list of potentially applicable or relevant and appropriate requirements. The preamble also provided a list of federal non-promulgated criteria, advisories and guidance, and state standards "to be considered," called TBCs. EPA also provided five limited circumstances in which ARARs could be waived.

On October 17, 1986, CERCLA was reauthorized with additional new requirements. Section 121 of CERCLA requires that, for any hazardous substance that will remain on-site, remedial actions must attain requirements under federal environmental or state environmental or facility siting laws that are applicable or

relevant and appropriate under the circumstances of the release or threatened release at the completion of the remedial action. The statute also retained most of the waivers, with a few additions.

Although section 121(d)(2) basically codified EPA's 1985 policy regarding compliance with other laws, the section also requires that state standards are also potential ARARs for CERCLA remedial actions when they are promulgated, more stringent than federal standards, and identified by the state in a timely manner.

Furthermore, the CERCLA amendments provide that federal water quality criteria established under the Clean Water Act (CWA) and maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act, must be attained when they are relevant and appropriate under the circumstances of the release.

Today's revision to the NCP continues the basic concept of compliance with ARARs for any remedy selected (unless a waiver is justified). ARARs will be determined based upon an analysis of which requirements are applicable or relevant and appropriate to the distinctive set of circumstances and actions contemplated at a specific site. Unlike the 1985 revisions to the NCP, where alternatives were developed based on their relative attainment of ARARs, in today's rule recognition is given to the fact that ARARs may differ depending on the specific actions and objectives of each alternative being considered (for more discussion of this point, see preamble of proposal at 53 FR 51438, section 9).

In today's rule, EPA retains its policy established in the 1985 NCP of requiring attainment of ARARs during the implementation of the remedial action (where an ARAR is pertinent to the action itself), as well as at the completion of the action, and when carrying out removal actions "to the extent practicable considering the exigencies of the situation."

For ease of identification, EPA divides ARARs into three categories: chemical-specific, location-specific, and action-specific, depending on whether the requirement is triggered by the presence or emission of a chemical, by a vulnerable or protected location, or by a particular action. (More discussion of these types can be found in the preamble of the proposal at 53 FR 51437, section 6).

Response to comments: EPA received a few comments on general ARARs policies. One commenter argued that the remedial action should not necessarily

have to attain the most stringent applicable or relevant and appropriate requirement if a less stringent requirement provides adequate protection of human health and the environment.

EPA disagrees. CERCLA requires that remedial actions comply with all requirements that are applicable or relevant and appropriate. Therefore, a remedial action has to comply with the most stringent requirement that is ARAR to ensure that all ARARs are attained. In addition, CERCLA requires that the remedies selected be protective of human health and the environment and attain ARARs. A requirement does not have to be determined to be necessary to be protective in order to be an ARAR. Conversely, the degree of stringency of a requirement is not relevant to the determination of whether it is an ARAR at a site and must be attained (except for state ARARs).

Another commenter asked for confirmation that variance or exemption provisions in a regulation can be potential ARARs as well as the basic standards. EPA agrees that meeting the conditions and requirements associated with a variance or exemption provision can be a means of compliance with an ARAR. For example, EPA expects that CERCLA sites will frequently be complying with the terms of the treatability variance under the RCRA land disposal restrictions (LDR) for soil and debris when LDR is an ARAR.

Limitations in a regulation, such as the quantity limitations that define small quantity generators under RCRA and affect what requirements a generator must comply with, will also affect what requirements are applicable at a CERCLA site. However, it is possible that a requirement could be relevant and appropriate even though the requirement is not applicable because of a limitation in the regulation.

Indian tribe commenters contended that ARARs should not be defined as promulgated laws, regulations, or requirements because some Indian tribe laws, which could apply to a Superfund cleanup, may not be promulgated in the same fashion as state or federal laws. CERCLA section 126 directs EPA to afford Indian tribes substantially the same treatment as states for certain specified subsections of CERCLA sections 103, 104 and 105. EPA believes, as a matter of policy, that it is similarly appropriate to treat Indian tribes as states for the purpose of identifying ARARs under section 121(d)(2). EPA realizes that tribal methods for promulgating laws may vary, so any evaluation of tribal ARARs will have to

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Page 77 is continuing page

water, thus, the removal action might be limited to removal of the drums and surface debris and excavation of highly contaminated soil. Requirements pertaining to the cleanup of ground-water contamination would not be ARARs for that action because the removal action is not intended to address ground water; rather, requirements pertaining to the drums, surface debris, or contaminated soil may be ARARs for the specific removal action. Once the lead agency makes the determination that the requirements are ARARs for a removal, then it must determine whether compliance is practicable.

It will generally be practicable for removal actions to comply with ARARs that are consistent with the goals and focus of the removal. However, as stated above, removals are intended to be responses to near-term threats, with the ability to respond quickly when necessary; thus, ARARs that would delay rapid response when it is necessary, or cause the response to exceed removal goals, may be determined to be impracticable. Of course, even where compliance with specific ARARs is not deemed practicable, the lead agency for a removal must use its best judgment to ensure that the action taken is protective of human health and the environment within the defined objectives of the removal action.

In order to better explain how a lead agency can determine when compliance with an ARAR is practicable, the preamble to the proposed NCP included three factors for consideration: Exigencies of the situation, scope of the removal action and the statutory limits (53 FR 51410-11). Upon consideration of comments, EPA has decided to enumerate in the rule only two of those three factors as important for determining practicability: Urgency (simply renaming exigencies) of the situation, and scope of the removal action. EPA believes that statutory limits, because they relate to the authority to conduct removal actions, are easier to consider within, rather than apart from, the factor of scope of the removal action when determining whether compliance with an ARAR is practicable.

The factor of urgency of the situation relates to the need for a prompt response. In many cases, appropriate response activities must be identified and implemented quickly in order to ensure the protection of human health and the environment. For example, if leaking drums pose a danger of fire or explosion in a residential area, the

drums must be addressed immediately, and it will generally be impracticable to identify and comply with all potential ARARs.

The second factor, the scope of the removal action relates to the special nature of removals in that they may be used to minimize and mitigate potential harm rather than totally eliminate it. Removals are further limited in the amount of time and Fund money that may be expended at any particular site in the absence of a statutory exemption. Again, using the example above, even though standards requiring cleanup of the lower level soil contamination would be an ARAR to that medium, they would be outside the scope of the removal action when such cleanup is not necessary for the stabilization of the site, or when it would cause an exceedance of the statutory limits and no exemption applied. Hence, such soil standards, while ARARs, would not be practicable to attain considering the exigencies of the situation. Of course, such standards may be ARARs for any remedial action that is subsequently taken at the site.

EPA disagrees with the comment that requiring PRPs to comply with ARARs to the extent practicable discourages PRPs from conducting removals because the statutory limits do not apply to non-Fund-financed actions. Although the limits apply by law to Fund-financed actions only, EPA has the discretion under CERCLA section 104(c)(1) to take removal actions that exceed those limits, in emergency situations or where the action is otherwise appropriate and consistent with the remedial action that may be taken at the site. EPA will select the appropriate remedy, even where an extensive removal action is warranted, regardless of whether the site is Fund-lead or PRP-based. The only difference is that if the site is Fund-lead, an exemption must first be invoked in order to proceed with the action. Thus, the time and dollar limitations generally will not result in PRPs performing a more extensive removal than EPA itself would conduct. That is, EPA's selection of a removal action, including what ARARs will be attained, will not be based on who will be conducting the removal.

Finally, as stated in the preamble to the proposed NCP (53 FR 51411), even if attainment of an ARAR is practicable under the factors described above, the lead agency may also consider whether one of the statutory waivers from compliance with ARARs is available for a removal action. EPA is developing guidance on the process of complying with ARARs during removal actions. EPA generally will only require

documentation of ARARs for which compliance is determined to be practicable, in order not to burden OSCs with substantial paperwork requirements.

Final rule: Proposed § 300.415(j) (renumbered as final § 300.415(i)) is revised as follows:

1. The following has been added to identify factors that are appropriate for consideration in determining the practicability of complying with ARARs:

In determining whether compliance with ARARs is practicable, the lead agency may consider appropriate factors, including the following:

- (1) The urgency of the situation; and
- (2) The scope of the removal action to be conducted.

2. The reference to advisories, criteria or guidance has been modified (see preamble section below on TBCs).

3. The description of ARARs has been reworded (see preamble section below on the definition of "applicable.")

Name: Sections 300.5, 300.415(g) and (h), 300.500(a), 300.505 and 300.525(a). State involvement in removal actions.

Existing rule: Sections 300.61 and 300.62 of the current NCP encourage states to undertake actions authorized under subpart F. Such actions include removal and remedial actions pursuant to CERCLA section 104(a)(1). The regulation notes further that CERCLA section 104(d)(1) authorizes the federal government to enter into contracts or cooperative agreements with the state to take Fund-financed response actions authorized under CERCLA, when the federal government determines that the state has the capability to undertake such actions.

Proposed rule: Proposed § 300.415(h) and (i) (renumbered as final § 300.415(g) and (h)) and § 300.525(a) would codify EPA's existing policy of entering into cooperative agreements with states to undertake Fund-financed removal actions, provided that states follow all the provisions of the NCP removal authorities. The preamble to the proposed rule suggested that non-time-critical actions are the most likely candidates for state-lead removals (53 FR 51410). Proposed § 300.510(b) provided further that facilities operated by a state or political subdivision require a minimum cost share of 50 percent of the total response costs if a remedial action is taken. Section 300.505 describes what EPA and a state may agree to in a Superfund Memorandum of Agreement (SMOA) regarding the nature and extent of interaction on EPA-lead and state-lead response. The preamble clarified that, where practicable, a SMOA may include general provisions

considered, as appropriate, in formulating a removal action.

Proposed rule: Proposed § 300.415(j) (renumbered as 300.415(i) in the final rule) required that removal actions attain, to the extent practicable considering the exigencies of the situation, all state as well as federal applicable or relevant and appropriate requirements (ARARs).⁶ Other federal and state criteria, advisories, and guidance shall, as appropriate, be considered in formulating the removal action. The proposed revisions also note that statutory waivers from attaining ARARs may be used for removal actions. In addition, the preamble to the proposed revisions provided guidance clarifying three factors to be considered in determining the "practicability" of complying with ARARs: The exigencies of the situation, the scope of the removal action to be taken, and the effect of ARAR attainment on the removal statutory limits for duration and cost (53 FR 51410-11).

Response to comments: Several commenters supported the proposed revision to the NCP requiring that both federal and state ARARs be complied with when conducting removal actions. One commenter asked what documentation is required to show that ARARs have been identified and requested that EPA develop guidance providing hypothetical conditions describing the extent to which ARAR analysis should be performed. Another commenter stated that non-Fund-financed removal actions conducted at federal facilities also should be required to comply with ARARs.

In opposition to the proposal, a number of commenters pointed out that Congress did not intend that removal actions be required to comply with ARARs. The commenters suggested that, based on the legislative history, Congress intended that only remedial actions be subject to compliance with ARARs. According to one commenter, the legislative history states that ARARs do not apply during removal actions because removal actions are short-term, relatively low-cost activities of great urgency that should be free of the delays that may arise if it is necessary to identify and attain ARARs.

Other commenters suggested that attainment of ARARs should not be required during removal actions because removal actions are not intended to completely clean up a site, but rather to quickly eliminate or control an

immediate threat. The commenters argued that compliance with ARARs is based on what remains on site after an entire remedy is completed, not after a particular problem is controlled. In addition, several commenters argued that the main purpose of the removal program is quick mitigation of threats, and that requiring ARARs to be complied with during removal actions undermines this purpose by slowing down the cleanup process. The commenters suggested that such procedural delays as identification of ARARs will hinder the removal program's ability to respond to emergencies swiftly.

Several additional commenters suggested that requiring attainment of ARARs discourages PRPs from undertaking removal actions. Fund-financed removals can use the statutory limits to limit attainment of ARARs; those limits do not apply to PRP actions.

One commenter opposed the provision that requires OSCs to justify why they are not attaining ARARs during a specific removal action. The commenter argued that the prospect of an OSC being required to justify why he or she is not attaining all ARARs is inconsistent with removal program objectives.

Other commenters believed that the current policy concerning compliance with ARARs during removal actions should be replaced with a more discretionary policy. They suggested that OSCs should only be required to comply with ARARs that are most crucial to the proper stabilization of the site and protection of public health and the environment.

In response, EPA has carefully reviewed this issue in light of the public comments, and believes a number of clarifying points need to be made. First, as a threshold matter, EPA agrees that Congress did not, in the 1986 amendments to CERCLA, "require" EPA to meet ARARs during removal actions. However, it has been EPA's policy since 1985, established in the NCP, to attain ARARs during removals to the extent practicable, considering the exigencies of the situation. EPA believes that this is still a sound policy. Reference to requirements under other laws (i.e., ARARs) help to guide EPA in determining the appropriate manner in which to take a removal action at many sites.

If, for example, a component of the removal action is to discharge treated waste to a nearby river or stream, effluent limitations based on federal or state water quality criteria will be useful in determining the extent of such treatment. Today's policy is consistent

with section 105 of CERCLA which directs that the NCP include methods and criteria for determining the appropriate extent of removals. Thus, EPA is maintaining the policy described in the preamble to the proposed NCP, although EPA has modified the factors to be considered in determining practicability.

A number of other comments questioned the extent to which removals should attempt to attain ARARs. In responding to such comments, it is important to note that the policy that removals comply with ARARs to the extent practicable is defined in large part by the purpose of removal actions.

The purpose of removal actions generally is to respond to a release or threat of release of hazardous substances, pollutants, or contaminants so as to prevent, minimize, or mitigate harm to human health and the environment. Although all removals must be protective of human health and the environment within their defined objectives, removals are distinct from remedial actions in that they may mitigate or stabilize the threat rather than comprehensively address a threat at a site. Consequently, removal actions cannot be expected to attain ARARs. Remedial actions, in contrast, must comply with all ARARs (or invoke a waiver). Indeed, the imposition by Congress of limits on the amount of time and Fund money that may be spent conducting a removal action often precludes comprehensive remedies by removal actions alone. Removal authority is mainly used to respond to emergency and time-critical situations where long deliberation prior to response is not feasible. All of these factors—limits on funding, planning time, and duration, as well as the more narrow purpose of removal actions—combine to circumscribe the practicability of compliance with ARARs during individual removal actions. Indeed, the vast majority of removals involve activities where consideration of ARARs is not even necessary, e.g., off-site disposal, provision of alternate water supply, and construction of fences, dikes and trenches.

Further, it should be noted that requirements are ARARs only when they pertain to the specific action being conducted. If, for example, a site has leaking drums, widespread soil contamination, and significant groundwater contamination, the removal action at the site might only involve actions necessary to reduce the near-term threats, such as direct contact and further deterioration of the ground

⁶ Note that proposed § 300.415(e) has been deleted (see preamble section above on "Listing sites in CERCLIS," and the remaining sections in § 300.415 have been renumbered.

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78

be made on a case-by-case basis. Tribal requirements, however, are still subject to the same eligibility criteria as states, as described in § 300.400(g)(4).

Another commenter disagreed with EPA's position that environmental laws do not apply to a CERCLA response action unless incorporated by CERCLA section 121(d). This commenter argued that EPA has confused the ARARs concept with one of preemption of state law.

In response, SARA established a process, in CERCLA sections 121(d)(2) and (d)(4), for how federal and state environmental laws should apply to on-site CERCLA remedial actions, i.e., the ARARs process. Based on these provisions, CERCLA remedies will incorporate (or waive) state standards, as appropriate under CERCLA. Thus, although other environmental laws do not independently apply to CERCLA response actions, the substantive requirements of such laws will be applied to such actions, consistent with section 121(d) and NCP § 300.400(g).

EPA's interpretation that CERCLA response actions are required to meet state (and other federal) environmental law standards only to the limited degree set out in CERCLA is also necessary to comply with the special mandates in CERCLA to respond quickly to emergencies, and to perform Fund-balancing. The position that on-site CERCLA response actions are not independently subject to other federal or state environmental laws is a long-standing one, based on a theory of implied repeal or pre-emption. See, e.g., 50 FR 47912, 47917-18 (Nov. 20, 1985); 50 FR 5862, 5865 (Feb. 12, 1985); "CERCLA Compliance With Other Environmental Laws" Opinion Memorandum, Francis S. Blake, General Counsel, to Lee M. Thomas, Administrator, Nov. 22, 1985.

Following are summaries of major comments and EPA's responses on specific sections of the ARARs policy.

Name: Sections 300.5 and 300.400(g)(1). Definition of "applicable."

Proposed rule: "Applicable requirements" means those cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. The preamble to the proposed rule pointed out that there is generally little discretion in determining whether the circumstances at a site match those specified in a requirement (53 FR 51435-37).

Response to comments: One commenter suggested that language used in § 300.400(g)(4) of the proposed NCP which provides that "only those state standards that are promulgated and more stringent than federal requirements may be applicable or relevant and appropriate" be added to the definition of ARARs found in § 300.5.

In response, EPA notes that the definition it proposed already includes the condition that standards, whether federal or state, must be promulgated in order to be potential ARARs. EPA accepts this comment on stringency and has revised both §§ 300.5 and 300.400(g) to specify that in order to be considered ARARs, state requirements must be more stringent than federal requirements. EPA notes that, in general, state regulations under federally authorized programs are considered federal requirements.

A commenter supported the discussion of ARARs in the preamble to the proposed NCP, but remarked that the definitions of ARARs do not adequately reflect many of the important aspects mentioned in the preamble. EPA believes that the definitions stated in the rule are sufficiently comprehensive and that the information contained in the preamble to the proposed and final rules will help the public in applying the definitions.

One commenter asked why EPA had deleted rule language that applicable requirements are those requirements that would be legally applicable if the response action were not undertaken pursuant to CERCLA. In working with this definition, EPA found the previous definition confusing because it was stated in the conditional, i.e., requirements that would apply if the action were not under CERCLA. EPA revised the definition to explain more specifically what it means by applicable requirements to avoid any confusion. However, the 1985 wording is still a correct statement of the applicability concept. EPA is modifying the definition, however, to make it clear that the standards, etc. do not have to be promulgated specifically to address CERCLA sites.

Final rule: The proposed definition of "applicable" in §§ 300.5 and 300.400(g)(1) are revised as follows:

1. Consistent with the language in CERCLA section 121(d)(2), the description of federal and state laws in § 300.5 is revised to read:

"... requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting law"
[Comparable changes are made in

§§ 300.415(i), 300.430(e)(2)(i)(A), 300.430(e)(9)(iii)(B) and 300.430(f)(1)(ii)(C).]

2. The following sentence is added to § 300.5: "Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."

3. In §§ 300.5 and 300.400(g)(1), the word "found" is added before "at a CERCLA site."

Name: Sections 300.5 and 300.400(g)(2). Definition of "relevant and appropriate."

Proposed rule: "Relevant and appropriate requirements" means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Section 300.400(g)(2) identified criteria that must be considered, where pertinent, to determine whether a requirement addresses problems or situations that are sufficiently similar to the circumstances of the release or remedial action that it is relevant and appropriate. The preamble to the proposed rule emphasized that a requirement must be both relevant and appropriate; this determination is based on best professional judgment. Also, the preamble stated that with respect to some statutes or regulations, only some of the requirements may be relevant and appropriate to a particular site, while others may not be (53 FR 51436-37).

Response to comments: 1. *General.* Several commenters expressed support in general for the revised definition of relevant and appropriate requirements and for the approach described in the proposal to identifying such requirements. Commenters in particular supported statements that a requirement must be both relevant, in that the problem addressed by a requirement is similar to that at the site, and appropriate, or well-suited to the circumstances of the release and the site, to be considered a relevant and appropriate requirement.

A few commenters recommended changes to the definition of relevant and appropriate requirements. One commenter suggested adding to the proposed definition that a relevant and appropriate requirement must be

"generally pertinent," a phrase used in the preamble of the proposed NCP in discussing the analysis of the relevance of a requirement, while another suggested adding "pertinent" to the circumstances of the site, expressing concern that "generally pertinent" was overly broad. EPA believes that the concept of "pertinence" is adequately considered as part of the evaluation of what is relevant and appropriate (see discussion of factors for determining relevant and appropriate requirements, below). EPA does not believe that the suggested changes should be made in the definition itself.

Another commenter suggested revising the definition to emphasize the jurisdictional prerequisites of a potentially relevant and appropriate requirement, recommending that a relevant and appropriate requirement be defined as one that, "while not applicable, sufficiently satisfies the jurisdictional prerequisites for legal enforceability." EPA disagrees, because the jurisdictional prerequisites, while key in the applicability determination, are not the basis for relevance and appropriateness. Rather, the evaluation focuses on the purpose of the requirement, the physical characteristics of the site and the waste, and other environmentally- or technically-related factors.

Another commenter objected to the policy that some portions of a regulation could be found relevant and appropriate, while other portions would not be. The commenter believed that this policy would lead to confusion and inconsistency, although the commenter agreed that the application of this policy to RCRA closure requirements, described in the proposal, was useful. EPA believes that this policy is appropriate and reflects its experience in evaluating RCRA closure requirements and other requirements as relevant and appropriate. Finding some parts of a regulation relevant and appropriate, and others not, allows EPA to draw on those standards that contribute to and are suited for the remedy and the site, even though all components of a regulation are not appropriate.

This approach has been particularly valuable as applied to RCRA closure, where the two applicable regulations, clean closure and landfill closure, address only the two poles of a potential continuum of closure responses. When RCRA closure is relevant and appropriate, Superfund may use a combination of these two regulations, known as hybrid closure, to fashion an appropriate remedy for a site that is

protective of both ground water and direct contact (for more discussion of hybrid closure, see preamble to the proposed NCP at 53 FR 51446).

2. *Factors for determining relevant and appropriate requirements.* One commenter suggested referencing the criteria described in § 300.400(g)(2) in the definition. EPA believes this is not appropriate because it could lead to confusion about the role of the criteria and result in greater emphasis on rigidly applying the criteria than is warranted.

Based on this latter comment and others about specific criteria in the proposal, EPA wants to clarify the role of the factors. (Note that the rule now refers to "factors" rather than "criteria.") EPA intends that the factors in § 300.400(g)(2) should be considered in identifying relevant and appropriate requirements, but does not want to imply that the requirement and site situation must be similar with respect to each factor for a requirement to be relevant and appropriate. At the same time, similarity on one factor alone is not necessarily sufficient to make a requirement relevant and appropriate. Rather, the importance of a particular factor depends on the nature of the requirement and the site or problem being addressed and will vary from site to site. While the factors are useful in identifying relevant and appropriate requirements, the final decision is based on professional judgment about the situation at the site and the requirement as a whole.

In addition, as EPA discussed in the proposal, a requirement must be both "relevant," in that it addresses similar situations or problems, and "appropriate," which focuses on whether the requirement is well-suited to the particular site. Consideration of only the similarity of certain aspects of the requirement and the site situation constitutes only half of the analysis of whether a requirement is relevant and appropriate.

After review of comments it received, EPA has revised the language in § 300.400(g)(2) because it is concerned that it was misleading. Some commenters viewed the analysis required by this section as requiring consideration only of the similarity of the requirement and the problems or situation at the CERCLA site. While non-substantive for the most part, the changes to § 300.400(g)(2) make clearer that a requirement and a site situation must be compared, based on pertinent factors, to determine both the relevance and appropriateness of the requirement. The rule also now uses the term "factors," rather than "criteria," a

change instituted to avoid confusion with the nine criteria for remedy selection in § 300.430.

One commenter suggested that factors be developed for use in evaluating whether a requirement is "appropriate." EPA does not believe this is necessary. Decisions about the appropriateness of a requirement are based on site-specific judgments using the same set of factors already identified. In the abstract it is very difficult to separate out those factors to be considered for relevance and those to be considered for appropriateness. In specific cases it would be possible to say, for example, that a requirement is relevant in terms of the substances but not appropriate in terms of the facility covered.

Several commenters questioned whether certain factors could legitimately be considered in identifying relevant and appropriate requirements. These and other comments on individual factors are discussed below; a brief description of each factor as described in the proposed NCP is given after the name of the factor.

(i): *Purpose of the requirement.* This factor compared the purpose of a requirement to the specific objectives of the CERCLA action. One commenter was concerned that the "objectives for the CERCLA action" could include the implementability of the remedy, its cost, and even the acceptability of the action to the community. This is not what EPA meant by "objectives." Rather, EPA intended that this factor consider the technical, or health and environmental purpose of the requirement compared to what the CERCLA action is trying to achieve. For example, MCLs are promulgated to protect the quality of drinking water; this is similar in purpose to a CERCLA action to restore ground water aquifers to drinkable quality. To avoid confusion, EPA has simplified the factor, which now states, "the purpose of the requirement and the purpose of the CERCLA action."

(ii): *The medium regulated by the requirement.* This factor compared the medium addressed by a requirement to the medium contaminated or affected at a CERCLA site. No comments were received on this factor, and the final rule is essentially unchanged from the proposal.

(iii): *The substances regulated by the requirement.* This factor compared the substances addressed by a requirement to the substances found at a CERCLA site. Several commenters argued that RCRA requirements for hazardous waste should not be potentially relevant and appropriate to wastes "similar" but not identical to a hazardous waste and

that this criterion should be dropped. EPA disagrees and has discussed this issue in the section of this preamble on RCRA ARARs.

(iv): *The entities or interests affected or protected by the requirement.* This factor compared the entities or interests addressed by a requirement and those affected by a CERCLA site. Two commenters expressed concern about this factor. One commenter was concerned that it could be used to disqualify standards from being relevant and appropriate simply because the requirement regulated entities different from those at a CERCLA site. In contrast, another commenter was concerned that EPA would broadly apply requirements to entities that were never intended to be subject to the requirement. EPA agrees that this factor is confusing. EPA believes that the characteristics intended to be addressed by this factor are adequately covered under other factors, such as purpose and type of facility. Therefore, this factor has been eliminated.

(v): *The actions or activities regulated by the requirement.* This factor compared the actions or activities addressed by a requirement to those undertaken in the remedial action at a CERCLA site. No comments were received on this factor, and the final rule is essentially unchanged from the proposal.

(vi): *Any variances, waivers, or exemptions of the requirement.* This factor considered the availability of variances, waivers, or exemptions from a requirement that might be available for the CERCLA site or action. One commenter asked for clarification on this factor and expressed his view that the CERCLA waiver provisions for ARARs were the only waivers allowable. However, EPA believes that it is reasonable to consider the existence of waivers, exemptions, and variances under other laws because generally there are environmental or technical reasons for such provisions. These provisions are generally incorporated into national regulations because there are specific circumstances where compliance with a requirement may be inappropriate for technical reasons or unnecessary to protect human health and the environment. Again, this factor is only one that should be considered; even if a waiver provision in a requirement matches the circumstances at the CERCLA site, there may be other reasons why the requirement is still relevant and appropriate.

(vii): *The type and size of structure or facility regulated by the requirement.* This factor compared the characteristics

of the structure or facility addressed by a requirement to that affected by or contemplated by the remedial action. One commenter argued that regulations routinely contain cut-offs based on type or size of the structure or facility for administrative or enforcement convenience. EPA agrees that cut-offs based solely on administrative reasons may not be critical in determining whether a requirement is relevant and appropriate. However, EPA believes that it is necessary and appropriate to consider the physical type or size of structure regulated because requirements may be neither relevant nor appropriate to structures or facilities that are dissimilar to those that the requirement was intended to regulate. In many cases, this factor is a very basic one: in identifying requirements relevant to landfills, one would turn to standards for landfills, not for tanks.

(viii): *Consideration of use or potential use of affected resources in the requirement.* This factor compared the resource use envisioned in a requirement to the use or potential use at a CERCLA site. One commenter objected to this factor based primarily on opposition to EPA's proposed ground water policy, which, along with the comments EPA has received on this issue, is discussed in the section on ground-water policy in the preamble discussion of § 300.430. EPA believes it is appropriate to compare the resource use considerations in a requirement with similar considerations at a CERCLA site.

Final rule: 1. The following sentence is added to the proposed definition of "relevant and appropriate" in § 300.5 (see preamble discussion above on "applicable"): "Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate."

2. Proposed § 300.400(g)(2) is revised as follows:

(2) If, based upon paragraph (g)(1) of this section, it is determined that a requirement is not applicable to a specific release, the requirement may still be relevant and appropriate to the circumstances of the release. In evaluating relevance and appropriateness, the factors in paragraphs (g)(2)(i) through (viii) shall be examined, where pertinent, to determine whether a requirement addresses problems or situations sufficiently similar to the circumstances of the release or remedial action contemplated, and whether the requirement is well-suited to the site, and therefore is both relevant and appropriate. The pertinence of each of the following factors will depend, in part, on whether a requirement addresses a chemical, location, or action. The following

comparisons shall be made, where pertinent, to determine relevance and appropriateness:

- (i) The purpose of requirement and the purpose of the CERCLA action;
- (ii) The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
- (iii) The substances regulated by the requirement and the substances found at the CERCLA site;
- (iv) The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site;
- (v) Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;
- (vi) The type of place regulated and the type of place affected by the release or CERCLA action;
- (vii) The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action;
- (viii) Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site.

Name: Section 300.400(g)(3). Use of other advisories, criteria or guidance to-be-considered (TBC).

Proposed rule: The preamble to the proposed rule provided that advisories, criteria or guidance to-be-considered (TBC) that do not meet the definition of ARAR may be necessary to determine what is protective or may be useful in developing Superfund remedies (53 FR 51438). The ARARs preamble described three types of TBCs: health effects information with a high degree of credibility, technical information on how to perform or evaluate site investigations or remedial actions, and policy.

For example, proposed § 300.400(g)(3) stated that other advisories, criteria, and guidance to be considered (TBCs) shall be identified, as appropriate, because they may be useful in developing CERCLA remedies. Proposed § 300.415(j)(1) (in the final rule) stated that other federal and state criteria, advisories, and guidance shall, as appropriate, be considered in formulating the removal action. Proposed § 300.430(b) stated that during project scoping the lead agency shall initiate a dialogue with the support agency on potential ARARs and TBCs. Proposed § 300.430(e)(2) provided that other pertinent information may be used to develop remediation goals. Proposed § 300.430(e)(8) provided that the lead agency shall notify the support agency of the alternatives to be analyzed to facilitate the identification of ARARs and TBCs. Proposed § 300.430(f) on selecting a remedy, however, referred to compliance with ARARs only, not TBCs. Proposed subpart F required that the

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Final rule: References to TBCs will be changed in the following sections to make it clear that their use is discretionary rather than mandatory: §§ 300.400(g)(3), 300.415(i), 300.430(b)(9), 300.430(d)(3), 300.430(e) (8) and (9), 300.505(d)(2)(iii), 300.515(d) and (d) (1) and (2), and 300.515(h)(2).

Name: Sections 300.400 (g)(4) and (g)(5), ARARs under state laws.

Proposed rule: Section 300.400(g) specified that only promulgated state standards may be considered potential ARARs. A promulgated state standard must be legally enforceable and of general applicability. The term "legally enforceable," according to the preamble to the proposed NCP, means that state laws or standards which are considered potential ARARs must be issued in accordance with state procedural requirements and contain specific enforcement provisions or be otherwise enforceable under state law. The preamble also explained that "of general applicability" means that potential state ARARs must be applicable to all remedial situations described in the requirement, not just CERCLA sites (53 FR 51437-38).

The preamble also discussed a dispute resolution process to be followed if there is disagreement about the identification of ARARs, as well as policies to be followed if a state insists that a remedy attain a requirement not determined to be ARAR (see 53 FR 51437 and 51457).

Response to comments: Commenters on this subject called for EPA to establish a formal procedure to be followed by states to demonstrate that proposed state ARARs are legally enforceable and of generally applicability. Commenters suggested that states be required to provide legal citations from appropriate sections of state laws, as well as appropriate citations to legal authority for issuing compliance orders, obtaining injunctions, or imposing civil or criminal penalties in the event of noncompliance. These citations, according to commenters, would demonstrate that proposed ARARs are legally enforceable.

Commenters suggested that general applicability could be demonstrated by requiring states to identify the chemicals, locations, and cleanup actions to which a proposed ARAR would apply.

The proposed NCP did not prescribe a specific procedure to be used in evaluating state standards as potential ARARs. A formal process for demonstrating that state requirements are promulgated is not required by

CERCLA. EPA believes that the imposition of a formal procedure on states would be a large administrative burden and could impede the cleanup process.

EPA expects, however, that states will substantiate submissions of potential ARARs by providing basic evidence of promulgation, such as a citation to a statute or regulation and, where pertinent, a date of enactment, effective date, or description of scope. Because a citation is the minimum needed to positively identify a requirement, EPA has added regulatory language requiring both lead and support agencies to provide citations when identifying their ARARs.

Section 300.400(g)(4) specifies that only promulgated state standards that are more stringent than federal requirements and are identified by the state in a timely manner may be considered potential ARARs. If a question is raised as to whether a requirement identified by a state conforms to the requirements for being a potential state ARAR, or is challenged on the basis that it does not conform to the definition, the state would have the burden of providing additional evidence to EPA to demonstrate that the requirement is of general applicability, is legally enforceable, and meets the other prerequisites for being a potential ARAR. If EPA does not agree that a state standard identified by a state is an ARAR, EPA will explain the basis for this decision.

Furthermore, the language of CERCLA section 121(d)(2)(A) makes clear, and program expediency necessitates, that the specific requirements that are applicable or relevant and appropriate to a particular site be identified. It is not sufficient to provide a general "laundry" list of statutes and regulations that might be ARARs for a particular site. The state, and EPA if it is the support agency, must instead provide a list of requirements with specific citations to the section of law identified as a potential ARAR, and a brief explanation of why that requirement is considered to be applicable or relevant and appropriate to the site.

Other comments on this section raised objections to EPA's acceptance of general goals as potential ARARs. One commenter questioned whether such general goals were implementable and satisfied the requirements of a promulgated standard, requirement, criteria, or limitation contained in CERCLA section 121(d). Another commenter argued that attempts to interpret compliance with a general goal will lead to confusion and delay. Several commenters requested clarification of

the status of state nondegradation goals and whether such goals qualified as potential ARARs.

In response, it is necessary to examine the nature of a general goal in order to determine whether it may be an ARAR. General goals that merely express legislative intent about desired outcomes or conditions but are non-binding are not ARARs. EPA believes, however, that general goals, such as nondegradation laws, can be potential ARARs if they are promulgated, and therefore legally enforceable, and if they are directive in intent. The more specific regulations that implement a general goal are usually key in identifying what compliance with the goal means.

For example, in the preamble to the proposed NCP, EPA cited the example of a state antidegradation statute that prohibits the degradation of surface water below a level of quality necessary to protect certain uses of the water body (53 FR 51438). If promulgated, such a requirement is clearly directive in nature and intent. State regulations that designate uses of a given water body and state water quality standards that establish maximum in-stream concentrations to protect those uses define how the antidegradation law will be implemented are, if promulgated, also potential ARARs.

Even if a state has not promulgated implementing regulations, a general goal can be an ARAR if it meets the eligibility criteria for state ARARs. However, EPA would have considerable latitude in determining how to comply with the goal in the absence of implementing regulations. EPA may consider guidelines the state has developed related to the provision, as well as state practices in applying the goal, but such guidance or documents would be TBCs, not ARARs.

Final rule: 1. EPA has revised § 300.400(g)(4) as follows:

(4) Only those state standards that are promulgated, are identified by the state in a timely manner, and are more stringent than federal requirements may be applicable or relevant and appropriate. For purposes of identification and notification of promulgated state standards, the term "promulgated" means that the standards are of general applicability and are legally enforceable.

2. Also, language has been added to § 300.400(g)(5) requiring that specific requirements for a particular site be identified as ARARs, and that citation be provided.

Name: Section 300.515(d)(1). Timely identification of state ARARs.

Proposed rule: Section 300.515(d)(1) stated that the lead and support agencies shall identify their respective

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case of "applicable" requirements. However, the determination of whether a requirement is relevant and appropriate is not based on its stringency; rather, other criteria are used, as discussed in the section on relevance and appropriateness, and the remedy must comply with the most stringent requirement determined to be ARAR. EPA also believes that, in some situations, the availability of certain requirements that more fully match the circumstances of the site may result in a decision that another requirement is not relevant and appropriate. EPA believes that one such situation is when an MCL or non-zero MCLG and an FWQC for human health are available for the same contaminant when a current or potential source of drinking water is of concern, and there are no impacts to aquatic organisms.

As discussed in this preamble, EPA believes that an MCL or non-zero MCLG is generally the relevant and appropriate requirement for ground water that is a current or potential source of drinking water. EPA also believes that an MCL or non-zero MCLG, promulgated specifically to protect drinking water, generally is the appropriate standard for ground water even if an FWQC for human health is also available for the contaminant, for the following reasons.

CERCLA section 121(d)(2)(B)(i) lists, among other factors, the purpose for which the criteria were developed and the designated or potential use of the water as factors in determining whether FWQC are relevant and appropriate. Since FWQC for human health are promulgated for exposures that include drinking water and consuming fish, on the one hand, and consuming fish only, on the other, it is not directly the purpose of such criteria to provide drinking water standards per se, although levels that protect such a use can be mathematically derived from these two values. Furthermore, such derived values for drinking water will not reflect the contribution of other sources (through an apportionment factor), as MCLs and MCLGs do. Finally, for carcinogens FWQC are recommended at zero, although values corresponding to risks of 10^{-6} , 10^{-5} , and 10^{-4} are also given. For the reasons given in the discussion of MCLs and MCLGs above, the zero value is not considered relevant and appropriate under CERCLA. MCLs, however, represent a level determined to be both protective of human health for drinking water and attainable by treatment.

For the same reasons, EPA believes that MCLs or non-zero MCLGs generally

standards for surface water designated as a drinking water supply, unless the state has promulgated water quality standards (WQS) for the water body that reflect the specific conditions of the water body. However, surface water bodies may be designated for uses other than drinking water supply, and therefore an FWQC intended to be protective of such uses, such as the FWQC for consumption of fish or for protection of aquatic life, may very well be relevant and appropriate in such cases. Also, where a contaminant does not have an MCL or MCLG, FWQC adjusted to reflect drinking water use may be used as relevant and appropriate requirements.

Final rule: EPA is including in the final rule at § 300.430(e)(2)(i)(E) language stating that FWQC are to be attained where relevant and appropriate under the circumstances of the release or threatened release.

Name: Section 300.435(b)(2). Compliance with applicable or relevant and appropriate requirements (ARARs) during the remedial action.

Proposed rule: CERCLA section 121 requires that, at the completion of a remedial action, a level or standard of control required by an ARAR will be attained for wastes that remain on-site. However, consistent with the 1985 NCP (§ 300.68(i), § 300.435(b)) of the proposed NCP also required compliance with ARARs during implementation of the action, stating that *during the course of the remedial design/remedial action (RD/RA)*, the lead agency shall be responsible for ensuring that all federal and state ARARs identified for the action are being met, unless a waiver is invoked. Examples of such requirements given in the preamble to the proposed rule included RCRA treatment, storage, and disposal requirements, Clean Air Act national ambient air quality standards, and Clean Water Act effluent discharge limitations (§3 FR 51440).

Response to comments: EPA received a number of comments that the NCP should not require compliance with ARARs during the remedial action. Commenters argued that this policy is inconsistent with the statute, which requires compliance with ARARs only at the completion of the remedial action, and questioned EPA's authority to require compliance with ARARs during remedial design/remedial action.

Several commenters pointed out that CERCLA section 121(d)(1) states that remedial actions must be protective and "must be relevant and appropriate under the circumstances," and argued that this standard should govern how the action itself is carried out. Design and

operation of the remedial action should be based on best professional judgment and undertaken in a manner that is protective. Other commenters suggested requiring compliance only with those ARARs that "can reasonably be achieved," or listing specific types of ARARs that must be met during RD/RA.

Commenters were particularly concerned about problems created by requiring compliance with RCRA requirements and the land disposal restrictions in particular for remedial actions.

EPA disagrees with these commenters. EPA believes that it is appropriate to require that remedial activities comply with the substantive requirements of other laws that apply or are relevant and appropriate to those activities. The reasons for complying with such laws during the conduct of the remediation are basically the same as the reasons for applying ARARs as remediation objectives: the laws help define how the activity can be carried out safely and with proper safeguards protect human health and the environment. EPA is concerned that, if the narrowest possible interpretation were applied to ARARs compliance, compliance with laws critical to protection of health and the environment would become subject to debate, laws such as those that govern surface water discharges or air emissions, or that set operational standards for incineration of hazardous waste.

Several commenters also stated that chemical-specific ARARs used as remediation goals, such as MCLs as ARARs for ground water remediation cannot be attained during implementation. EPA wants to clarify that it recognizes that ARARs that are used to determine final remediation levels apply only at the completion of the action.

It is worthwhile to point out, in the context of this policy on complying with ARARs pertaining to the remedial activity itself, that CERCLA provides a waiver from ARARs for interim action provided the final action will attain the waived standard. If there is doubt whether an ARAR represents a final remediation goal or an interim standard and it cannot be met during the action, this waiver could be invoked.

Comments were also received concerning EPA's discussion of compliance with ARARs during remedial investigation in the preamble to the proposed rule (FR 51442-43). In that discussion, EPA stated that on-site handling, treatment or disposal of investigation-derived waste must satisfy ARARs and

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field investigation teams should use best professional judgment in determining when such wastes contain hazardous substances. One commenter recommended that investigation-derived samples be required to be handled, treated, and disposed in accordance with applicable RCRA requirements.

In response, EPA wishes to clarify the discussion in the preamble to the proposed NCP. CERCLA section 101(23) defines "removal" to include "such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances . . . [including] action taken under section 104(b) of [CERCLA]." EPA has stated, therefore, that studies and investigations undertaken pursuant to CERCLA section 104(b), such as activities conducted during the RI/FS, are considered removal actions (54 FR 13298, March 31, 1989). EPA's policy, explained elsewhere in today's preamble, is that removal actions will comply with ARARs to the extent practicable, considering the exigencies of the circumstances. Thus, the field investigation team should, when handling, treating or disposing of investigation-derived waste on-site, conduct such activities in compliance with ARARs to the extent practicable, considering the exigencies of the situation. Investigation-derived waste that is transported off-site (e.g., for treatability studies or disposal) must comply with applicable requirements of the CERCLA off-site policy (OSWER Directive No. 9834.11 (November 13, 1987)) and § 300.440 when finalized (see 53 FR 48218, November 29, 1988).²⁰ EPA notes that CERCLA section 104(c)(1) provides that the statutory limits on removals do not apply to investigations, monitoring, surveying, testing and other information-gathering performed under CERCLA section 104(b).

Final rule: EPA is promulgating the rule as proposed except for minor editing revisions.

Name: 300.5. Distinction between substantive and administrative requirements.

Proposed rule: The proposed definitions of "applicable" and "relevant and appropriate" stated that they are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations. The preamble to the proposed rule explained that requirements that do not in and of

themselves define a level or standard of control are considered administrative (53 FR 51443). Administrative requirements include the approval of, or consultation with, administrative bodies, issuance of permits, documentation, and reporting and recordkeeping. Response actions under CERCLA are required to comply with ARARs, which are defined not to include administrative requirements.

Response to comments: Many comments were received on EPA's differentiation between substantive and administrative requirements. Some commenters supported the distinction between substantive and administrative requirements. Other commenters disagreed with EPA's interpretation for various reasons.

Several commenters argued that Superfund actions should not be exempt from consultation requirements. One commenter argued that consultation with a state may be necessary to determine how state ARARs apply to the remedy. A commenter contended that it is virtually impossible to meet substantive requirements without consultation. One commenter asserted that state procedures or methodology necessary to determine permit levels should be considered state ARARs. Another argued that not requiring consultation runs opposite to the spirit of cooperation with states. One commenter suggested narrowing the exemption to allow for consultation through existing Superfund mechanisms such as consent orders, SMOAs, and cooperative agreements.

Commenters also objected to the exemption from reporting and recordkeeping requirements. One contended that EPA had no legal authority for such exemption. Others argued that reporting and recordkeeping are necessary to ensure proper control of hazardous substances that will remain on-site and are also necessary for activities with local impacts: Long-term water diversions and air or surface water releases. Commenters asserted that the lead agency must meet reporting requirements to avoid gaps in a state's environmental data. One commenter noted that there are a number of federal and state programs that require the maintenance of complete databases and that the NCP's approach is inconsistent with such programs. Under these programs, a state needs all discharge information in order to evaluate surface water toxicity impacts in a stream or to establish total maximum daily loads.

The concern was also raised that maintaining reporting and recordkeeping procedures on a site-by-site basis would

undermine a state's standardized reporting requirements, e.g., ground-water monitoring report forms, NPDES forms, etc. Also, unique site approaches to reporting and recordkeeping may result in problems not detected by a state. Further, these commenters stated that they were not aware of Superfund recordkeeping and reporting requirements. One commenter stated that reporting requirements and compliance mechanisms during remedy implementation and O&M periods should be specified through Superfund mechanisms, as appropriate. One commenter contended that if Superfund insists on this distinction, a determination whether a requirement is substantive or administrative must be documented.

EPA has reviewed these comments, but concludes, as stated in the preamble to the proposed NCP (53 FR 51443), that CERCLA response actions should be subject only to substantive, not administrative, requirements. EPA believes that this interpretation is most consistent with the terms of CERCLA and with the goals of the statute. Section 121(d)(2) provides that remedial actions should require "a level or standard of control" which attains ARARs; only substantive standards set levels or standards of control. Moreover, Congress made clear in sections 121(d)(2) and (d)(4) that the "standards" or "requirements" of other laws that are ARARs should be applied to actions conducted on-site, and specifically provided in section 121(e)(1) that federal and state permits would not be required for such on-site response actions. These subsections reflect Congress' judgment that CERCLA actions should not be delayed by time-consuming and duplicative administrative requirements such as permitting, although the remedies should achieve the substantive standards of applicable or relevant and appropriate laws. Indeed, CERCLA has its own comparable procedures for remedy selection and state and community involvement. EPA's approach is wholly consistent with the overall goal of the Superfund program, to achieve expeditious cleanups, and reflects an understanding of the uniqueness of the CERCLA program, which directly impacts more than one medium (and thus overlaps with a number of other regulatory and statutory programs). Accordingly, it would be inappropriate to formally subject CERCLA response actions to the multitude of administrative requirements of other federal and state offices and agencies.

²⁰ The CERCLA off-site policy requires that servicing facilities are in compliance with "applicable laws." Note that many treatability study wastes are exempt from the permitting requirement under RCRA (see 40 CFR 261.4(e) and (f)).

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At the same time, EPA recognizes the benefits of consultation, reporting, etc. To some degree, these functions are accomplished through the state involvement and public participation requirements in the NCP. In addition, EPA has already strongly recommended that its regional offices (and states when they are the lead agency) establish procedures, protocols or memoranda of understanding that, while not recreating the administrative and procedural aspects of a permit, will ensure early and continuous consultation and coordination with other EPA programs and other agencies. CERCLA Compliance with Other Laws Manual, OSWER Directive No. 9234.1-01 (August & 1988). In working with states, EPA generally will coordinate and consult with the state Superfund office. That state superfund office should distribute to or obtain necessary information from other state offices interested in activities at Superfund sites.

The basis for this recommendation is a recognition that such coordination and consultation is often useful to determine how substantive requirements implemented under other EPA programs and by other agencies should be applied to a Superfund action. For example, although the Superfund office will make the final decisions on using ARARs, a water office may provide information helpful in determining ARARs when a surface water discharge is part of the Superfund remedy. Such information may include surface water classifications, existing use designations, technology-based requirements, and water quality standards. A water office may also be able to provide advice during the detailed analysis of alternatives on the effectiveness and implementability of treatment alternatives and the likely environmental fate and effects of surface or ground-water discharges. Other offices or agencies with different environmental responsibilities may similarly provide useful information, if it is given in a timely manner.

EPA also recognizes the importance of providing information to other programs and agencies that maintain environmental data bases. This is particularly true where the remedy includes releases of substances into the air or water and the extent of such releases is integral for air and water programs to maintain accurate information on ambient air and surface water quality in order to set statutorily-specified standards. Monitoring requirements themselves are considered substantive requirements and are necessary in order to document

attainment of cleanup levels and compliance with emission limitations or discharge requirements identified as ARARs in the decision document. EPA strongly encourages its OSCs or RPMs, or the agency that is responsible for maintaining the operation and maintenance of an action (e.g., pump and treat system), to provide reports on monitoring activities to other offices in a form usable to those offices.

In summary, cleanup standards must be complied with; although administrative procedures such as consultation are not required, they should be observed when, for example, they are useful in determining the cleanup standards for a site. EPA believes that in order to ensure that Superfund actions proceed as rapidly as possible it must maintain a distinction between substantive and administrative requirements.

Final rule: EPA is promulgating the reference to "substantive" in the § 300.5 definitions of "applicable" and "relevant and appropriate" as proposed.

Name: Section 300.430(f)(1)(ii)(B). Consideration of newly promulgated or modified requirements.

Proposed rule: The preamble to the proposed rule discussed how new requirements or other information developed subsequent to the initiation of the remedial action should be addressed (53 FR 51440). It explained that new requirements or other information should be considered as part of the five-year review (as provided for in § 300.430(f)(3)(v)) (renumbered as final § 300.430(f)(5)(iii)(C)) to ensure that the remedial action is still protective of human health and the environment. That is, if a requirement that would be applicable or relevant and appropriate to the remedy is promulgated after the initiation of remedial action, the remedy will be evaluated in light of the new requirement to ensure that the remedy is still protective.

Response to comments: Several commenters objected to EPA's policy requiring consideration of new requirements on the grounds that the statute requires the five-year review only to determine that a remedy is still protective. These commenters were concerned that consideration of new requirements would require additional analysis and perhaps drastic changes in design; would impose an open-ended liability on PRPs; and would violate PRPs' right to due process. Two commenters suggested that making new requirements part of a negotiation process based on a reopener in the settlement agreement could alleviate the second and third concern.

Based on the comments and its experience in carrying out remedies, EPA is modifying its policy on considering newly promulgated or modified requirements to address those requirements that are promulgated or modified after the ROD is signed, rather than those requirements promulgated or modified after the initiation of remedial action, as discussed in the proposal. Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy. EPA believes that it is necessary to "freeze ARARs" when the ROD is signed rather than at initiation of remedial action because continually changing remedies to accommodate new or modified requirements would, as several commenters noted, disrupt CERCLA cleanups, whether the remedy is in design, construction, or in remedial action. Each of these stages represents significant time and financial investments in a particular remedy. For instance, the design of the remedy (treatment plant, landfill, etc.) is based on ARARs identified at the signing of the ROD. If ARARs were not frozen at this point, promulgation of a new or modified requirement could result in a reconsideration of the remedy and a restart of the lengthy design process, even if protectiveness is not compromised. This lack of certainty could adversely affect the operation of the CERCLA program, would be inconsistent with Congress' mandate to expeditiously cleanup sites and could adversely affect PRP negotiations, as noted by commenters. The policy of freezing ARARs will help avoid constant interruption, re-evaluation, and re-design during implementation of selected remedies.

EPA believes that this policy is consistent with CERCLA section 121(d)(2)(A), which provides that "the remedial action selected . . . shall require, at the completion of the remedial action," attainment of ARARs. EPA interprets this language as requiring attainment of ARARs identified at remedy selection (i.e., those identified in the ROD), not those that may come into existence by the completion of the remedy.²¹ Neither the explicit statutory language nor the legislative history supports a conclusion that a ROD may be subject to indefinite revision as a result of shifting

²¹ No commenters objected to the position in the preamble to the proposed rule that CERCLA remedial actions should attain ARARs identified at the initiation—versus completion—of the action.

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requirements. Rather, given the need to ensure finality of remedy selection in order to achieve expeditious cleanup of sites, and given the length of time often required to design, negotiate, and implement remedial actions, EPA believes that this is the most reasonable interpretation of the statute.

As EPA discusses elsewhere in this preamble, one variation to this policy occurs when a component of the remedy was not identified when the ROD is signed. In that situation, EPA will comply with ARARs in effect when that component is identified (e.g., during remedial design), which could include requirements promulgated both before and after the ROD was signed. EPA notes that newly promulgated or modified requirements may directly apply or be more relevant and appropriate to certain locations, actions or contaminants than existing standards and, thus, may be potential ARARs for future responses.

It is important to note that a policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment.

In response to the specific comments received, EPA notes that under this policy, EPA does not intend that a remedy must be modified solely to attain a newly promulgated or modified requirement. Rather, a remedy must be modified if necessary to protect human health and the environment; newly promulgated or modified requirements contribute to that evaluation of protectiveness. For example, a new requirement for a chemical at a site may indicate that the cleanup level selected for the chemical corresponds to a cancer risk of 10^{-5} rather than 10^{-4} , as originally thought. The original remedy would then have to be modified because it would result in exposures outside the acceptable risk range that generally defines what is protective.

This policy that newly promulgated or modified requirements should be considered during protectiveness reviews of the remedy, but should not require a reopening of the ROD during implementation every time a new state or federal standard is promulgated or modified, was discussed in the preamble to the proposed rule (53 FR at 51440) but not in the rule section itself. For the reasons outlined above, EPA believes that this concept is critical to the expeditious and cost-effective

accomplishment of remedies duly selected under CERCLA and the NCP, and thus is appropriate for inclusion in § 300.430(f)(1)(ii)(B) of the final NCP. This will afford both the public and implementing agencies greater clarity as to when and how requirements must be considered during CERCLA responses, and thus will allow the CERCLA program to carry out selected remedies with greater certainty and efficiency. Of course, off-site CERCLA remedial actions are subject to the substantive and procedural requirements of applicable federal, state, and local laws at the time of off-site treatment, storage or disposal.

Final rule: EPA is adding the following language to the rule at § 300.430(f)(1)(ii)(B):

(B) On-site remedial actions selected in a ROD must attain those ARARs that are identified at the time of ROD signature or provide grounds for invoking a waiver under § 300.430(f)(1)(ii)(C)(3).

(3) Requirements that are promulgated or modified after ROD signature must be attained (or waived) only when determined to be applicable or relevant and appropriate and necessary to ensure that the remedy is protective of human health and the environment.

(2) Components of the remedy not described in the ROD must attain (or waive) requirements that are identified as applicable or relevant and appropriate at the time the amendment to the ROD or the explanation of significant differences describing the component is signed.

Name: Applicability of RCRA requirements.

Proposed rule: The preamble to the proposed rule discussed when RCRA subtitle C requirements will be applicable for site cleanups (53 FR 51443). It described the prerequisites for "applicability" at length, which are that: (1) The waste must be a listed or characteristic RCRA hazardous waste and (2) treatment, storage or disposal occurred after the effective date of the RCRA requirements under consideration (for example, because the activity at the CERCLA site constitutes treatment, storage, or disposal, as defined by RCRA).

The preamble explained how EPA will determine when a waste at a CERCLA site is a listed RCRA hazardous waste. It noted that it is often necessary to know the origin of the waste to determine whether it is a listed waste and that, if such documentation is lacking, the lead agency may assume it is not a listed waste.

The preamble discussed how EPA will determine that a waste is a characteristic hazardous waste under RCRA. It stated that EPA can test to

determine whether a waste exhibits a characteristic or can use best professional judgment to determine whether testing is necessary. "applying knowledge of the hazard characteristic in light of the materials or process used."

The preamble also discussed when a CERCLA action constitutes "land disposal," defined as placement into a land disposal unit under section 3004(k) of RCRA, which triggers several significant requirements, including RCRA land disposal restrictions (LDRs) and closure requirements (when a unit is closed). It equated an area of contamination (AOC), consisting of continuous contamination of varying amounts and types at a CERCLA site, to a single RCRA land disposal unit, and stated that movement within the unit does not constitute placement. It also stated that placement occurs when waste is redeposited after treatment in a separate unit (e.g., incinerator or tank), or when waste is moved from one AOC to another. Placement does not occur when waste is consolidated within an AOC, when it is treated in situ, or when it is left in place.

Response to comments: EPA received many comments on its discussion of when RCRA requirements can be applicable to CERCLA response actions. On the issue of compliance with RCRA in general, most of these commenters argued that RCRA requirements are not intended for site cleanup actions, that such compliance will result in delays and that RCRA requirements are often unnecessary to protect human health and the environment at CERCLA sites. Other commenters argued, however, that EPA is trying to avoid compliance with RCRA requirements. Most of the comments, however, focused on when LDRs are applicable to CERCLA actions and on EPA's discussion of what actions associated with remediation trigger LDRs.

Some commenters opposed EPA's interpretation of "land disposal" or "placement" as too lenient, believing that EPA is trying to avoid compliance with RCRA laws, particularly LDRs. These commenters argued that LDRs should be applicable when hazardous wastes are managed, excavated, or moved in any way. One argued that ARARs waivers are available to address situations when the LDR levels cannot be achieved and should be used as necessary, rather than trying to narrowly define the universe of ARARs to avoid waivers. This commenter was also concerned with EPA's use of the term "unit," calling it an inappropriate concept for Superfund sites because it

will allow the excavation and redeposition of waste within very large areas without ever meeting RCRA design and operating standards and LDR. One commenter asserted that EPA concerns on LDRs stem from an unjustifiable belief that LDR cleanup levels cannot be achieved.

Other commenters believed that the definition of "placement" should provide more flexibility. One asserted that replacement of treated residuals in the proximate area should not constitute placement. The commenter argued that Congress intended to address, preventively or prospectively, the original act of disposal, and that an innocent government or public entity should not be required to assume the entire environmental responsibility of the original disposers. The commenter also argued that establishing that replacement of treated waste triggers LDRs will be a serious disincentive to treating wastes. Some commenters argued that LDRs should not be relevant and appropriate where the CERCLA waste to be disposed on land is merely similar in composition to RCRA banned waste.

Other commenters argued that LDRs are inappropriate for CERCLA remedial actions. They noted an inherent conflict between LDRs, which require treatment to BDAT levels, and the CERCLA process, and claimed that LDRs will supplant CERCLA's "carefully articulated and balanced approach to remedy selection." Commenters asserted that compliance with LDRs will create technical problems because of differences between CERCLA wastes and those evaluated for LDRs. The solutions recommended by these commenters primarily focused on narrowing or eliminating RCRA applicability, but included suggestions for creating treatability groups for CERCLA-type waste and seeking legislative waivers from LDRs, e.g., a waiver from LDRs for Superfund actions at NPL sites.

One commenter believed that the concept of "unit" is not readily transferable to CERCLA sites due to the age and former uses of many of the sites undergoing remediation. Given the ramifications of LDRs, the commenter argued, it may be more reasonable to create a presumption of treating the entire site as one "unit," even if remediation includes a series of operable units.

Some comments were received on EPA's statements on consolidating waste. One stated that consolidation of small amounts of waste across units should not be considered placement, because that will lead to less

environmentally sound and less cost-effective solutions, particularly if LDRs are triggered. Another recommended that EPA should allow consolidation of small volumes of waste anywhere on-site, for purposes of storage or treatment, without triggering otherwise applicable RCRA standards. Another commenter requested clarification that consolidation within a unit included normal earthmoving and grading operations.

1. Actions constituting land disposal. EPA disagrees with commenters who considered EPA's interpretation of the definition of "land disposal" under RCRA section 3004(k) to be too narrow. These commenters argued that any movement of waste should be considered "placement" of waste, and thus "land disposal" under RCRA section 3004(k).

The definition of "land disposal" is central to determining whether the RCRA LDRs are applicable to a hazardous waste which is being managed as part of a CERCLA response action, or RCRA closure or corrective action. The term "land disposal" is defined under RCRA section 3004(k) as including, but not limited to, "any placement of such hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, or underground mine or cave." The terms "landfill," "surface impoundment," and the others, refer to specific types of units defined under RCRA regulations. Thus, Congress generally defined the scope of the LDR program as the placement of hazardous waste in a land disposal unit, as those units are defined under RCRA regulations.

EPA has consistently interpreted the phrase "placement . . . in" one of these land disposal units to mean the placement of hazardous wastes into one of these units, not the movement of waste within a unit. See e.g., 51 FR 40577 (Nov. 7, 1986) and 54 FR 41566-67 (October 10, 1989) (supplemental proposal of possible alternative interpretations of "land disposal"). EPA believes that its interpretation that the "placement . . . in" language refers to a transfer of waste into a unit (rather than simply any movement of waste) is not only consistent with a straightforward reading of section 3004(k), but also with the Congressional purpose behind the LDRs. The central concern of Congress in establishing the LDR program was to reduce or eliminate the practice of disposing of untreated hazardous waste at RCRA hazardous waste facilities. The primary aim of Congress was prospective rather than

directed at already-disposed waste within a land disposal unit. See 51 FR 40577 (Nov. 7, 1986). Moreover, interpreting section 3004(k) to require application of the LDRs to any movement of waste could be difficult to implement and could interfere with necessary operations at an operating RCRA facility. For instance, when hazardous waste is disposed of in a land disposal unit at an operating RCRA facility, there may well be some "movement" of the waste already in the unit. Under the commenters' approach, such movement without pretreatment of the moved waste could be in violation of the LDRs. Thus, under the commenters' interpretation, virtually no operational activities could occur at any RCRA land disposal unit containing hazardous waste without pretreatment of any waste disturbed by the operation; clearly an infeasible approach.

EPA also believes that this interpretation of section 3004(k) is supported by the legislative history for this provision (see 129 Cong. Rec. H8139 (Oct. 8, 1983) (statement of Rep. Breaux)), and by the Congressional choice to define "land disposal" more narrowly for purposes of application of the LDRs than the already-existing term "disposal", which has a much broader meaning under RCRA. Under RCRA section 1004(3), the term "disposal" is very broadly defined and includes any "discharge, deposit, injection, dumping, spilling, leaking, or placing" of waste into or on any land or water. Thus, "disposal" (in a statutory, rather than the regulatory subtitle C meaning of the term) would include virtually any movement of waste, whether within a unit or across a unit boundary. In fact, the RCRA definition of "disposal" has been interpreted by numerous courts to include passive leaking, where no active management is involved (see, e.g., *U.S. v. Waste Industries, Inc.*, 734 F.2d 159 (4th Cir. 1984)). However, Congress did not use the term "disposal" as its trigger for the RCRA land disposal restrictions, but instead specifically defined the new and more narrow, term "land disposal" in section 3004(k). The broader "disposal" language continues to be applicable to RCRA provisions other than those in subtitle C, such as section 7003. Thus, for the reasons outlined above, EPA believes that the existing interpretation, that movement of waste within a unit does not constitute "land disposal" for purposes of application of the RCRA LDRs, is reasonable.

With respect to the commenter who asked whether normal earthmoving and grading operations within a land disposal unit constitute "placement into

the unit", under EPA's interpretation of RCRA section 3004(k), such activity would not be "placement into the unit" and thus the RCRA LDRs and other subtitle C disposal requirements would not be applicable (nor would the requirement to obtain a permit under RCRA or minimum technology requirements in RCRA section 3004(o) apply).

Given this interpretation of section 3004(k), EPA does not believe that it is necessary to invoke ARAR waivers of LDRs for any movement of waste within a unit, which was the alternative suggested by the commenters. Nor does EPA believe that the widespread use of such waivers would be practical or desirable. 54 FR 41568-69 (October 10, 1989).

EPA also does not fully agree with the commenters who argued that the RCRA concept of "unit" does not apply to CERCLA sites. The commenters who criticized the application of the RCRA "unit" to the CERCLA area of contamination for purposes of section 3004(k) believed it to be either too broad, allowing large areas to escape the LDRs, or too narrow, not allowing entire CERCLA sites to be considered a single "unit". In contrast to hazardous waste management units at a RCRA facility, CERCLA sites often do not involve discrete waste management units, but rather involve land areas on or in which there can be widespread areas of generally dispersed contamination. Thus, determining the boundaries of the RCRA land disposal "unit" for which section 3004(k) would require application of the LDRs at these sites, is not always self-evident.

EPA generally equates the CERCLA area of contamination with a single RCRA land-based unit, usually a landfill. 54 FR 41444 (December 21, 1988). The reason for this is that the RCRA regulatory definition of "landfill" is generally defined to mean a land disposal unit which does not meet the definition of any other land disposal unit, and thus is a general "catchall" regulatory definition for land disposal units. As a result, a RCRA "landfill" could include a non-discrete land area on or in which there is generally dispersed contamination. Thus, EPA believes that it is appropriate generally to consider CERCLA areas of contamination as a single RCRA land-based unit, or "landfill". However, since the definition of "landfill" would not include discrete, widely separated areas of contamination, the RCRA "unit" would not always encompass an entire CERCLA site.

Waste consolidation from different units or AOCs at a CERCLA site are

subject to any applicable RCRA requirements regardless of the volume of the waste or the purpose of the consolidation. Thus, EPA disagrees with those commenters that asserted that small volumes of hazardous waste at a CERCLA site can be consolidated anywhere on-site for storage or treatment purposes without consideration of any applicable RCRA requirements. Such requirements may, however, be subject to ARAR waivers in appropriate circumstances.

The remaining comments received with respect to EPA's interpretation of section 3004(k) discussed the achievability of LDR cleanup levels, questioned the appropriateness of applying the LDRs to remedial actions, and requested more flexibility regarding the LDRs. These comments were the basis for EPA's supplemental notice and proposed reinterpretation of section 3004(k), which is discussed below.

In light of the numerous comments received on the interpretation of "land disposal" in RCRA section 3004(k), as it relates to removal, treatment, and redeposition of hazardous wastes generated by CERCLA and RCRA remedial and other activities, and in view of the important policy decisions that RCRA LDRs pose for the CERCLA and RCRA programs, EPA decided to separately and more fully discuss the issue, the interpretation outlined in the proposed NCP, and possible alternative interpretations of "land disposal". In a supplemental notice to the proposed NCP (54 FR 41566 (Oct. 10, 1989)), EPA outlined several technical, policy, and legal issues concerning LDR applicability to removal, treatment, and redeposition of hazardous wastes, and requested comment on two alternative interpretations of "land disposal". The first alternative would allow the excavation and replacement of previously disposed hazardous wastes in the same unit or area of contamination; since the same wastes would remain in the same unit, this activity would not constitute "land disposal". Under the second alternative, hazardous wastes could be excavated and redeposited either within the original unit or area of contamination, or elsewhere at the site in a new or existing unit. These interpretations would allow greater flexibility in remedial decision-making, in the context of both CERCLA actions and RCRA corrective actions and closures.

On November 6 and 7, 1989, EPA held a forum on contaminated soil and groundwater ("Contaminated Media Forum") to provide an opportunity for interested groups to further address these issues. The Contaminated Media

Forum was attended by representatives from EPA, states, environmental groups, Congress, and the regulated community. A summary of the concerns raised and suggested solutions appears in the public docket for this rulemaking.

2. Selection of LDR treatment standards. Upon further examination, EPA believes that many of the problems discussed in the supplemental notice, and raised by commenters, result from treatment standards developed pursuant to the RCRA LDR program that are generally inappropriate or infeasible when applied to contaminated soil and debris. As discussed in the October 1989 notice, EPA's experience under CERCLA has been that treatment of large quantities of soil and debris containing relatively low levels of contamination using LDR "best demonstrated available technology" (BDAT) is often inappropriate. 54 FR 41567, 41568 (October 10, 1989). EPA noted that:

Experience with the CERCLA program has shown that many sites will have large quantities—in some cases, many thousands of cubic meters—of soils that are contaminated with relatively low concentrations of hazardous wastes. These soils often should be treated, but treatment with the types of technologies that would meet the standard of BDAT may yield little if any environmental benefit over other treatment based remedial options.

54 FR 41568 (October 10, 1989). Examples of these and other situations reflecting EPA's experience concerning the inappropriateness of incinerating contaminated soil and debris are included in the record for this rule. In addition, as discussed below, EPA has experienced problems in achieving the current noncombustion LDRs for contaminated soil and debris. Based on EPA's experience to date and the virtually unanimous comments supporting this conclusion, EPA has determined that, until specific standards for soils and debris are developed, current BDAT standards are generally inappropriate or unachievable for soil and debris from CERCLA response actions and RCRA corrective actions and closures. Instead, EPA presumes that, because contaminated soil and debris is significantly different from the wastes evaluated in establishing the BDAT standards, it cannot be treated in accordance with those standards and thus qualifies for a treatability variance from those standards under 40 CFR 268.44.

Accordingly, persons seeking a treatability variance from LDR treatment standards for contaminated soil and debris do not need to demonstrate on a case-by-case basis

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believes that it is unnecessary for petitioners (or the lead Agency in CERCLA response actions) to make site-specific demonstrations that BDAT standards are inappropriate for contaminated soil and debris. The numerous comments and Agency experience supporting a presumption that the BDAT standards are inappropriate or not achievable is clearly warranted at this time because the criteria in 40 CFR 268.44 for treatability variances are generally met for soil and debris. As a result, under EPA's established treatability variance procedures (40 CFR 268.44), variance applications for contaminated soil and debris do not need to demonstrate that the physical and chemical properties differ significantly from wastes analyzed in developing the treatment standard and that, therefore, the waste cannot be treated to specified levels or by specified methods. Petitions need only focus on justifying the proposed alternative levels of performance, using existing interim guidance containing suggested treatment levels for soil and debris (Superfund LDR Guidance #8A, "Obtaining a Soil and Debris Treatability Variance for Remedial Actions", EPA OSWER Directive 9347.3-06FS, July 1989) as a benchmark.

Although the presumption is that BDAT standards are not appropriate for soil and debris, there may be special circumstances where EPA determines that the existing BDAT standards are appropriate for contaminated soils and debris at a particular site, such as where high levels of combustible organics in soil are present. In these circumstances, the Agency would make a determination that treatment to the BDAT standards was appropriate and would require such treatment.

EPA regulations provide that treatability variances may be issued on a site-specific basis. 40 CFR 268.44(h).²²

²² In light of today's determination, the application of this rule requires clarification in two respects. First, although EPA is today establishing a general presumption that BDAT standards are inappropriate or not achievable for treating soil and debris, the Agency does not believe that this presumption triggers the rulemaking variance procedures in 40 CFR 268.44(a). Even with the presumption, treatment levels will be determined on a case-by-case basis, and commenters may submit information contending that the presumption is not applicable in a particular case. Thus, it is EPA's view that the site-specific, non-rulemaking procedures in 40 CFR 268.44(h) are entirely appropriate. See 53 FR 31190-31200 (August 17, 1988).

Second, EPA does not interpret its site specific variance procedures as invariably requiring applicants to demonstrate that they cannot meet applicable treatment levels or methods. The first sentence of 40 CFR 268.44(h) makes it clear that an applicant may make one of two demonstrations to qualify for a variance: he may show either that he

Thus, they may be approved simultaneously with the issuance of a RCRA permit, the approval of a RCRA closure plan, or the selection of a remedy in a CERCLA response action in the ROD. In the case of an on-site CERCLA response action, the procedural requirements of the variance process do not apply. See CERCLA sections 121(e)(1) and 121(d)(2). The variance decision will be made as part of EPA's remedy selection process, during which data justifying alternative treatment levels will be included in the administrative record files, and public participation opportunities and Agency response to comment will be afforded as appropriate under this rule.

In EPA's view, the Agency's determination that the BDAT standards are generally inappropriate for contaminated soil and debris addresses many of the practical concerns raised by commenters in the supplemental notice on the Agency's interpretation of the term "land disposal". For this reason, and because EPA has had insufficient time to review and evaluate the many lengthy and complex issues raised by commenters on the supplemental notice, EPA is deferring any final decision to modify that interpretation. (EPA will respond to comments on the alternatives in the supplemental notice when the Agency makes a final decision on the proposed reinterpretation of land disposal.) Until a final decision is made, the interpretation announced in the preamble to the proposed NCP and discussed in section 1 above will remain in effect.

Final rule: There is no rule language on this issue.

Name: Determination of whether a waste is a hazardous waste.

Proposed rule: The preamble to the proposed rule discussed how to determine whether hazardous waste regulated under RCRA Subtitle C was present at a site (53 FR 51444).

Response to comments: Some commenters raised questions about EPA's discussion about determining whether a waste exhibits a hazardous characteristic. One argued that EPA cannot assume a waste is not a characteristic waste in the absence of testing and should therefore adopt a liberal and inclusive approach to

cannot meet a treatment standard, or that a treatment method (or the method underlying the standard) is inappropriate for his waste. The final sentence of § 268.44(h), identifying the showing an applicant must include in his variance application, on its terms applies only to applications submitted under the first criterion. EPA's presumption, however, applies to soil and debris regardless of which of the two types of variances apply.

determining whether RCRA applies to avoid expensive and time-consuming testing. Another commenter asked for clarification on who was responsible for applying "process knowledge" to determine whether a waste was a hazardous waste in the absence of testing. The commenter asserted that, under RCRA, EPA exercises prosecutorial discretion if a generator, acting in good faith, decides incorrectly that his waste is not hazardous. EPA notes that when it determines that there is a violation there will normally be some kind of enforcement action taken; the level and type of prosecutorial response will depend on a number of factors, for example, the size of the company, the significance of the violation, the intent, etc.

Under RCRA rules, a generator is not required to test, but may use knowledge of the waste and its constituents to judge whether the waste exhibits a characteristic. (See 40 CFR 262.11(c).) EPA believes this should also apply if the lead agency or PRP at a CERCLA site is the "generator." EPA wants to make clear, however, that a decision that a waste is not characteristic in the absence of testing may not be arbitrary, but must be based on site-specific information and data collected on the constituents and their concentration during investigations of the site. If on site data, it will be very clear in cases that a waste cannot be characteristic; for example, if a waste does not contain a constituent regulated as EP toxic, a decision that the waste does not exhibit this characteristic can reliably be made without testing for EP toxicity. EPA does not expect to undertake testing when it can otherwise be determined with reasonable certainty whether or not the waste will exhibit a characteristic.

In response to the second concern, the determination whether a waste is a hazardous waste may be made by EPA, the state, or a PRP, depending on the nature of the action. EPA will take any necessary or appropriate action if decisions about the hazardous nature of the waste are in error or are made without proper basis.

Several commenters discussed the question of whether RCRA requirements can be applicable to RCRA hazardous waste disposed of before the RCRA requirements went into effect in 1980. One commenter argued that they could not be, unless the waste exhibited a characteristic at the time of the CERCLA action. However, as one commenter noted, EPA has consistently met in enforcement actions that RCRA requirements apply to any waste

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APPENDIX B to EPA/540/G-91/009

OSWER DIRECTIVE 9347.3-05 FS
SUPERFUND LDR GUIDE #5



United States
Environmental Protection
Agency

Office of
Solid Waste and
Emergency Response

Superfund Publication:
9347.3-OSFS
July 1989

Superfund LDR Guide #5

Determining When Land Disposal Restrictions (LDRs) Are Applicable to CERCLA Response Actions

CERCLA Section 121(d)(2) specifies that on-site Superfund remedial actions shall attain "other Federal standards, requirements, criteria, limitations, or more stringent State requirements that are determined to be legally applicable or relevant and appropriate (ARAR) to the specified circumstances at the site." In addition, the National Contingency Plan (NCP) requires that on-site removal actions attain ARARs to the extent practicable. Off-site removal and remedial actions must comply with legally applicable requirements. This guide outlines the process used to determine whether the Resource Conservation and Recovery Act (RCRA) land disposal restrictions (LDRs) established under the Hazardous and Solid Waste Amendments (HSWA) are "applicable" to a CERCLA response action. More detailed guidance on Superfund compliance with the LDRs is being prepared by the Office of Solid Waste and Emergency Response (OSWER).

For the LDRs to be applicable to a CERCLA response, the action must constitute placement of a restricted RCRA hazardous waste. Therefore, site managers (OSCs, RPMs) must answer three separate questions to determine if the LDRs are applicable:

- (1) Does the response action constitute placement?
- (2) Is the CERCLA substance being placed also a RCRA hazardous waste? and if so
- (3) Is the RCRA waste restricted under the LDRs?

Site managers also must determine if the CERCLA substances are California list wastes, which are a distinct category of RCRA hazardous wastes restricted under the LDRs (see Superfund LDR Guide #2).

(1) DOES THE RESPONSE CONSTITUTE PLACEMENT?

The LDRs place specific restrictions (e.g., treatment of waste to concentration levels) on RCRA hazardous wastes prior to their placement in land disposal units. Therefore, a key determination is whether the response action will constitute placement of wastes into a land disposal unit. As defined by RCRA, land disposal units include landfills, surface impoundments, waste piles, injection wells, land treatment facilities, salt dome formations, underground mines or caves, and concrete bunkers or vaults. If a CERCLA response includes disposal of wastes in any of these types of off-site land disposal units, placement will occur. However, uncontrolled hazardous waste sites often have widespread and dispersed contamination, making the

concept of a RCRA unit less useful for actions involving on-site disposal of wastes. Therefore, to assist in defining when "placement" does and does not occur for CERCLA actions involving on-site disposal of wastes, EPA uses the concept of "areas of contamination" (AOCs), which may be viewed as equivalent to RCRA units, for the purposes of LDR applicability determinations.

An AOC is delineated by the areal extent (or boundary) of contiguous contamination. Such contamination must be continuous, but may contain varying types and concentrations of hazardous substances. Depending on site characteristics, one or more AOCs may be delineated. Highlight 1 provides some examples of AOCs.

Highlight 1: EXAMPLES OF AREAS OF CONTAMINATION (AOCs)

- A waste source (e.g., waste pit, landfill waste pile) and the surrounding contaminated soil.
- A waste source, and the sediments in a stream contaminated by the source, where the contamination is continuous from the source to the sediments.*
- Several lagoons separated only by dikes, where the dikes are contaminated and the lagoons share a common liner.

* The AOC does not include any contaminated surface or ground water that may be associated with the land-based waste source.

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For on-site disposal, placement occurs when wastes are moved from one AOC (or unit) into another AOC (or unit). Placement does not occur when wastes are left in place, or moved within a single AOC. Highlight 2 provides scenarios of when placement does and does not occur, as defined in the proposed NCP. The Agency is currently reevaluating the definition of placement prior to the promulgation of the final NCP, and therefore, these scenarios are subject to change.

Highlight 2: PLACEMENT

Placement does occur when wastes are:

- Consolidated from different AOCs into a single AOC;
- Moved outside of an AOC (for treatment or storage, for example) and returned to the same or a different AOC; or
- Excavated from an AOC, placed in a separate unit, such as an incinerator or tank that is within the AOC, and redeposited into the same AOC.

Placement does not occur when wastes are:

- Treated in situ;
- Capped in place;
- Consolidated within the AOC; or
- Processed within the AOC (but not in a separate unit, such as a tank) to improve its structural stability (e.g., for capping or to support heavy machinery).

In summary, if placement on-site or off-site does not occur, the LDRs are not applicable to the Superfund action.

(2) IS THE CERCLA SUBSTANCE A RCRA HAZARDOUS WASTE?

Because a CERCLA response must constitute placement of a restricted RCRA hazardous waste for the LDRs to be applicable, site managers must evaluate whether the contaminants at the CERCLA site are RCRA hazardous wastes. Highlight 3 briefly describes

the two types of RCRA hazardous wastes - listed and characteristic wastes.

Highlight 3: RCRA HAZARDOUS WASTES

A RCRA solid waste* is hazardous if it is listed or exhibits a hazardous characteristic.

Listed RCRA Hazardous Wastes

Any waste listed in Subpart D of 40 CFR 261, including:

- F waste codes (Part 261.31)
- K waste codes (Part 261.32)
- P waste codes (Part 261.33(e))
- U waste codes (Part 261.33(f))

Characteristic RCRA Hazardous Wastes

Any waste exhibiting one of the following characteristics, as defined in 40 CFR 261:

- Ignitability
- Corrosivity
- Reactivity
- Extraction Procedure (EP) Toxicity

* A solid waste is any material that is discarded or disposed of (i.e., abandoned, recycled in certain ways, or considered inherently waste-like). The waste may be solid, semi-solid, liquid, or a contained gaseous material. Exclusions from the definition (e.g., domestic sewage sludge) appear in 40 CFR 261.4(a). Exemptions (e.g., household wastes) are found in 40 CFR 261.4(b).

Site managers are not required to presume that a CERCLA hazardous substance is a RCRA hazardous waste unless there is affirmative evidence to support such a finding. Site managers, therefore, should use "reasonable efforts" to determine whether a substance is a RCRA listed or characteristic waste. (Current data collection efforts during CERCLA removal and

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remedial site investigations should be sufficient for this purpose.) For listed hazardous wastes, if manifests or labels are not available, this evaluation likely will require fairly specific information about the waste (e.g., source, prior use, process type) that is "reasonably ascertainable" within the scope of a Superfund investigation. Such information may be obtained from facility business records or from an examination of the processes used at the facility. For characteristic wastes, site managers may rely on the results of the tests described in 40 CFR 261.21 - 261.24 for each characteristic or on knowledge of the properties of the substance. Site managers should work with Regional RCRA staff, Regional Counsel, State RCRA staff, and Superfund enforcement personnel, as appropriate, in making these determinations.

In addition to understanding the two categories of RCRA hazardous wastes, site managers will also need to understand the derived-from rule, the mixture rule, and the contained-in interpretation to identify correctly whether a CERCLA substance is a RCRA hazardous waste. These three principles, as well as an introduction to the RCRA delisting process, are described below.

Derived-from Rule (40 CFR 261.3(c)(2))

The derived-from rule states that any solid waste derived from the treatment, storage, or disposal of a listed RCRA hazardous waste is itself a listed hazardous waste (regardless of the concentration of hazardous constituents). For example, ash and scrubber water from the incineration of a listed waste are hazardous wastes on the basis of the derived-from rule. Solid wastes derived from a characteristic hazardous waste are hazardous wastes only if they exhibit a characteristic.

Mixture Rule (40 CFR 261.3(a)(2))

Under the mixture rule, when any solid waste and a listed hazardous waste are mixed, the entire mixture is a listed hazardous waste. For example, if a generator mixes a drum of listed F006 electroplating waste with a non-hazardous wastewater (wastewaters are solid wastes - see Highlight 3), the entire mixture of the F006 and wastewater is a listed hazardous waste.

Mixtures of solid wastes and characteristic hazardous wastes are hazardous only if the mixture exhibits a characteristic.

Contained-in Interpretation (OSW Memorandum dated November 13, 1986)

The contained-in interpretation states that any mixture of a non-solid waste and a RCRA listed hazardous waste must be managed as a hazardous waste as long as the material contains (i.e., is above health-based levels) the listed hazardous waste. For example, if soil or ground water (i.e., both non-solid wastes) contain an F001 spent solvent, that soil or ground water must be managed as a RCRA hazardous waste, as long as it "contains" the F001 spent solvent.

Delisting (40 CFR 260.20 and 22)

To be exempted from the RCRA hazardous waste "system," a listed hazardous waste, a mixture of a listed and solid waste, or a derived-from waste must be delisted (according to 40 CFR 260.20 and 22). Characteristic hazardous wastes never need to be delisted, but can be treated to no longer exhibit the characteristic. A contained-in waste also does not have to be delisted; it only has to "no longer contain" the hazardous waste.

If site managers determine that the hazardous substance(s) at the site is a RCRA hazardous waste(s), they should also determine whether that RCRA waste is a California list waste. California list wastes are a distinct category of RCRA wastes restricted under the LDRs (see Superfund LDR Guide #2).

(3) IS THE RCRA WASTE RESTRICTED UNDER THE LDRs?

If a site manager determines that a CERCLA waste is a RCRA hazardous waste, this waste also must be restricted for the LDRs to be an applicable requirement. A RCRA hazardous waste becomes a restricted waste on its HSWA statutory deadline or sooner if the Agency promulgates a standard before the deadline. Because the LDRs are being phased in over a period of time (see Highlight 4), site managers may need to determine what type of restriction is in

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APPENDIX C To EPA/540/6-91/009

OSWER DIRECTIVE 9330.2-04
DISCHARGE OF WASTEWATER FROM CERCLA SITES INTO POTWs

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Highlight 4: LDR STATUTORY DEADLINES

Waste	Statutory Deadline
Spent Solvent and Dioxin-Containing Wastes	November 8, 1986
California List Wastes	July 8, 1987
First Third Wastes	August 8, 1988
Spent Solvent, Dioxin-Containing, and California List Soil and Debris From CERCLA/RCRA Corrective Actions	November 8, 1988
Second Third Wastes	June 8, 1989
Third Third Wastes	May 8, 1990
Newly Identified Wastes	Within 6 months of identification as a hazardous waste

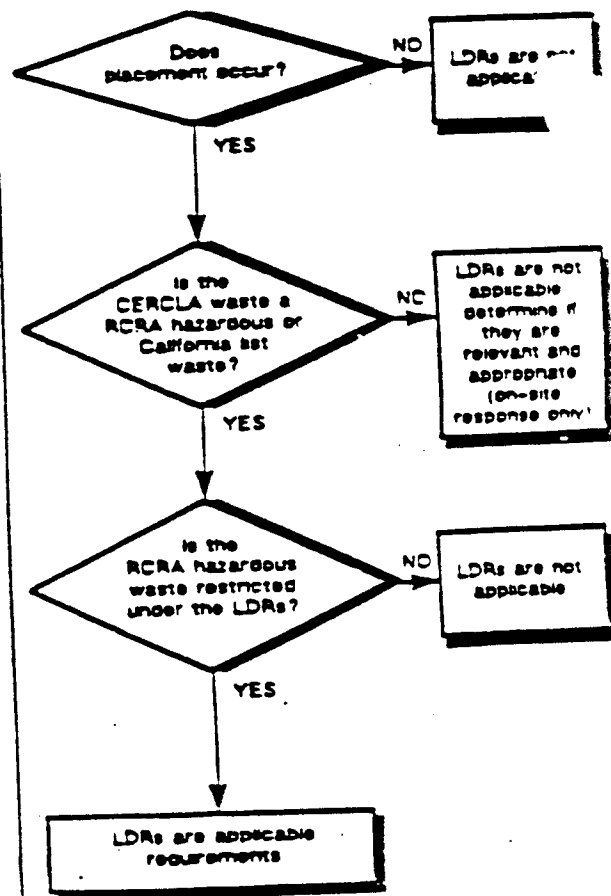
effect at the time placement is to occur. For example, if the RCRA hazardous wastes at a site are currently under a national capacity extension when the CERCLA decision document is signed, site managers should evaluate whether the response action will be completed before the extension expires. If these wastes are disposed of in surface impoundments or landfills prior to the expiration of the extension, the receiving unit would have to meet minimum technology requirements, but the wastes would not have to be treated to meet the LDR treatment standards.

APPLICABILITY DETERMINATIONS

If the site manager determines that the LDRs are applicable to the CERCLA response based on the previous three questions, the site manager must: (1)

comply with the LDR restriction in effect, (2) comply with the LDRs by choosing one of the LDR compliance options (e.g., Treatability Variance, No Migration Petition), or (3) invoke an ARAR waiver (available only for on-site actions). If the LDRs are determined **not** to be applicable, then, for on-site actions only, the site manager should determine if the LDRs are relevant and appropriate. The process for determining whether the LDRs are applicable to a CERCLA action is summarized in Highlight 5.

Highlight 5 - DETERMINING WHEN LDRS ARE APPLICABLE REQUIREMENTS



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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 15 1985

OSWER Directive 9330.2-4

MEMORANDUM

SUBJECT: Discharge of Wastewater from CERCLA Sites into POTWS

FROM: Henry L. Longest II, Director
Office of Emergency and Remedial Response

Rebecca Hamner, Director
Office of Water Enforcement and Permits

Gene A. Lucero, Director
Office of Waste Programs Enforcement

TO: Waste Management Division Directors
Regions I - X

Water Management Division Directors
Regions I - X

A number of emergency removals and remedial cleanup actions under CERCLA will involve consideration of publicly owned treatment works (POTWS) for discharge of wastewater. The current off-site policy (issued on May 6, 1985) does not address the set of concerns and issues unique to POTWS that must be evaluated during the Remedial Investigation and Feasibility Study (RI/FS) for discharge of CERCLA wastewater to POTWS.

Recently, we have had meetings with representatives of the Association of Metropolitan Sewerage Authorities (AMSA) to discuss technical and policy concerns related to the POTW/CERCLA issue. This memorandum is to highlight some of the major points under consideration which were shared with AMSA at their recent Winter Technical Conference. The Agency intends to develop policy on the use and selection of POTWS for CERCLA wastewater. Your comments are sought on the proposed criteria set forth herein. These criteria may be useful in evaluation of POTWS for response actions (fund financed or responsible party financed) to be taken in the interim.

Our position is that no CERCLA discharges to a POTW should occur unless handled in a manner demonstrated to be protective of human health and the environment. Full compliance with all applicable requirements of the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), and any other relevant or appropriate environmental statutes will be necessary.

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The national pretreatment program, under the Clean Water Act, requires an analysis to determine whether the discharge of an industrial user of a POTW may pass through the POTW to cause receiving water quality problems or may interfere with POTW operations (including sludge disposal). If the analysis suggests that limits on the industrial user's discharge are needed to prevent pass through or interference, local limits or other safeguards, as necessary, must be established by the POTW and/or the NPDES permitting authority. The national pretreatment program requirements apply to the introduction of all non-domestic wastewater into any POTW, and include, among other things, the following elements:

- o Prohibited discharge standards - prohibit the introduction of pollutants to the POTW which are ignitable, corrosive, excessively high in temperature, or which may cause interference or pass through at the POTW.
- o Categorical discharge standards - include specific pretreatment standards which are established by EPA for the purpose of regulating industrial discharges in specific industrial categories.
- o Local limits - where no categorical standards have been promulgated or where more stringent controls are necessary.

POTWs under consideration as potential receptors of CERCLA wastewaters may include those POTWs either with or without an approved pretreatment program. POTWs with an approved pretreatment program are required to have the mechanisms necessary to ensure compliance by industrial users with applicable pretreatment standards and requirements.* POTWs without an approved pretreatment program must be evaluated to determine whether sufficient mechanisms exist to allow the POTW to meet the requirements of the national pretreatment program in accepting CERCLA wastewaters. As noted above, pass through and interference are always prohibited, regardless of whether a POTW has an approved pretreatment program. POTWs without an approved pretreatment program must therefore have mechanisms which are adequate to apply the requirements of the national pretreatment program to specific situations.

*POTWs with approved pretreatment programs must, among other things, establish procedures to notify industrial users (IUs) of applicable pretreatment standards and requirements, receive and analyze self-monitoring reports from IUs, sample and analyze industrial effluents, investigate noncompliance, and comply with public participation requirements.

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Determination of a POTW's ability to accept CERCLA wastewater as an alternative to on-site treatment and direct discharge to receiving waters must be made during the Remedial Investigation/Feasibility Study (RI/FS) process. During the remedial alternatives analysis, the appropriateness of using a POTW must be carefully evaluated. Water Division officials and their state counterparts should participate in the evaluation of any remedial alternatives recommending the use of a POTW, and should concur on the selection of the POTW.

If an alternative considers the discharge of wastewater from a CERCLA site into a POTW, the following points should be evaluated in the RI/FS prior to the selection of the remedy for the site:

- o The quantity and quality of the CERCLA wastewater and its compatibility with the POTW (The constituents in the CERCLA wastewater must not cause pass through or interference, including unacceptable sludge contamination or a hazard to employees at the POTW; in some cases, control equipment at the CERCLA site may be appropriate in order to pretreat the CERCLA discharge prior to introduction to the POTW).
- o The ability (i.e., legal authority, enforceable mechanisms, etc.) of the POTW to ensure compliance with applicable pretreatment standards and requirements, including monitoring and reporting requirements.
- o The POTW's record of compliance with its NPDES permit and pretreatment program requirements to determine if the POTW is a suitable disposal site for the CERCLA wastewater.
- o The potential for volatilization of the wastewater at the CERCLA site and POTW and its impact upon air quality.
- o The potential for groundwater contamination from transport of CERCLA wastewater or impoundment at the POTW, and the need for groundwater monitoring.
- o The potential effect of the CERCLA wastewaters upon the POTW's discharge as evaluated by maintenance of water quality standards in the POTW's receiving waters, including the narrative standard of "no toxics in toxic amounts".

- 4 -

- o The POTW's knowledge of and compliance with any applicable RCRA requirements or requirements of other environmental statutes (RCRA permit-by-rule requirements may be triggered if the POTW receives CERCLA wastewaters that are classified as "hazardous wastes" without prior mixing with domestic sewage, i.e., direct delivery to the POTW by truck, rail, or dedicated pipe; CERCLA wastewaters are not all necessarily considered hazardous wastes; case by case determinations have to be made).
- o The various costs of managing CERCLA wastewater, including all risks, liabilities, permit fees, etc. (It may be appropriate to reflect these costs in the POTW's connection fees and user charge system).

Based upon consideration of the above elements, the discharge of CERCLA wastewater to a POTW should be deemed inappropriate if the evaluation indicates that:

- o The constituents in the CERCLA discharge are not compatible with the POTW and will cause pass through, interference, toxic pollutants in toxic amounts in the POTW's receiving waters, unacceptable sludge contamination, or a hazard to employees of the POTW.
- o The impact of the transport mechanism and/or discharging of CERCLA wastewater into a POTW would result in unacceptable impacts upon any environmental media.
- o The POTW is determined to be an unacceptable receptor of CERCLA wastewaters based upon a review of the POTW's compliance history.
- o The use of the POTW is not cost-effective.

If consideration of the various elements indicates that the discharge of CERCLA wastewater to a POTW is deemed appropriate:

- o There should be early public involvement, including contact with POTW officials and users, in accordance with the CERCLA community relations plan and public participation requirements.
- o The NPDES permit and fact sheet may need to be modified to reflect the conditions of acceptance of CERCLA wastewaters; permit modification may be necessitated by the need to incorporate specific pretreatment requirements, local limits, monitoring requirements and/or limitations on additional pollutants of concern in the POTW's discharge or other factors.

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Policy to be developed in the future will apply to all removal, remedial, and enforcement actions taken pursuant to CERCLA and Section 7003 of RCRA. We would appreciate your feedback on this memorandum and any experience in the use of POTWs for CERCLA removal or remedial actions that you have to offer.

If you have any comments or questions on this issue, please submit written comments to the workgroup co-chairs: Shirley Ross (PTS-382-5755) from the Office of Emergency and Remedial Response, or Victoria Price (PTS-382-5681) from the Office of Water.

cc: Ed Johnson
Russ Wyer
Tim Fields
Steve Lingle

011946

APPENDIX D to EPA/546/6-91/009
TCLP CONSTITUENTS

011947

TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

Constituent	Regulatory level (mg/L)
	5.0
Arsenic	100.0
Barium	0.5
Benzene	1.0
Cadmium	0.5
Carbon tetrachloride	0.03
Chlorodane	100.0
Chlorobenzene	6.0
Chloroform	5.0
Chromium	200.0
o-Cresol	200.0
m-Cresol	200.0
p-Cresol	10.0
2,4-D	7.5
1,4-Dichlorobenzene	0.5
1,2-Dichloroethane	0.7
1,1-Dichloroethylene	0.13
2,4-Dinitrotoluene	0.02
Endrin	0.008
Heptachlor (and its hydroxide)	0.13
Hexachlorobenzene	0.5
Hexachloro-1,3-butadiene	3.0
Hexachlorethane	5.0
Lead	0.4
Lindane	0.2
Mercury	10.0
Methoxychlor	200.0
Methyl ethyl ketone	2.0
Nitrobenzene	

TOXICITY CHARACTERISTIC CONSTITUENTS AND REGULATORY LEVELS

Constituent	Regulatory level (mg/L)
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichlorethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-TP (Silvex)	1.0
Vinyl chloride	2.0

011949

APPENDIX E To EPA/540/G-91/00.
GLOSSARY OF TERMS

GLOSSARY OF TERMS

AOC - Area of Contamination
ARARs - Applicable or Relevant and Appropriate Requirements
BDAT - Best Demonstrated Available Technology
BOA - Basic Ordering Agreement
CAA - Clean Air Act
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CLP - Contract Laboratory Program
CWA - Clean Water Act
DE - Disposable Equipment
FIT - Field Investigation Team
HSWA - Hazardous and Solid Waste Amendments
IDW - Investigation - Derived Wastes
LDRs - Land Disposal Restrictions
NCP - National Contingency Plan
PCB - Polychlorinated Biphenyls
PPE - Personal Protective Equipment
POTW - Publicly Owned Treatment Works
PRPs - Potentially Responsible Parties
RCRA - Resource Conservation and Recovery Act
RI/FS - Remedial Investigation/Feasibility Study
RPO - Regional Project Officer
SDWA - Safe Drinking Water Act
SI - Site Inspection
SM - Site Inspection Manager
SWDA - Solid Waste Disposal Act
TSD - Treatment, Storage, and Disposal
TCLP - Toxicity Characteristic Leaching Procedure
TSCA - Toxic Substances Control Act

United States
Environmental Protection
Agency

Office of
Solid Waste and
Emergency Response

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Guide to Management of Investigation-Derived Wastes

(2)

Office of Emergency and Remedial Response
Hazardous Site Control Division OS-220W

Quick Reference Fact Sheet

CERCLA field investigation activities (e.g., remedial investigation/feasibility studies and remedial designs) may result in the generation of waste materials that may pose a risk to human health and the environment. These investigation-derived wastes (IDW) may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues (e.g., ash, spent carbon, well development purge water) from testing of treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE); and solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment. The management of IDW must ensure protection of human health and the environment and comply with (or waive) regulatory requirements that are applicable or relevant and appropriate requirements (ARAR). This fact sheet presents an overview of possible IDW management options, discusses the protectiveness requirements and ARARs associated with these options, and outlines general objectives established for IDW management under Superfund.¹

The general options for managing IDW (see Highlight 1) are collection and either (1) immediate disposal or (2) some type of interim management. Interim management may include storage or temporary measures. As discussed below, the specific option selected will depend on the type of waste produced, its relative threat to human health and the environment, and other site-specific conditions.

IDW MANAGEMENT REQUIREMENTS

When managing IDW, site managers are required to choose an option that: (1) is protective of human health and the environment and (2) complies with (or waives) ARARs, as described below.

Protectiveness

In determining if a particular management/disposal option is protective, site managers should consider the following:

- The contaminants, their concentrations, and total volume of IDW;
- Media potentially affected (e.g., ground water, soil) under management options;
- Location of the nearest population(s) and the likelihood and/or degree of site access;

¹ Management of treatability study and treatment pilot wastes is discussed in Guide for Conducting Treatability Studies Under CERCLA, Interim Final, December 1989, EPA/540/2-89/058. Information on management of IDW generated during Remedial Investigation/Feasibility Studies and Site Investigations is provided in Management of Investigation-Derived Waste During Site Investigations, May 1990, EPA/540/G-91/009.

- Potential exposures to workers; and
- Potential for environmental impacts.

As a general rule, it will be necessary to use best professional judgment, in light of the site-specific conditions, to determine whether an option is protective of human health and the environment. For example, a site manager may determine that storing IDW temporarily until the final action or returning IDW to its source is protective, based on knowledge that the material poses low risk and/or that the final action will address any risks posed by the wastes and there will be no unacceptable risks in the interim.

Alternatively, if the site includes or is near residential areas, the site is unsecured, and/or contaminants appear to be present at unacceptable levels, it may not be protective to return excavated soil to the source. Storing IDW in containers in an on-site, secure location, or sending it off site immediately may be more appropriate.

Site managers also need to consider the potential effects of IDW management-related activities on environmental media. For example, pouring contaminated purge water on the ground around a well may not be prudent, because such an action could mobilize any hazardous constituents present in the soil or introduce contaminants into clean soil.

Compliance with ARARs

Remedial Investigation/Feasibility Study (RI/FS) and Remedial Design (RD) actions must comply with ARARs "to the extent practicable, considering the exigencies of the situation" (NCP, 55 FR 8756, emphasis added); therefore, it generally will not be necessary to obtain a waiver if an ARAR cannot be attained during these actions. If a site manager determines that, based on site-

Highlight 1: IDW MANAGEMENT OPTIONS

Type of IDWGeneration Processes*Management Options

Soil

- Well/test pit installation
- Borehole drilling
- Soil sampling

- Return to boring, pit, or source immediately after generation
- Spread around boring, pit, or source within the AOC*
- Consolidate in a pit (within the AOC)
- Send to on-site TDU*
- Send to TDU off site immediately
- Store for future treatment and/or disposal

Sludges/sediment

- Sludge pit/sediment sampling

- Return to boring, pit, or source immediately after generation
- Send to on-site TDU
- Send to TDU off site immediately
- Store for future treatment and/or disposal

Aqueous liquids (ground water, surface water, drilling fluids, other wastewaters)

- Well installation/development
- Well purging during sampling
- Ground water discharge during pump tests
- Surface water sampling

- Discharge to surface water
- Pour onto ground close to well (non-hazardous waste)
- Send to on-site TDU
- Send to off-site commercial treatment unit
- Send to POTW*
- Store for future treatment and/or disposal

Decontamination fluids

- Decontamination of PPE* and equipment

- Send to on-site TDU
- Evaporate (for small amounts of low contamination organic fluids)
- Send to TDU off site immediately
- Store for future treatment and/or disposal

Disposable PPE

- Sampling procedures or other on-site activities

- Send to on-site TDU
- Place in on-site industrial dumpster
- Send to TDU off site immediately
- Store for future treatment and/or disposal

* The generation processes listed here are provided as examples. IDW may also be produced as a result of activities not listed here.

* AOC: Area of Contamination (AOCs at a site may not yet have been identified at the time of the RI/FS); TDU: Treatment/disposal Unit; POTW: Publicly Owned Treatment Works; PPE: Personal Protective Equipment

... factors, compliance with an ARAR is practicable but an action waiver is warranted for an RI/FS or RD action, an interim action waiver may be available if the final remedy will attain the ARAR. An action memorandum should be prepared for the waiver, the state given an opportunity to comment, and the decision document placed in the administrative record.

Potential ARARs for IDW at CERCLA sites include regulations under the Resource Conservation and Recovery Act (RCRA) (including both Federal and State underground injection control (UIC) regulations), the Clean Water Act (CWA), the Clean Air Act (CAA), the Toxic Substances Control Act (TSCA), and other State environmental laws. How these various requirements may direct or influence IDW management decisions is described below.

Resource Conservation and Recovery Act (RCRA). Certain sections of the RCRA Subtitle C hazardous waste regulations (e.g., land disposal restrictions and storage restrictions) may be ARARs for IDW should RCRA hazardous waste be identified at a site. (Note that RCRA may be relevant and appropriate even if the IDW is not a RCRA hazardous waste.) A waste is hazardous under RCRA if it is listed as such in 40 CFR 261.31 - 261.33 or if it exhibits one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Site managers should not assume that a waste considered to be a potential risk at a CERCLA site is a listed or characteristic hazardous waste. Until there is positive evidence (records, results, other knowledge of waste properties) that the IDW is a RCRA hazardous waste, site managers should manage it in a protective manner (but not necessarily in accordance with Subtitle C requirements). Business records or facility processes should be examined to determine whether RCRA listed wastes were generated and are present in the IDW. For characteristic wastes, site managers should rely on testing results or on knowledge of the material's properties. If best professional judgment and available information indicate that, for protectiveness reasons (or because RCRA requirements are relevant and appropriate), IDW is best managed as a "hazardous waste," management in accordance with Subtitle C requirements is prudent, regardless of whether it is known to be a RCRA waste.

If aqueous liquid IDW is considered a RCRA hazardous waste, the site manager should determine whether the Domestic Sewage Exclusion (DSE) applies to the discharge of that IDW to a POTW. The RCRA DSE exempts domestic sewage and any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment from classification as a solid waste and, therefore, as a RCRA hazardous waste (40 CFR 261.4).

• Land Disposal Restrictions

If IDW is determined to be a RCRA hazardous waste and subject to the land disposal restrictions (LDRs), "land disposal" of the IDW will be prohibited unless specified treatment standards are met. Superfund LDR Guides #5 and #7, Determining When LDRs Are Applicable to CERCLA Response Actions and Determining When LDRs Are Relevant and Appropriate to CERCLA Response Actions, OSWER Directive 9347.3-05FS and

9347.3-08FS, June 1989 and December 1989 and the NCP, 55 FR 8759, March 8, 1990). "Land disposal" occurs when wastes from different AOCs are consolidated into one AOC; when wastes are moved outside an AOC (for treatment or storage) and returned to the same or a different AOC; or when wastes are excavated, placed in a separate hazardous waste management unit such as an incinerator or tank within the AOC, and then redeposited into the AOC.

Storing IDW in a container ("a portable device in which a material is stored, transported, treated, disposed of, or otherwise handled" (40 CFR 260.10)) within the AOC and then returning it to its source, however, is allowable without meeting the specified LDR treatment standards. Under the definition of "hazardous waste management unit" (40 CFR 260.10), EPA states that "a container alone does not constitute a unit; the unit includes the containers and the land or pad upon which they are placed." Therefore, returning IDW that has been stored in containers (not tanks or other RCRA-regulated units) within the AOC to its source does not constitute land disposal, as long as containers are not managed in such a manner as to constitute a RCRA storage unit as defined in 40 CFR 260.10. In addition, sampling and direct replacement of wastes within an AOC do not constitute land disposal.

• Storage

Subtitle C outlines the storage requirements for RCRA hazardous wastes. Under RCRA, "storage" is defined as "the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR 260.10).

On-site Superfund actions are only required to comply with the substantive standards of other laws (see 40 CFR 300.5, definitions of applicable or relevant and appropriate requirements). Superfund sites are also exempt from permit requirements under CERCLA §121(e). Therefore, site managers are not required to comply with administrative requirements triggered by RCRA storage deadlines (e.g., contingency planning, inspections, recordkeeping). Generally equivalent administrative activities are undertaken at Superfund sites, however, under existing Superfund management practices.

Site managers storing known RCRA hazardous waste must comply with the substantive, technical requirements of 40 CFR Parts 264 and 265 Subparts I (containers), J (tanks), and L (waste piles), to the extent practicable. (See Highlight 2 for a summary of these technical requirements for each type of unit). In addition, the ground-water monitoring requirements of 40 CFR Parts 264 and 265 Subpart F are potential ARARs, and to the extent they are determined to be ARARs at a site, they should be attained to the extent practicable (or waived). (In many cases, ground-water monitoring conducted during the RI/FS will provide protection equivalent to the Subpart F requirements.)

[NOTE: Under the LDRs, restricted RCRA hazardous waste may not be stored at a site unless the storage is solely for the purpose of accumulating sufficient quantities of the waste to facilitate proper disposal, treatment, or recovery (see 40 CFR 268.50). Generally, storing IDW until a final disposal option is

**Highlight 2:
EXAMPLES OF RCRA TECHNICAL STORAGE
REQUIREMENTS***

RCRA storage requirements, applicable to both less-than-90-days generators and permitted or interim status storage facilities, may include the following substantive requirements:

Containers 40 CFR 264 Subpart I and 265 Subpart I

- Containers must be in good condition
- Wastes must be compatible with container
- Container must be closed during storage
- Container storage areas must have a containment system that can contain 10 percent of the volume of containers or of the largest container
- Spilled or leaked waste must be removed from the collection area as necessary to prevent overflow

Tanks 40 CFR 264 Subpart J and 265 Subpart J

- Tanks must have a secondary containment system that includes a liner, a vault, a double-walled tank, or an equivalent device (applies only to certain tanks)

Waste Piles 40 CFR 264 Subpart L and 265 Subpart L

- Waste piles must have a liner and a leachate collection and removal system
- Owners/operators must have a run-on control system to prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm
- Owners/operators must have a run-off management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm
- This is a partial list of substantive requirements. For more detail, see 40 CFR Part 264 and 265.

selected in a Record of Decision (ROD) and implemented during the remedial action is allowable storage under the RCRA LDR storage prohibition.]

• **Recordkeeping and Manifesting**

If hazardous wastes are sent off site, the site manager must comply with both administrative and substantive elements of the RCRA generator requirements of 40 CFR Part 262 and LDR notification and certification requirements of Part 268. (For example, a site manager must prepare an LDR notification and certification when restricted wastes are sent off site to a land disposal facility.) These standards include requirements such as manifests for shipping waste that list all hazardous waste listings and characteristics applicable to the waste (see 40 CFR 262.11), packaging and transport requirements, and recordkeeping requirements.

If the LDRs are applicable, the following information should be collected and available before the removal of wastes to an off-site disposal facility: EPA hazardous waste number, LDR treatment standards, manifest number for the waste shipment, and waste analysis data.

• **Underground Injection Control (UIC) Program**

Under the UIC regulations, RCRA hazardous wastes may be injected into Class I permitted wells. In some cases, hazardous liquids, such as extracted ground water from pump and treat operations, may be injected into a Class IV UIC well. For example, ground water contaminated with RCRA hazardous wastes may be injected into Class IV permitted wells if it is part of a CERCLA response action or a RCRA corrective action and if it has been treated to "substantially reduce hazardous constituents prior to such injection..." (RCRA § 3020(b)). (See Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment ReInjection, OSWER Directive #9234.1-06, December 1989.)

• **Non-RCRA Hazardous Wastes**

Some non-RCRA hazardous waste may be subject to management requirements under Subtitle D of RCRA as solid wastes. Subtitle D regulates disposal of solid waste in facilities such as municipal landfills. Therefore, non-RCRA hazardous IDW, such

as decontaminated PPE or equipment, may need to be disposed of in a Subtitle D facility (depending on State requirements).

Clean Water Act (CWA). Discharges of aqueous IDW to surface water and publicly owned treatment works (POTWs) may be required to comply with CWA Federal, State, and local requirements. Requirements to be met may include water quality criteria, pre-treatment standards, State water quality standards, and NPDES permit conditions. Direct discharges to on-site waters are subject only to substantive requirements, while discharges to POTWs and other off-site discharges must comply with both substantive and administrative CWA requirements (including permitting requirements). (See Guide to Discharging CERCLA Aqueous Wastes to POTWs, June 1991 and CERCLA Compliance with the CWA and SDWA, #9234.2-06FS, January 1991.)

Toxic Substances Control Act (TSCA). If IDW contains PCBs, TSCA treatment and/or disposal requirements may apply during its management. TSCA requirements regulate the disposal of material contaminated with PCBs at concentrations of 50 ppm or greater as found on site (i.e., based on sample analysis and not the PCB concentration of the source material (e.g., transformer fluid)). (See PCB Guidance Manual, EPA/540/G-90/007, August 1990.) In addition, TSCA storage requirements may apply that limit the time that PCBs may be stored to one year. Furthermore, if PCB materials are mixed with a RCRA hazardous waste, they may be regulated by the LDR California list prohibitions. (See RCRA sections 3004(d)(2)(D) and (E).)

Department of Transportation (DOT) requirements. Where IDW will be disposed of off site or transported on public roads to a site,

requirements for containerizing, labeling, and transporting
ous materials and substances may apply.

State requirements. Promulgated State regulations that are legally enforceable, timely identified, and more stringent than Federal regulations may be potential ARARs for IDW managed on site. Substantive requirements of State law that may be ARARs for IDW management include State water quality standards, direct discharge limits, and RCRA requirements (including underground injection control regulations) promulgated in a State with an authorized RCRA hazardous waste management program (as well as programs authorized by State laws). Off-site, substantive and administrative requirements of State law may apply.

Off-Site Policy. In addition to complying with requirements of Federal and State laws, all off-site disposal of wastes must comply with CERCLA section 121(d)(3) and the CERCLA Off-Site Policy (OSWER Directive No. 9834.11 (November 13, 1987)). The Off-Site Policy establishes criteria for selecting an appropriate treatment, storage, or disposal facility (TSDF), including release criteria for all facilities that receive wastes from CERCLA-authorized or funded response actions. In addition, receiving facilities must be in compliance with all "applicable laws."

Before shipping wastes off site, approval should be obtained for the proposed disposal facility from EPA's Regional Off-Site Policy Coordinator. In addition, EPA has adopted a policy for Superfund wastes shipped out of State that written notification should be sent to receiving States (OSWER Directive 9330.2-07, November 14, 1989).

GENERAL OBJECTIVES FOR IDW MANAGEMENT

In addition to the two requirements of protectiveness and compliance with ARARs to the extent practicable (on site) or compliance with applicable law (off site), EPA has identified two general objectives that Superfund site managers should consider when managing IDW: (1) minimization of IDW generation; and (2) management of IDW consistent with the final remedy for the site. The extent to which these objectives can be achieved is highly dependent on site-specific circumstances.

IDW Minimization

Site managers should strive to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information from the site inspection. The potential problems of managing IDW should be a factor in choosing an investigative method. Site managers may wish to consider techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic on clean and hot zones, and drilling methods and sampling techniques that generate little waste. Examples of such techniques include using gridding techniques to minimize the number of test

pits or using soil borings instead of test pits. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer instead of coring. Site managers should also be careful to keep hazardous wastes separate from nonhazardous wastes.

Management Consistent with Final Remedy

Most IDW (with the exception of non-indigenous IDW) generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements.

Because early planning for IDW management can prevent unnecessary costs and the use of treatment or disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated/disposed of immediately or addressed with the final remedy. If addressed with the final remedy, IDW volumes should be considered in the FS. In addition, when IDW is stored on site, it should be managed as part of the first remedial action/operable unit that addresses the affected media.

SELECTION OF IDW DISPOSAL OPTIONS

The following sections present the Agency's presumptions for IDW management that have been established based on the above considerations. The actual option selected should be based upon best professional judgment and should take into account the following factors:

- The type and quantity of IDW generated (sludge/soil, aqueous liquid, non-indigenous IDW);
- Risk posed by managing the IDW on site (e.g., based on site access controls, contaminant concentrations);
- Compliance with ARARs, to the extent practicable (on site);
- IDW minimization; and
- Whether the final remedy is anticipated to be an off-site or on-site remedy (or this information is unknown) and whether IDW can be managed consistent with the final remedy.

Off-site Final Remedies

If a site manager believes that the final remedy will involve off-site disposal of wastes, EPA's presumption is to manage the IDW as part of the remedial action addressing the waste/medium. Thus, until the final action, the IDW may be stored (e.g., drummed, covered waste pile) or returned to its source. However, the management option selected should also take into account any protectiveness concerns, ARARs, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

There are several potential reasons why it may be advisable to store IDW until the final action. First, because wastes at the site shipped off site eventually, returning IDW (especially sludges or soils) to its source would require that it be excavated again. Second, site managers may consider it practical to containerize IDW as soon as it is generated. Second, storing IDW in containers may be more protective than returning it to its source. Third, because off-site actions may trigger such requirements as the LDRs, temporary storage will eliminate the need to meet these additional requirements until the final remedy.

In some cases, circumstances may lead site managers to choose to return the IDW to its source. This may be appropriate if it is determined that returning IDW to the source is protective and that storage at the site is not possible or practicable (i.e., given State or community concerns). In other cases, long-term storage may not be protective, and immediate off-site disposal may be a better option.

Off-site Remedy

Example: A site involves volatile organic RCRA hazardous wastes that will likely be sent off site for final treatment and disposal. Site conditions are such that temporary storage of IDW is considered protective until the remedial action begins. Because off-site disposal will trigger RCRA disposal requirements such as the LDRs and immediate containerization would be more protective than redepositing into the source area at the time of sampling, the site manager decides to containerize the IDW (and comply with RCRA substantive technical tank and container standards) until the final action is initiated.

On-site Final Remedies (or Final Management in an Unknown Location)

When final management of wastes is likely to occur on site, the management presumptions vary depending on the type of IDW produced.

Sludge/soil

Generally, the Agency expects sludge or soil IDW will be returned to its source if short-term protectiveness is not an issue. The reason behind this presumption is that IDW that may pose a risk to human health and the environment in the long term will be addressed by the final action. Storage of RCRA hazardous IDW in containers within the AOC prior to returning it to the source will not trigger the LDRs, as long as the containers are not managed in such a way as to constitute a RCRA storage unit as defined in 40 CFR 260.10. Therefore, it may be possible to store IDW temporarily before redispersing of it. However, EPA believes that, in many cases, returning sludges and soils to their source immediately will be protective and will avoid potentially increased costs and requirements associated with storage. Site-specific decisions on how to manage sludge and soil IDW may ultimately

vary from the presumption based on protectiveness, ARARs, and/or community concerns.

Sludge/Soil

Example 1: The soil at a site contains wastes that are expected to be stabilized on site during the final remedial action. The site manager determines that sending soil IDW off site is not cost-effective, because off-site disposal would involve testing and transport costs for a relatively small amount of waste. Instead, knowing that the site is secure and that redispersing the waste at the source will not increase site risk or violate ARARs, the site manager decides to return soil IDW to the source area from which it originated.

Example 2: A site manager determines that returning highly contaminated PCB wastes to the ground at a site is not protective because of the potential risks associated with the material; instead, the site manager chooses to drum the waste and send it off site (in compliance with TSCA). (Off-site disposal may occur immediately or at a later date.)

Example 3: Soil IDW contaminated with a RCRA hazardous waste is generated from a soil boring. The site manager decides to put the IDW back into the borehole immediately after generation, but ensures that site risks will not be increased (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas) and that the contamination will be addressed in the final remedy.

Aqueous liquids

EPA has not established a presumption for the management of aqueous liquid IDW (e.g., ground water). Site managers should determine the most appropriate disposal option for aqueous liquids on a site-specific basis. Parameters to consider, especially in making the protectiveness decision, include the volume of IDW, the contaminants present in the ground water, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the ground-water plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components. Examples of aqueous liquid management decisions considering these factors are presented in the box on the next page.

Non-indigenous IDW

Non-indigenous IDW (e.g., sampling materials, disposable PPE, decontamination fluids) should be stored until the final remedy or disposed of immediately. If contaminated, such waste may not be disposed of onto the ground because such an action would add contamination that was not present when activities began at the site (e.g., solvents used for decontamination). If non-indigenous IDW is contaminated with RCRA hazardous waste, it must be managed in accordance with RCRA Subtitle C requirements. Otherwise, site

Aqueous Liquids

Example 1: A site manager has large volumes of ground water IDW and does not know if it is contaminated. Pouring this IDW on the ground would not be protective, because it may contaminate previously uncontaminated soil or may mobilize contaminants that are present in the soil. Therefore, the site manager stores the water in a mobile tank until a determination is made as to whether the water and soil are contaminated or until the final action.

Example 2: IDW is generated from the sampling of background, upgradient wells. Because there are no community concerns or evidence of any soil contamination from other sources, the site manager decides to pour this presumably uncontaminated IDW on the ground around the well.

Example 3: Purge water from a deep aquifer is known to be contaminated with a RCRA hazardous waste. At this site, if this water were poured on the ground, it could contaminate a previously uncontaminated shallow aquifer that is a potential drinking water source and would have to comply with the LDRs. The site manager decides to containerize the water within the AOC and store it until the final remedy.

ers may generally dispose of it in an on-site dumpster (for PPE).

Non-indigenous IDW

Example 1: Disposable PPE (e.g., gloves, shoe covers) becomes contaminated with RCRA hazardous waste during the field investigation. The site manager containerizes and disposes of this IDW in compliance with RCRA Subtitle C requirements.

Example 2: Disposable equipment becomes contaminated during a field investigation. The site manager decontaminates them and sends them to a Subtitle D facility.

COMMUNITY CONCERNS

Residents of communities near a CERCLA site, local governments, or States may have concerns about certain disposal methods or long-term storage of IDW at the site. As with all CERCLA activities, site managers should evaluate community concerns regarding disposal of IDW in deciding what action to take. For example, if a community is concerned about the direct discharge of IDW water to surface water on site, site managers may want to consider sending the water to a POTW, if one is located nearby. In some instances, it may be appropriate to prepare fact sheets, include options in other community relations documents, or explain IDW management decisions at public meetings prior to actions.

NOTICE: The policies set out in this memorandum are not final agency action, but are intended solely as guidance. They are not ded, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. The Agency also reserves the right to change this guidance any time without public notice.

There are several potential reasons why it may be advisable to store IDW until the final action. First, because wastes at the site will be shipped off site eventually, returning IDW (especially sludges and soil) to its source would require that it be excavated again. Thus, site managers may consider it practical to containerize IDW as soon as it is generated. Second, storing IDW in containers may be more protective than returning it to its source. Third, because off-site actions may trigger such requirements as the LDRs, temporary storage will eliminate the need to meet these additional requirements until the final remedy.

In some cases, circumstances may lead site managers to choose to return the IDW to its source. This may be appropriate if it is determined that returning IDW to the source is protective and that storage at the site is not possible or practicable (i.e., given State or community concerns). In other cases, long-term storage may not be protective, and immediate off-site disposal may be a better option.

Off-site Remedy

Example: A site involves volatile organic RCRA hazardous wastes that will likely be sent off site for final treatment and disposal. Site conditions are such that temporary storage of IDW is considered protective until the remedial action begins. Because off-site disposal will trigger RCRA disposal requirements such as the LDRs and immediate containerization would be more protective than redepositing into the source area at the time of sampling, the site manager decides to containerize the IDW (and comply with RCRA substantive technical tank and container standards) until the final action is initiated.

On-site Final Remedies (or Final Management in an Unknown Location)

When final management of wastes is likely to occur on site, the management presumptions vary depending on the type of IDW produced.

Sludge/soil

Generally, the Agency expects sludge or soil IDW will be returned to its source if short-term protectiveness is not an issue. The reason behind this presumption is that IDW that may pose a risk to human health and the environment in the long term will be addressed by the final action. Storage of RCRA hazardous IDW in containers within the AOC prior to returning it to the source will not trigger the LDRs, as long as the containers are not managed in such a way as to constitute a RCRA storage unit as defined in 40 CFR 260.101. Therefore, it may be possible to store IDW temporarily before redistributing it. However, EPA believes that, in many cases, returning sludges and soils to their source immediately will be protective and will avoid potentially increased costs and requirements associated with storage. Site-specific decisions on how to manage sludge and soil IDW may ultimately

vary from the presumption based on protectiveness, ARAR community concerns.

Sludge/Soil

Example 1: The soil at a site contains wastes that are expected to be stabilized on site during the final remedial action. The site manager determines that sending soil IDW off site is not cost-effective, because off-site disposal would involve testing and transport costs for a relatively small amount of waste. Instead, knowing that the site is secure and that redistributing the waste at the source will not increase site risk or violate ARARs, the site manager decides to return soil IDW to the source area from which it originated.

Example 2: A site manager determines that returning highly contaminated PCB wastes to the ground at a site is not protective because of the potential risks associated with the material; instead, the site manager chooses to drum the waste and send it off site (in compliance with TSCA). (Off-site disposal may occur immediately or at a later date.)

Example 3: Soil IDW contaminated with a RCRA hazardous waste is generated from a soil boring. The site manager decides to put the IDW back into the borehole immediately after generation, but ensures that site risks will not be increased (e.g., the contaminated soil will not be replaced at a greater depth than where it was originally that it will not contaminate "clean" areas) and that contamination will be addressed in the final remedy.

Aqueous liquids

EPA has not established a presumption for the management of aqueous liquid IDW (e.g., ground water). Site managers should determine the most appropriate disposal option for aqueous liquid IDW on a site-specific basis. Parameters to consider, especially making the protectiveness decision, include the volume of IDW, contaminants present in the ground water, the presence of contaminants in the soil at the site, whether the ground or surface water is a drinking water supply, and whether the ground-water plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant components. Examples of aqueous liquid management decisions considering these factors are presented in the box on the next page.

Non-indigenous IDW

Non-indigenous IDW (e.g., sampling materials, disposable decontamination fluids) should be stored until the final remedy is disposed of immediately. If contaminated, such waste may not be disposed of onto the ground because such an action would cause contamination that was not present when activities began at the site (e.g., solvents used for decontamination). If non-indigenous IDW is contaminated with RCRA hazardous waste, it must be managed in accordance with RCRA Subtitle C requirements. Otherwise

FINAL

PHASE 2 WORK PLAN

for the

REMEDIAL INVESTIGATION
GROUP NO. 2 SITES

at

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

Submitted to:

U.S. ARMY CORPS OF ENGINEERS
Tulsa District

DECEMBER 1994

Prepared by:

SVERDRUP ENVIRONMENTAL, INC.
ST. LOUIS, MISSOURI

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	1 of 6
1.1 Introduction	1 of 6
1.2 Purpose and Scope	3 of 6
1.3 Regulatory Background	4 of 6
1.4 Work Plan Organization	4 of 6
1.5 Project Management	6 of 6
2.0 FACILITY BACKGROUND	1 of 4
2.1 Location	1 of 4
2.2 Boundary Features	1 of 4
2.3 Facility Background	3 of 4
2.4 Climate	4 of 4
2.5 Additional Information	4 of 4
3.0 NATURE AND EXTENT OF CONTAMINATION	1 of 52
3.1 LHAAP 12: Active Landfill	1 of 52
3.1.1 Site History	1 of 52
3.1.2 Site Description	2 of 52
3.1.3 Previous Investigations	4 of 52
3.1.4 Assessment of Existing Data	6 of 52
3.1.5 Potential Contaminants and Migration Pathways	8 of 52
3.1.6 Identification of Potential Receptors	9 of 52
3.2 LHAAP 16: Old Landfill	10 of 52
3.2.1 Site History	10 of 52
3.2.2 Site Description	11 of 52
3.2.3 Previous Investigations	13 of 52
3.2.4 Assessment of Existing Data	15 of 52
3.2.5 Potential Contaminants and Migration Pathways	17 of 52
3.2.6 Identification of Potential Receptors	18 of 52
3.3 LHAAP 17: Burning Ground No.2/Flashing Area	19 of 52
3.3.1 Site History	19 of 52
3.3.2 Site Description	19 of 52
3.3.3 Previous Investigations	21 of 52
3.3.4 Assessment of Existing Data	23 of 52
3.3.5 Potential Contaminants and Migration Pathways	25 of 52
3.3.6 Identification of Potential Receptors	26 of 52

TABLE OF CONTENTS (CONTINUED)

Section	Page
3.4 LHAAP 18/24: Burning Ground No.3/Unlined Evaporation Pond	27 of 52
3.4.1 Site History	27 of 52
3.4.2 Site Description	28 of 52
3.4.3 Previous Investigations	30 of 52
3.4.4 Assessment of Existing Data	33 of 52
3.4.5 Potential Contaminants and Migration Pathways	34 of 52
3.4.6 Identification of Potential Receptors	35 of 52
3.5 LHAAP 29: Former TNT Production Area	36 of 52
3.5.1 Site History	36 of 52
3.5.2 Site Description	37 of 52
3.5.3 Previous Investigations	41 of 52
3.5.4 Assessment of Existing Data	42 of 52
3.5.5 Potential Contaminants and Migration Pathways	43 of 52
3.5.6 Identification of Potential Receptors	44 of 52
3.6 LHAAP 32: Former TNT Waste Disposal Plant	45 of 52
3.6.1 Site History	46 of 52
3.6.2 Site Description	46 of 52
3.6.3 Previous Investigations	48 of 52
3.6.4 Assessment of Existing Data	49 of 52
3.6.5 Potential Contaminants and Migration Pathways	50 of 52
3.6.6 Identification of Potential Receptors	52 of 52
4.0 PLAN OF INVESTIGATIONS	1 of 27
4.1 LHAAP 12: Active Landfill	1 of 27
4.2 LHAAP 16: Old Landfill	6 of 27
4.3 LHAAP 17: Burning Ground No.2/Flashing Area	10 of 27
4.4 LHAAP 18/24: Burning Ground No.3/Unlined Evaporation Pond	14 of 27
4.5 LHAAP 29: Former TNT Production Area	19 of 27
4.6 LHAAP 32: Former TNT Waste Disposal Plant	24 of 27

LIST OF FIGURES

<u>Number</u>		<u>Page</u>
1-1	Site Location Map	2 of 6
2-1	Site Vicinity Map	2 of 4
3-1	LHAAP 12: Site Layout and Sample Locations	3 of 52
3-2	LHAAP 12: Soil Profile A-A'	5 of 52
3-3	LHAAP 16: Site Layout and Sample Locations	12 of 52
3-4	LHAAP 16: Soil Profile A-A'	14 of 52
3-5	LHAAP 17: Site Layout and Sample Locations	20 of 52
3-6	LHAAP 17: Soil Profile A-A'	22 of 52
3-7	LHAAP 18/24: Site Layout and Sample Locations	29 of 52
3-8	LHAAP 18/24: Soil Profile E-E'	31 of 52
3-9	LHAAP 29: Site Layout and Sample Locations	38 of 52
3-10	LHAAP 29: Soil Profile A-A'	39 of 52
3-11	LHAAP 29: Soil Profile B-B'	40 of 52
3-12	LHAAP 32: Site Layout and Sample Locations	47 of 52
4-1	LHAAP 12: Sample Locations	4 of 27
4-2	LHAAP 16: Sample Locations	8 of 27
4-3	LHAAP 17: Sample Locations	12 of 27
4-4A	LHAAP 18/24: Sample Locations	16 of 27
4-4B	LHAAP 18/24: Geoprobe Borings and Wells	17 of 27
4-5	LHAAP 29: Sample Locations	22 of 27
4-6	LHAAP 32: Sample Locations	26 of 27
4-7	Group 2 Sites: Additional Surface Water/Sediment Sampling Locations	27 of 27

LIST OF TABLES

<u>Number</u>		<u>Page</u>
1-1	Areas for Phase 2 Remedial Investigation Activities at LHAAP	2 of 6

LIST OF ACRONYMS/ABBREVIATIONS

ACD	Air Curtain Destructor
AMCCOM	U.S. Army Armament, Munitions, and Chemical Command
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
DCA	dichloroethane
DCE	dichloroethene
DEHP	bis(2-ethylhexyl)phthalate
DNB	dinitrobenzene
DNT	dinitrotoluene
EPA	U.S. Environmental Protection Agency
EPS	Environmental Protection Systems, Inc.
FFA	Federal Facility Agreement
GG	groundwater grab
GOCO	government-owned, contractor-operated
INF	Intermediate-Range Nuclear Forces
LHAAP	Longhorn Army Ammunition Plant
MCL	Maximum Contaminant Level
MEC	methylene chloride
MEK	methyl ethyl ketone, 2-butanone
MW	monitoring well
NGVD	National Geodetic Vertical Datum
NPL	National Priorities List
NT	nitrotoluene
PCB	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SB	soil boring
SDWA	Safe Drinking Water Act
SMCL	Secondary Maximum Concentration Limit
SS	shallow soil
SSHPP	Site Safety and Health Plan
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCA	trichloroethane
TCE	trichloroethene, trichloroethylene
TNB	trinitrobenzene
TNRCC	Texas Natural Resources Conservation Commission
TOX	total organic halides
TWC	Texas Water Commission
UEP	Unlined Evaporation Pond
USACE	United States Army Corps of Engineers
USAEHA	United States Army Environmental Hygiene Agency
VOC	volatile organic compound
WL	waste line
WW	monitoring well

011964

LHAAP Group 2 RI Phase 2 WP
Section: 1
Revision: 3
Date: December 1994
Page: 1 of 6

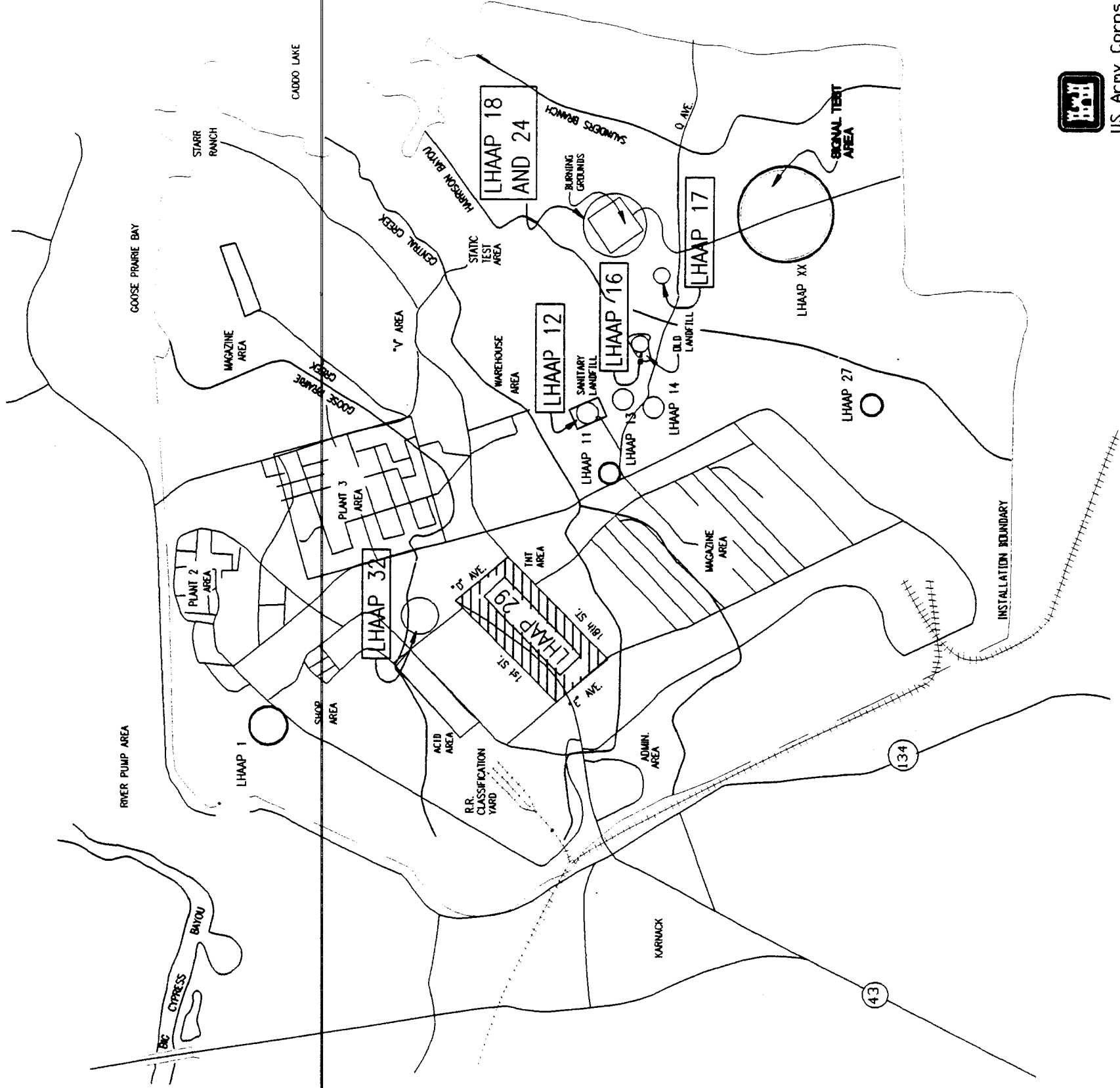
SECTION 1.0

INTRODUCTION

1.1 Introduction

This Phase 2 Work Plan describes the remedial activities necessary to conduct a Phase 2 Remedial Investigation (RI) at the Group 2 sites 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 2 RI at seven (7) LHAAP sites, as listed in Table 1-1. The site locations within LHAAP are shown on Figure 1-1.

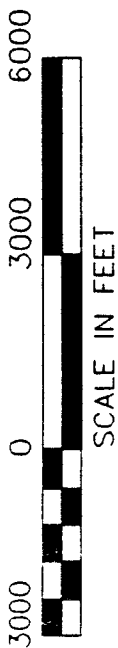
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 US Army Corps
of Engineers
Tulsa District

GROUP 2 SITES IN THIS INVESTIGATION

- LHAAP 12
- LHAAP 16
- LHAAP 17
- LHAAP 18/24
- LHAAP 29
- LHAAP 32



CORPS OF ENGINEERS, TULSA DISTRICT

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

SITE LOCATION MAP

Sverdrup
Environmental

FIGURE 1-1

LHAAP Group 2 RI Phase 2 WP
Section: 1
Revision: 3
Date: December 1994
Page: 3 of 6

TABLE 1-1

Group 2 Sites for Phase 2 Remedial Investigation Activities at LHAAP

LHAAP NO.	AREA NAME
12	Active Landfill
16*	Old Landfill
17*	Burning Ground No. 2/ Flashing Area
18*	Burning Ground No.3/Unlined Evaporation Pond
29*	Former TNT Production Area
32	Former TNT Waste Disposal Plant

* Indicates a SWMU listed in the RCRA Permit

1.2 Purpose and Scope

The purpose of this Phase 2 Work Plan is to ensure that environmental impacts associated with past and present activities at the LHAAP are thoroughly investigated in the Phase 2 RI at the Group 2 Sites, so that, if necessary, 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 Phase 2 Work Plan is to present the rationale and step-by-step plan of action for each field activity included in the Phase 2 RI at the Group 2 Sites.

LHAAP Group 2 RI Phase 2 WP
Section: 1
Revision: 3
Date: December 1994
Page: 4 of 6

1.3 Regulatory Background

LHAAP was placed on the National Priorities List (NPL) on August 30, 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 Solid Waste Management Units (SWMUs) in the Part B permit are followed by an asterisk in Table 1-1.

1.4 Work Plan Organization

The Phase 2 Work Plan describes general information about the facility, previous investigations, and the proposed plan for the Phase 2 RI. This work plan is designed to complement the LHAAP RI/FS Work Plan prepared in June, 1992. Companion documents include the Phase 2 Chemical Data Acquisition Plan (CDAP) and the RI/FS Site Safety and Health Plan (SSHP). The Phase 2 CDAP incorporates

LHAAP Group 2 RI Phase 2 WP
Section: 1
Revision: 3
Date: December 1994
Page: 5 of 6

modifications to the RI/FS CDAP dated June 1992. The original RI/FS SSHP has been implemented without change for completion of the Phase 2 RI.

The Phase 2 Work Plan has been divided into four sections. Section 1.0 introduces the sites to be investigated, the regulatory background, and the organization of the Work Plan.

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 seven areas included in the Phase 2 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 potential 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 seven sites. The number of samples, type of samples (soil, groundwater, sediment, or surface water), and parameters to be analyzed are presented. The field procedures for obtaining the samples and lab procedures for analysis are described in the Phase 2 CDAP.

011980

LHAAP Group 2 RI Phase 2 WP
Section: 1
Revision: 3
Date: December 1994
Page: 6 of 6

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 U. S. Army Corps of Engineers (USACE) and the Corps' contractors to perform the remedial activities at LHAAP. The USACE 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.

LHAAP Group 2 RI Phase 2 WP
Section: 2
Revision: 3
Date: December 1994
Page: 1 of 4

SECTION 2.0

FACILITY BACKGROUND

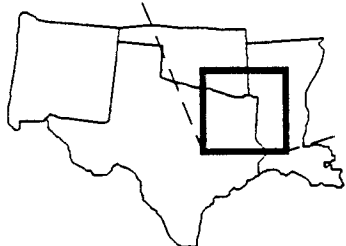
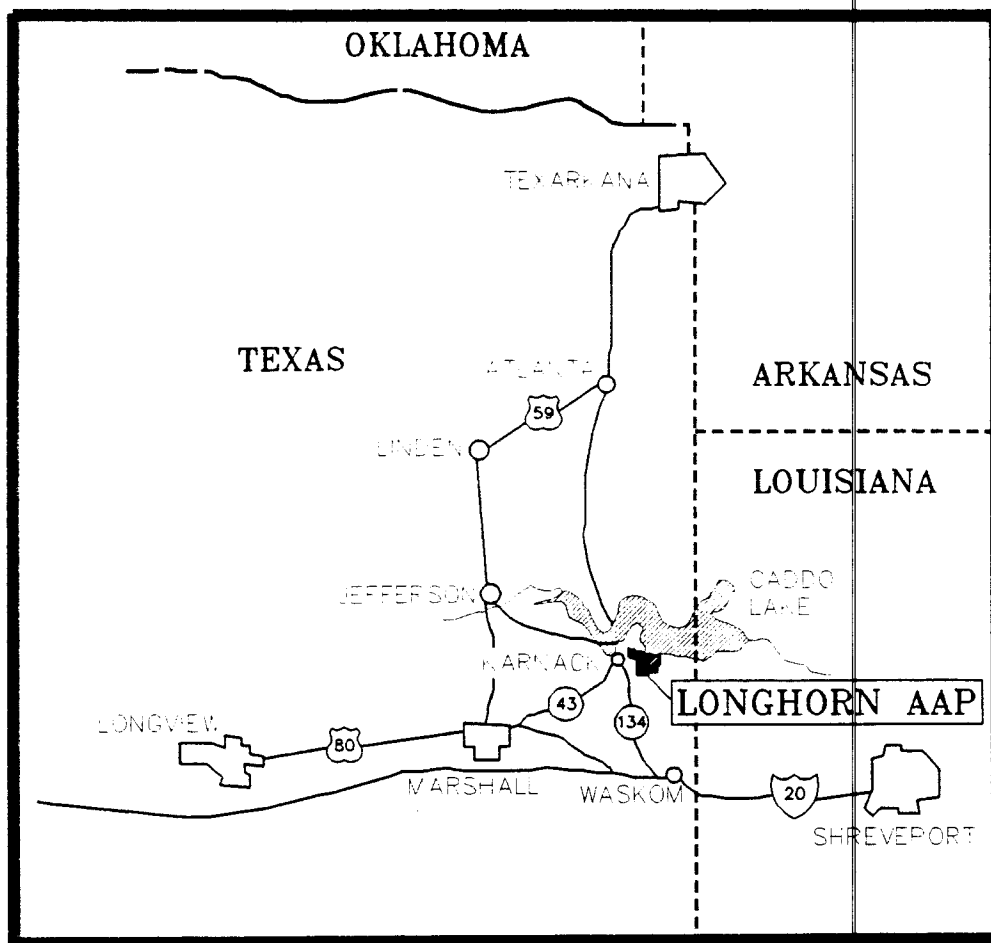
2.1 Location

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, Texas, 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 regionally known as the Pineywoods of east Texas.

011971



CORPS OF ENGINEERS, TULSA DISTRICT

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

SITE VICINITY MAP

**Sverdrup
Environmental**

FIGURE 2-1

LHAAP Group 2	RI Phase 2 WP
Section:	2
Revision:	3
Date:	December 1994
Page:	3 of 4

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 TNT Production 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. The plant was placed on standby status until February 1952. From 1952 until 1956, Universal Match Corporation was the operating contractor, producing pyrotechnic ammunition such as photoflash bombs, simulators, hand signals, and 40 mm tracers.

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.

LHAAP Group 2 RI Phase 2 WP
Section: 2
Revision: 3
Date: December 1994
Page: 4 of 4

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 for 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 background information about the Longhorn Army Ammunition Plant facility, 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 RI/FS Work Plan, Volume I - General.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 1 of 52

SECTION 3.0

NATURE AND EXTENT OF CONTAMINATION

3.1 LHAAP 12 : Active Landfill

3.1.1 Site History. The Active Landfill was started in 1963 and used intermittently for the disposal of industrial solid wastes, and possibly hazardous waste, generated at LHAAP. Since 1978, the site has apparently been in continuous use for the disposal of industrial solid wastes generated at LHAAP. The landfill was used for disposal of non-hazardous industrial solid waste, under TNRCC Registration No. 30990. The landfill was closed in April, 1994.

Much of the history of the site is revealed by aerial photographs taken in May 1954, April 1963, and December 1978. Photos from 1954 reveal a ditch excavated through a low ridge between Central Creek and one of its principal tributaries that collects surface runoff from the southern part of the Magazine Area. The low ridge segment of the ditch and part of the borrow area were subsequently filled with waste and soil to form the nucleus of the current Active Landfill site. Aerial photos from 1963 show that waste materials had just begun to be disposed in the ditch about 350 ft downstream from its confluence with the diverted tributary stream. By 1978, photographs showed that a considerable volume of additional waste had been disposed in the ditch.

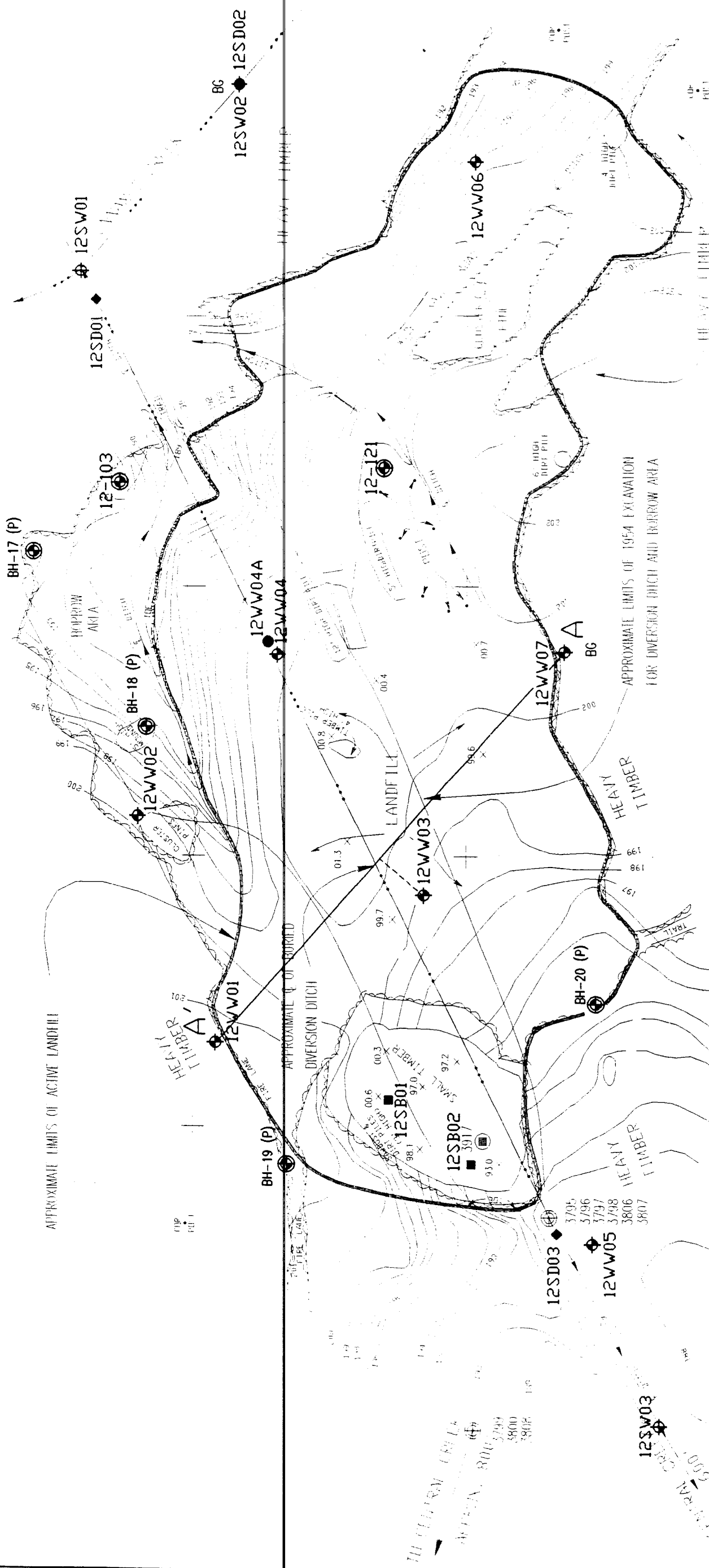
LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 2 of 52

During the early 1980's, a large area alongside the southeast margin of the former diversion ditch was cleared for future waste disposal. This area received waste which consisted of nonhazardous combustible and non-combustible wastes having no scrap value.

3.1.2 Site Description. The Active Landfill is located in the central portion of LHAAP. The center of the site is about 1,700 feet east northeast of the intersection of Avenue P and Q. The entrance to the site's graveled access road is on Avenue Q about 0.2 mile east of Avenue P. The site contains an area of approximately 7 acres. A detailed map of the Active Landfill showing current site conditions is provided as Figure 3-1.

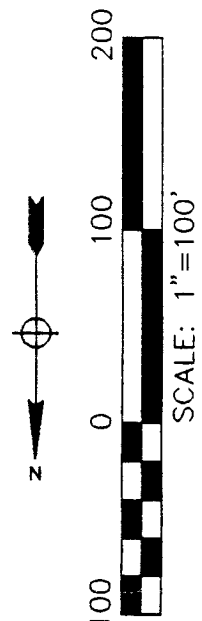
General soil and geologic maps indicate that the site is situated on the outcrop of the Wilcox Group. The Wilcox materials at the site generally consist of a few feet of residually-derived soils overlying silty and clayey sands, and sandy silts and clays. Excavations at the site removed some of the residual soils and exposed the underlying sands, silts, and clays. Most of the excavated materials were later replaced with waste and soil fill materials.

Surficial soils generally range in thickness from 0 to 3.5 ft, and consist of brown and gray clayey silt grading into a brown sandy clay. Below the surficial soils, a moist, brown to reddish brown sandy clay ranging from



LEGEND

- ◆ SURFACE SEDIMENT SAMPLE (RI PHASE 1)
- ⊕ SURFACE WATER SAMPLE (RI PHASE 1)
- ⊕ SURFACE WATER/SEDIMENT SAMPLE (PREVIOUS)
- SURFACE SOIL SAMPLE (RI PHASE 1)
- SURFACE SOIL SAMPLE (PREVIOUS)
- ⊕ SHALLOW MONITORING WELL (RI PHASE 1)
- ⊕ MONITORING WELL (PREVIOUS)
- SOIL BORING (RI PHASE 1)
- SOIL BORING (PREVIOUS)
- ⊕ BACKGROUND SAMPLE LOCATION
- ⊕ MONITORING WELL PLUGGED DURING RI PHASE 1
- SURFACE WATER FLOW DIRECTION
- - - APPROXIMATE LIMITS OF WASTE MANAGEMENT AREA
- A-A' SOIL PROFILE LOCATION



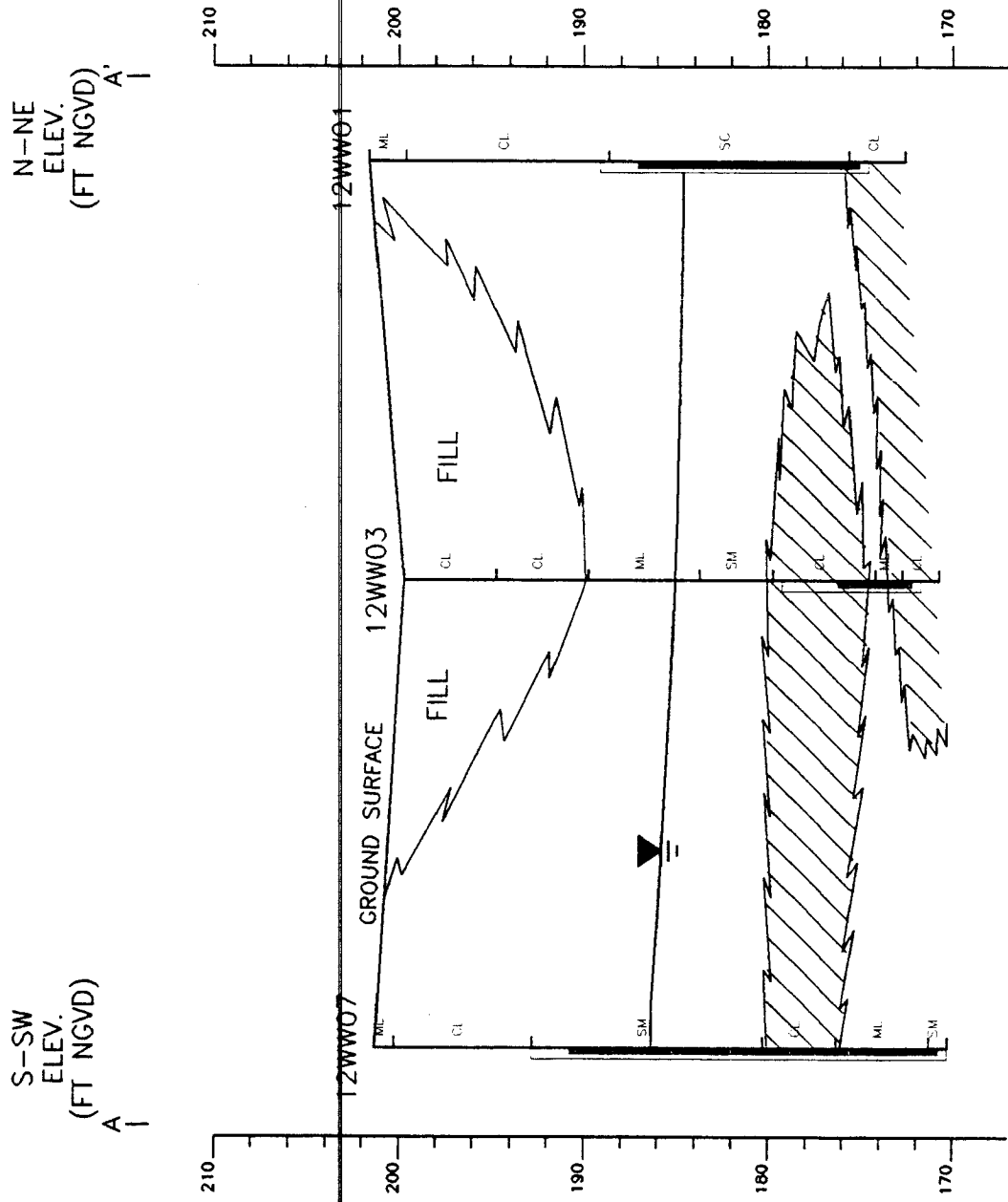
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LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 12 ACTIVE LANDFILL SITE LAYOUT AND SAMPLE LOCATIONS	
Sverdrup <i>Environmental</i>	FIGURE 3-1

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 4 of 52

3 to 10 ft thick is typically encountered across LHAAP 12. Extending below this zone to depths ranging from 6 to 17.5 ft below ground surface is a saturated silty, sometimes clayey, brown and gray sand. A clay layer, which may locally act as an aquitard to groundwater movement, was encountered within the suspected boundary of the landfill at approximately El. 172 to 180 ft NGVD. This clay layer was not encountered in borings 12-WW-05 and 12-WW-07, however. Figure 3-2 depicts a generalized soil profile across LHAAP 12.

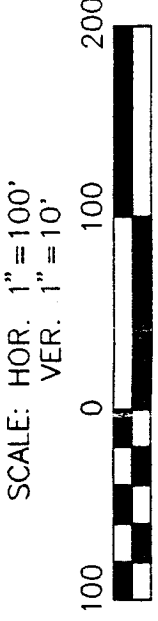
Fill material, consisting of debris mixed with gray, clayey sandy silt, was encountered in borings 12-WW-03 and 12-WW-04. The fill material ranged in thickness from 5 to 10 ft in 12-WW-03 and from 10 to 18 ft in 12-WW-04. These borings were located near the suspected centerline of the landfill. Seven groundwater monitoring wells (12-WW-01 through 12-WW-07) were drilled and installed during the Phase 1 RI, and information from these wells, coupled with information from two previously installed monitoring wells, were utilized to investigate the shallow aquifer of LHAAP 12.

3.1.3 Previous Investigations. The Active Landfill was included in a contamination survey conducted under contract by Environmental Protection Systems, Inc. (EPS), as documented in June 1984. EPS installed two monitoring wells (103 and 121); groundwater samples were analyzed for explosives, selected metals, and selected anions.



LEGEND

- CL UNIFIED SOIL CLASSIFICATION SYMBOL
- MONITORING WELL SCREEN INTERVAL
- MONITORING WELL FILTER SAND INTERVAL
- LOCALLY CONFINING LAYER
- GROUNDWATER POTENTIOMETRIC SURFACE



NOTE: SOIL CONTACTS AND GROUNDWATER SURFACE ARE INTERPRETED.

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LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 12 ACTIVE LANDFILL SOIL PROFILE A-A'	
Sverdrup Environmental	FIGURE 3-2

011979

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 6 of 52

During the Phase 1 Remedial Investigation conducted by Sverdrup in 1993, groundwater, surface water, sediment, and soil samples were collected and analyzed for volatiles, semi-volatiles, explosives, metals, and anions. Three surface water samples (12-SW-01 through 12-SW-03) and three sediment samples (12-SD-01 through 12-SD-03) were collected at the locations outside the perimeter of the site to determine if contamination is moving offsite through surface drainage. Four soil borings, completed as wells 12-WW-01, -02, -05, and -07, were located outside the suspected boundary of the landfill to investigate whether water moving through potentially contaminated fill material and soil may be leaching contaminants and carrying them into underlying soils and pose a threat to groundwater. Three soil borings, completed as wells 12-WW-03, -04, and -06, were drilled within areas suspected to contain landfilled materials. Overall, nine groundwater samples were collected from site monitoring wells.

3.1.4 Assessment of Existing Data. Previous investigations by EPS indicated elevated concentrations of metals and anions in many surface water samples; copper, iron, and magnesium in several sediment samples; and chloride, cadmium, manganese, and traces of 1,3-DNB in groundwater samples. Groundwater samples also contained methylene chloride at 45 $\mu\text{g/l}$, exceeding the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) of 5 $\mu\text{g/l}$.

011980

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 7 of 52

The Phase 1 Remedial Investigation detected no significant contamination in the three surface water and sediment samples, with the exception of sediment sample 12-SD-03 (located at the north edge of the site), which contained concentrations of barium (384 $\mu\text{g/kg}$), chromium (24.7 $\mu\text{g/kg}$), lead (10.7 $\mu\text{g/kg}$), nickel (11.4 $\mu\text{g/kg}$), thallium (4.11 $\mu\text{g/kg}$), chloride (137 $\mu\text{g/kg}$), and sulfate (88.6 $\mu\text{g/kg}$) elevated above background levels at location 12-SD-02.

Analyses of soil samples from background boring 12-WW-07 detected bis(2-ethylhexyl) phthalate (DEHP) ranging in concentration from 660 to 5000 $\mu\text{g/kg}$ from 5 to 17 feet in depth. Trace concentrations of acetone, toluene, ethylbenzene, and xylene were detected within borings 12-WW-03 and 12-WW-04 within the debris materials from 5 to 16 ft.

Groundwater contamination approaching or in excess of MCLs was detected in 5 of 9 wells. Detected contaminants included trichloroethene (TCE) in wells 12-WW-01 (27 $\mu\text{g/l}$) and 12-WW-03 (16 $\mu\text{g/l}$), 1,1,1-trichloroethane in Well 103 (66 $\mu\text{g/l}$), methyl ethyl ketone (MEK) in Well 121 (11 $\mu\text{g/l}$), and DEHP in well 12-WW-01 (15 $\mu\text{g/l}$). Well 12-WW-03 contained elevated concentrations greater than MCLs for lead, chromium, and nickel at 58, 162, and 207 $\mu\text{g/l}$, respectively. Barium was detected approaching the MCL in well 12-WW-03 at 979 $\mu\text{g/l}$ (MCL=2000 $\mu\text{g/l}$). The explosive 1,3,5-trinitrobenzene (TNB) was detected in Well 121 at 17 $\mu\text{g/l}$. Well 121 also

011981

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 8 of 52

contained trace concentrations of other explosives, including 2,4,6-TNT at 2.5 $\mu\text{g/l}$, 4-am-2,6-DNT at 0.78 $\mu\text{g/l}$, 2-am-4,6-DNT at 0.34 $\mu\text{g/l}$, and 2-nitrotoluene at 1.4 $\mu\text{g/l}$. 2-am-4,6-DNT was also detected in wells 12-WW-04 and 12-WW-06 at 0.16 $\mu\text{g/l}$ and 0.56 $\mu\text{g/l}$, respectively.

3.1.5 Potential Contaminants and Migration Pathways. The primary sources of potential contamination at this site are industrial solid wastes generated at LHAAP and disclosed intermittently at the site since 1963. Soil samples taken from landfill materials contained trace concentrations of VOCs, primarily acetone, toluene, ethylbenzene, and xylene. Contaminants detected in groundwater included high concentrations of lead, chromium, and nickel exceeding MCLs in monitoring well 12-WW-03. Other groundwater contaminants included TCE in wells 12-W-01 and 12-WW-03 and 1,1,1-TCA in Well 103.

Migration pathways for contaminants include surface water, sediment, soil, and groundwater. Rainfall runoff from surficial fill materials and soils could transport contaminants to collection ditches and streams. Erosion of contaminated fill materials and soils during heavy rainfall could produce contaminated sediment that would be carried downstream. Water percolating downward through contaminated fill materials and soils appears to have leached contaminants and carried them into underlying soils and groundwater.

011982

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 9 of 52

Groundwater is encountered at a relatively shallow depth at the site and is an important pathway for contaminant migration. Contaminant transport within the shallow aquifer was estimated using slug test data from the site monitoring wells, which indicated a mean hydraulic conductivity (K) of $8E-04$ ft per min, and a resultant groundwater velocity ($v=Ki/n$) of 0.03 ft per day, calculated using average hydraulic gradient (i) = 0.004 to the east-northeast, and an aquifer porosity (n) = 0.15. Contaminated groundwater could discharge to surface water. All surface drainage would eventually enter Caddo Lake via Central Creek. The total flow distance from the site to the lake is 2.1 miles.

3.1.6 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, since the entrance road is closed with a locked access gate. Occasionally, hunters visit the site and adjoining areas.

A potential threat to public health and safety posed by contaminated groundwater originating at this site could be its emergence into the surface water flow regime of Central Creek and its tributaries. The nearest public water supply well, Well 902, is approximately 2.3 miles southwest, and hydraulically upgradient, of the site. There are no public water supply wells located in the directions of expected groundwater flow

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 10 of 52

downgradient from the site and none are expected to be installed. Groundwater generally flows from the site in a general east-northeasterly direction toward Caddo Lake. During wet periods, however, portions of groundwater flow may be more influenced by local surface topography to flow towards the north-northwest or south-southeast.

3.2 LHAAP 16 : Old Landfill

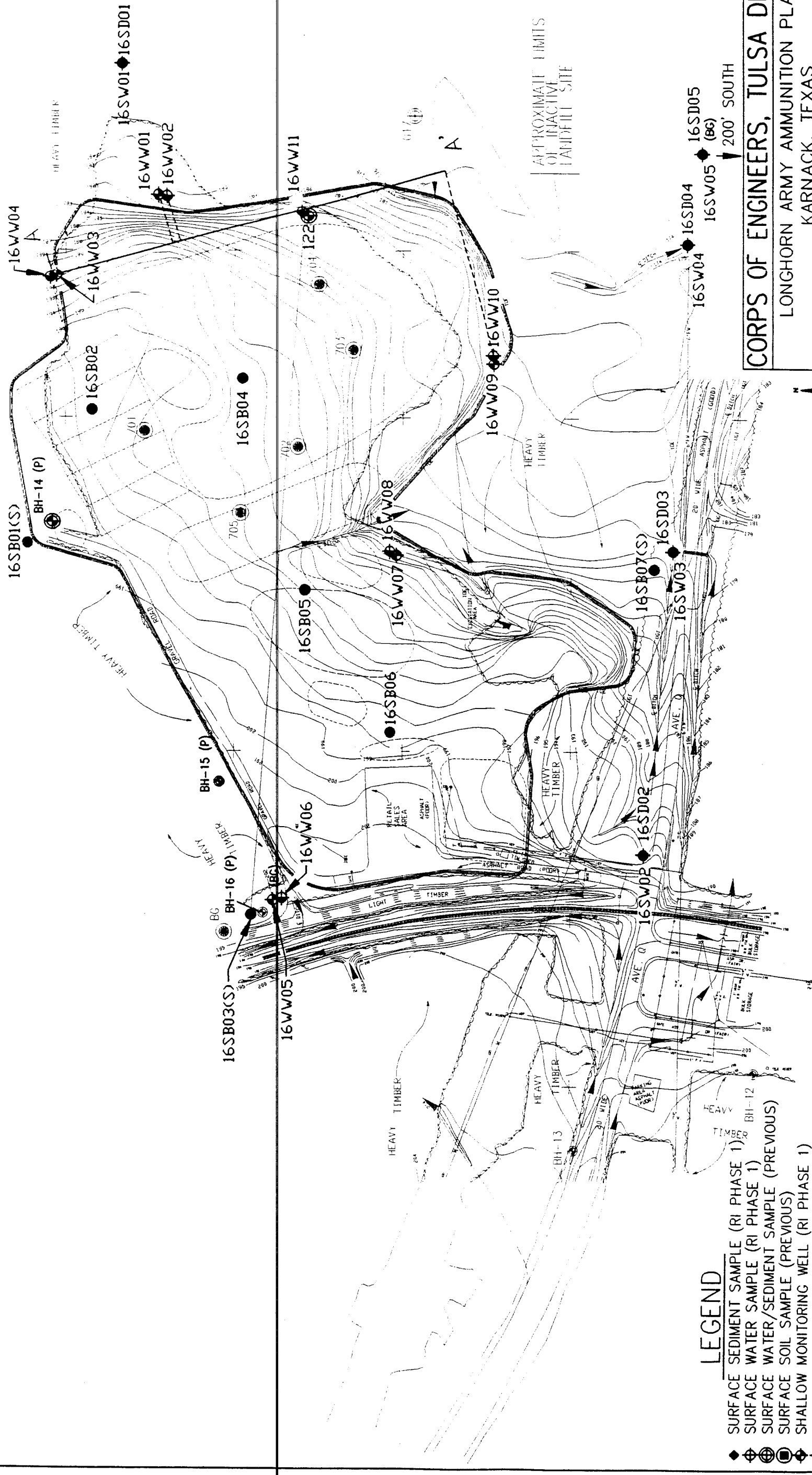
3.2.1 Site History. The Old Landfill was originally used from 1942 to 1944 for the disposal of TNT red water ash generated from the TNT Waste Disposal Plant (LHAAP 32). In the mid-to-late 1950s, three rocket motor casings were reportedly burned and possibly buried on the eastern side of the site. During this time, a large bermed depression encompassing the central section of the site was reportedly used for the disposal of a variety of materials such as substandard TNT, barrels of chemicals, oil, paint, scrap iron, and wood. This area was eventually filled in, and landfilling operations continued moving eastward, eventually raising the ground surface to its current elevation approximately 15 ft above the original grade. Burn pits and waste storage were common waste disposal activities conducted at the site during the history of its operation, but little is known about the nature of the wastes. The site continued to be used for a variety of waste disposal and treatment activities into the 1980s, when the disposal of inert solid wastes was moved to the Active Landfill (LHAAP 12).

LHAAP Group 2 RI Phase 2 WP
 Section: 3
 Revision: 3
 Date: December 1994
 Page: 11 of 52

3.2.2 Site Description. LHAAP 16 is located in the south-central portion of LHAAP, just north of Avenue Q and adjacent to the active retail sales area. The site encompasses approximately 20 acres and is composed of an open, grassy area bounded on the western and northern edges by a gravel road and by wooded areas along the eastern and southern edges. A rectangular paved area, known as the former retail sales area, is located at the western edge of the site. A tributary of the Harrison Bayou runs along the eastern edge. A detailed map of the Old Landfill showing current site conditions is provided as Figure 3-3.

Geologic maps indicate that the landfill is situated on Wilcox materials with the toe along the eastern edge of the area extending onto alluvial materials of the Harrison Bayou floodplain. Surficial soils at LHAAP 16 consist of medium plastic silts and clays. Dry to moist, silty fine sand containing silt and clay lenses is encountered at depths of 5-15 ft; it generally becomes saturated below 15-20 ft depth. Medium to highly plastic silts and clays exist below the sand and range in thickness from 10-30 ft. A second, saturated, fine to medium silty sand exists at depths of 30-50 ft. The deeper sand layer is generally less silty than the upper sand layer, and contains lenses of silt and clay throughout. A hard, silty clay is encountered below the second sand at depths of 40 to 80 ft. Groundwater is first encountered in the shallow silty sand aquifer at

06110



LEGEND

- ◆ SURFACE SEDIMENT SAMPLE (RI PHASE 1)
 ⊕ SURFACE WATER SAMPLE (RI PHASE 1)
 ⊗ SURFACE WATER/SEDIMENT SAMPLE (PREVIOUS)
 ⊠ SURFACE SOIL SAMPLE (PREVIOUS)
 ⊕ SHALLOW MONITORING WELL (RI PHASE 1)
 ⊗ INTERMEDIATE MONITORING WELL (RI PHASE 1)
 ⊕ MONITORING WELL (PREVIOUS)
 ● SOIL BORING (RI PHASE 1)
 ⊙ SOIL BORING (PREVIOUS)
 (S) STRATIGRAPHIC BORING (RI PHASE 1)
 BG BACKGROUND SAMPLE LOCATION
 (P) MONITORING WELL PLUGGED DURING RI PHASE 1
 - SURFACE WATER FLOW DIRECTION
 — APPROXIMATE LIMITS OF WASTE MANAGEMENT AREA
 — APPROXIMATE LIMITS OF DISPOSAL SITES
 A-A' SOIL PROFILE LOCATION

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LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

RI PHASE 2 WORK PLAN

LHAAP 16

OLD LANDFILL

SITE LAYOUT

AND SAMPLE LOCATIONS

**Sverdrup
Environmental**

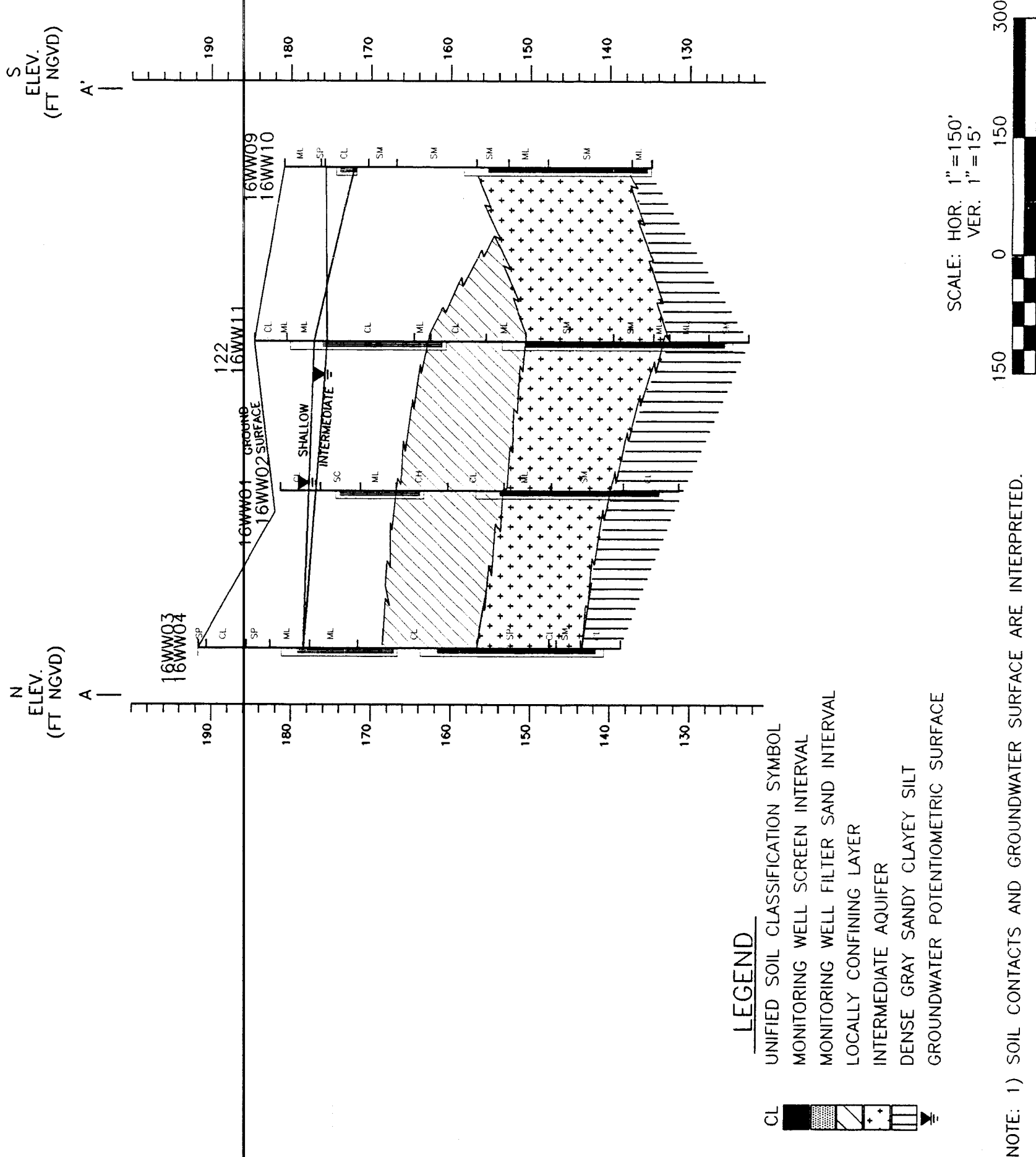
FIGURE 3-3

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 13 of 52

depths of 5 to 20 ft below the surface of the landfill. The intervening clay aquitard between the shallow aquifer and deeper groundwater appears to be thicker and more consistent at LHAAP 16 than at LHAAP 12, averaging 15 to 20 ft thick. Figure 3-4 depicts a generalized soil profile across LHAAP 16.

3.2.3 Previous Investigations. The Old Landfill was investigated by EPS for USATHAMA and Morton Thiokol, Inc., as presented in reports published in June 1984 and May 1988, respectively. Ten surface soil samples were taken to a depth of 6 inches each along the eastern toe of the landfill; deeper soil samples were taken from a total of 20 soil borings within the limits of the landfill. All samples were analyzed for explosives, selected metals and anions.

During the Phase 1 Remedial Investigation conducted by Sverdrup in 1993, groundwater, surface water, sediment, and soil samples were collected and analyzed for volatile, semi-volatile, explosives, metals, and anions. Four soil borings (16-SB-02, -04, -05, and -06) were located within the suspected limits of the former waste disposal activity. Three of the borings (16-SB-04, -05, and -06) were located along the east-west centerline of the landfill in an effort to profile the depth of landfilled materials. The fourth boring (16-SB-02) was located in the northern end of the landfill within one of the former burn pit locations. Three deep



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LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 16 OLD LANDFILL SOIL PROFILE A-A'	
Sverdrup Environmental	FIGURE 3-4

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 15 of 52

borings (16-SB-01, -03, -07) were drilled to further define the geologic stratigraphy beneath the site. These borings were constructed outside of the boundary of the landfill to reduce the potential for cross contamination of water-bearing zones.

Five surface water samples (16-SW-01 through 16-SW-05) and five sediment samples (SD-01 through 16-SD-05) were also collected. Four of the samples targeted the surface water drainage paths leading from the site to determine if contaminants are migrating towards Harrison Bayou. Monitoring wells 16-WW-01 through 16-WW-11 were installed onsite at locations along the perimeter of the landfill area.

3.2.4 Assessment of Existing Data. Previous investigations by EPS indicated low concentrations of explosives and organic compounds in the soils at depths within the landfill, in the surface soils of the landfill, and the groundwater downgradient of the landfill. Contaminants 2,6-DNT and vinyl chloride were noted at concentrations of 8.6 µg/l and 10.5 µg/l, respectively, in groundwater. 2,6-DNT was also detected in soil samples as high as 73 µg/kg. Previous samplings of monitoring well 122 exceeded the MCL of 5 µg/l for cadmium with concentrations of 6.84 and 10 µg/l, obtained in 1984 and 1988, respectively.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 16 of 52

The Phase 1 Remedial Investigation analyses detected no contamination in the five surface water and sediment samples. Contaminants detected in soil samples taken within landfilled materials included TCE in borings 16-SB-02 (7 - 10,000 $\mu\text{g/kg}$) and 16-SB-04 (130 - 3,100 $\mu\text{g/kg}$), cis-1,2-DCE in borings 16-SB-02 (6.5 - 2,600 $\mu\text{g/kg}$) and 16-SB-04 (180 - 630 $\mu\text{g/kg}$), and methylene chloride in boring 16-SB-02 (940 - 1,400 $\mu\text{g/kg}$). Concentrations of di-n-butyl phthalate reached up to 2600 $\mu\text{g/kg}$ and 3100 $\mu\text{g/kg}$ in borings 16-SB-02 and 16-SB-04, respectively.

Groundwater contamination was detected in 6 of 11 new wells. Contaminants exceeding MCLs included TCE at 6,400 $\mu\text{g/l}$ (MCL=5 $\mu\text{g/l}$), methylene chloride at 520 $\mu\text{g/l}$ (MCL=5 $\mu\text{g/l}$), and nickel at 142 $\mu\text{g/l}$ (MCL=100 $\mu\text{g/l}$) in well 16-WW-03. Arsenic and cadmium were detected in Well 122 at 17 $\mu\text{g/l}$ and 5.45 $\mu\text{g/l}$, respectively, exceeding the MCLs of 5 $\mu\text{g/l}$. Selenium was detected as high as 15.6 $\mu\text{g/l}$ in well 16-WW-04. Other contaminants detected in groundwater included acetone (17 $\mu\text{g/l}$), cis-1,2-DCE (52 $\mu\text{g/l}$), nitrobenzene (1.5 $\mu\text{g/l}$), and lead (3.67 $\mu\text{g/l}$). Ten of twelve monitoring wells sampled exceeded the SDWA SMCLs of 250 mg/l for chlorides and sulfates. Wells 16-WW-05 and 16-WW-06 contained concentrations of chloride above the SMCL. Sulfate concentrations were particularly elevated in well 16-WW-02 at 1,850 $\mu\text{g/l}$, well 16-WW-03 at 4,926 $\mu\text{g/l}$, and well 16-WW-04 at 7,266 $\mu\text{g/l}$.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 17 of 52

3.2.5 Potential Contaminants and Migration Pathways The suspected sources of contamination are primarily buried explosive and solvent wastes. Materials deposited in the landfill are potential sources for contamination of the soil, surface water, and groundwater. Soil samples taken within landfilled materials detected notable concentrations of TCE, methylene chloride, cis-1,2-DCE, and vinyl chloride. Groundwater contaminants, detected in 6 of 11 new wells, included TCE, methylene chloride, cis-1,2-DCE, nitrobenzene, nickel, and cadmium.

The potential for surface water contamination exists due to run off across surface soils contaminated with explosives and from possible discharge of contaminated groundwater to surface water drainage. Erosion of contaminated soils during heavy rainfall and flooding could produce contaminated sediment that would be carried by surface water runoff into the tributary of Harrison Bayou adjacent to the site. Contaminated fill material and soils at the surface to depths of at least 15 feet create the potential for contaminating surface runoff from the site and for leaching contaminants down to groundwater beneath the site.

Groundwater within the shallow and intermediate aquifers is a significant pathway for contaminant migration from the site. Wells completed in the shallow aquifer, 16-WW-01 and 16-WW-03, contained levels of TCE exceeding the MCL, with cis-1,2-DCE approaching the MCL. Well 16-WW-03 also

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 18 of 52

contained concentrations of methylene chloride well above the MCL. Wells 16-WW-04 and 16-WW-11, completed in the intermediate aquifer beneath the first clay aquitard, contained TCE contamination at levels exceeding the MCL. Contaminant transport within the silty sand shallow aquifer and intermediate aquifer was estimated using slug test data from the site monitoring wells, which indicated a mean hydraulic conductivity (K) of $4E-04$ ft per minute for the shallow aquifer and $1E-03$ ft per minute for the intermediate aquifer, and resultant groundwater velocities ($v=Ki/n$) of 0.02 ft per day and 0.12 ft per day, respectively, calculated using an average hydraulic gradient (i) of 0.005 and an aquifer porosity (n) of 0.15. Contaminated groundwater could discharge to the tributary of Harrison Bayou. The total flow distance from the site to Caddo Lake is over 2.0 miles.

3.2.6 Identification of Potential Receptors. The general public does not have ready access to the Old Landfill site because it is confined within secured LHAAP boundaries. Access is further restricted by a locked gate on the entrance road to the site. The population having direct use of the site is primarily limited to the occasional hunter. There are no public supply wells in the direction of regional groundwater flow towards Caddo Lake. The horizontal distance that contaminants must travel to the nearest public supply well, Well 902, is approximately 2.2 miles southwest and upgradient of the site.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 19 of 52

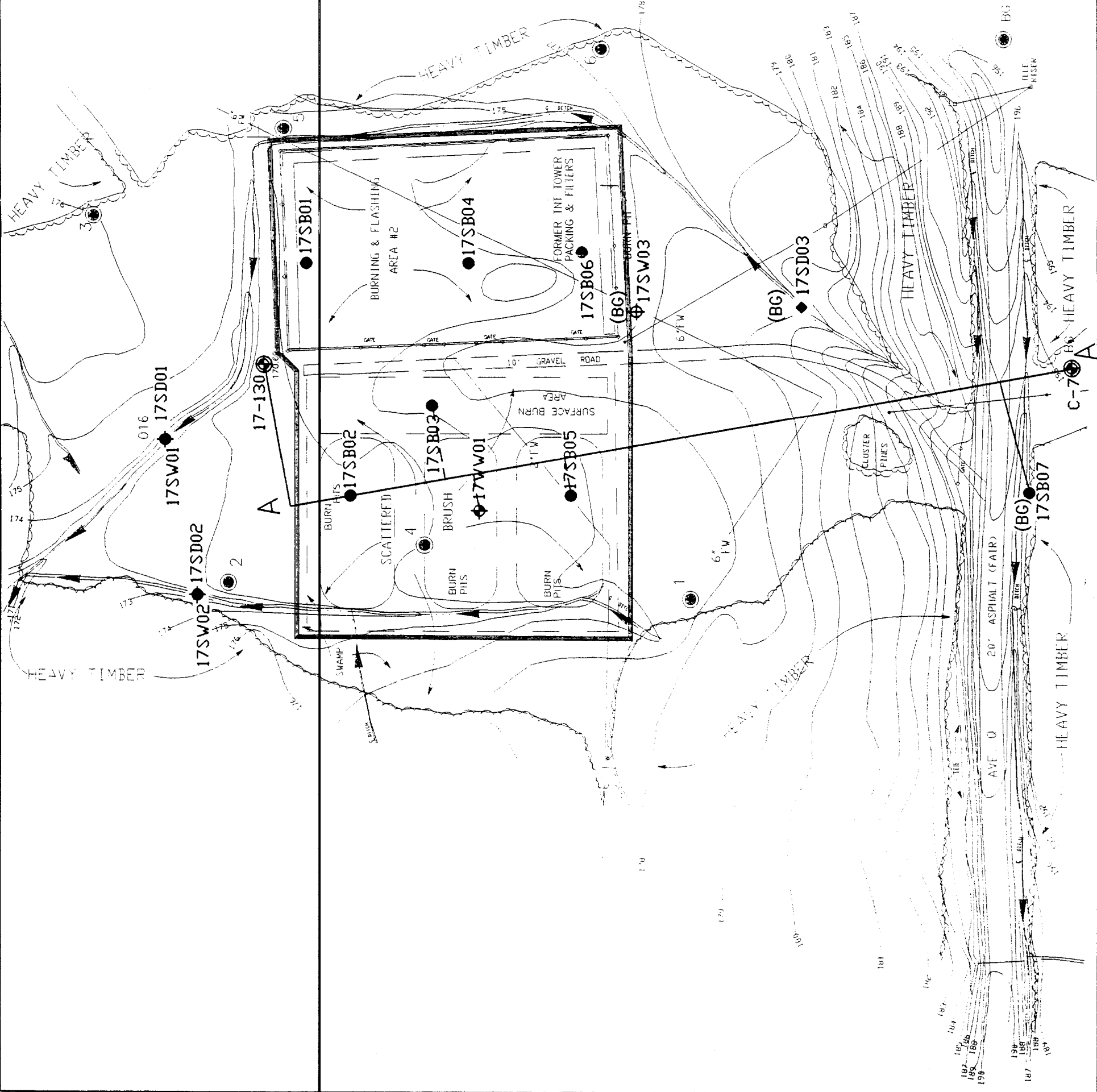
3.3 LHAAP 17: Burning Ground No.2/Flashing Area

3.3.1 Site History. Burning Ground No. 2/Flashing Area was used for burning bulk TNT, photo flash powder, and reject material when LHAAP was operated by Universal Match Corporation. In 1959, all of the materials removed from the TNT Production Area (LHAAP 29) and the TNT Waste Disposal Plant (LHAAP 32) during razing were burned and/or flashed at this site. The site was then used until 1980 as a flashing area to decontaminate recoverable metal by-products. Burning trenches were located around the inside perimeter of the previously fenced area and within the open area on the western side of the site. As each trench filled with ash, the trench was covered and a new trench was dug. The waste residues were reportedly removed in 1984 and the site was allowed to revegetate. The site is presently inactive.

3.3.2 Site Description. LHAAP 17 is located in the southeastern quadrant of LHAAP at the intersection of Long Point Road and Avenue Q and immediately southwest of LHAAP 18. The site is located within a heavily wooded section of LHAAP. The site has two 185 x 305 ft cleared areas separated by a gravel entrance road. The site is relatively flat and is covered with grass and scattered brush. A detailed map of the site showing current site conditions is provided as Figure 3-5.

LEGEND

- ◆ SURFACE SEDIMENT SAMPLE (RI PHASE 1)
- ⊕ SURFACE WATER SAMPLE (RI PHASE 1)
- ⊗ SURFACE WATER/SEDIMENT SAMPLE (PREVIOUS)
- ⊙ SHALLOW MONITORING WELL (RI PHASE 1)
- ⊕ MONITORING WELL (PREVIOUS)
- SOIL BORING (RI PHASE 1)
- SOIL BORING (PREVIOUS)
- ⊙ BACKGROUND SAMPLE LOCATION
- BG SURFACE WATER FLOW DIRECTION
- APPROXIMATE LIMITS OF WASTE MANAGEMENT AREA
- - - APPROX. LIMITS OF BURN PITS/TRENCHES
- A A' SOIL PROFILE LOCATION



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

RI PHASE 2 WORK PLAN

LHAAP 17

BURNING GROUND NO. 2

FLASHING AREA

SITE LAYOUT & SAMPLE LOCATIONS

Sverdrup
Environmental

FIGURE 3-5

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 21 of 52

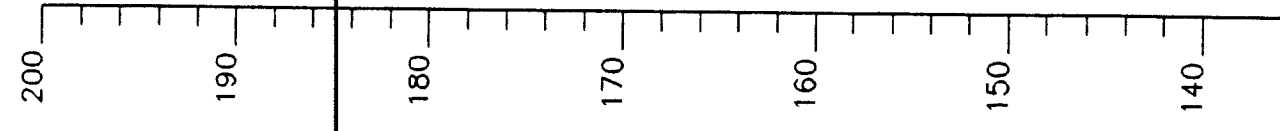
LHAAP 17 is situated on alluvial materials overlying Wilcox Group materials. Surficial soils consist of medium plastic silts and clays containing thin sand lenses. Some borings encountered soft clay which may represent backfill of former disposal trenches or burn pits. An apparently consistent clay layer was noted from 5-8 ft depth. Saturated silty fine to medium sand was encountered beneath the clay layer from 8 to 15 ft depth. Figure 3-6 depicts a generalized soil profile across LHAAP 17.

Harrison Bayou flows approximately 1,200 ft northwest of the site. Surface drainage from LHAAP 17 flows to ditches along the eastern and western edges of the site, which lead to Harrison Bayou. The entire site is within the 100-year floodplain of the bayou.

3.3.3 Previous Investigations. The site was originally investigated as a potentially contaminated site by EPS for USATHAMA and Morton Thiokol, Inc., as documented in reports dated June 1984 and May 1988. The investigations included seven 5 ft deep soil borings and several surface soil samples. All samples were analyzed for explosives, VOCs, and selected (total) metals.

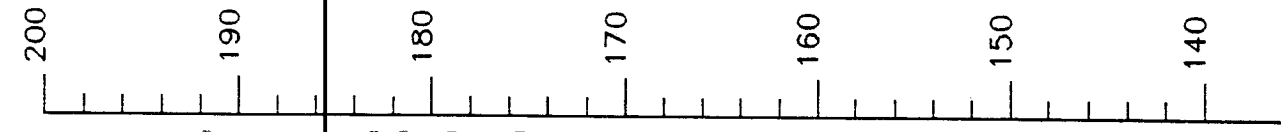
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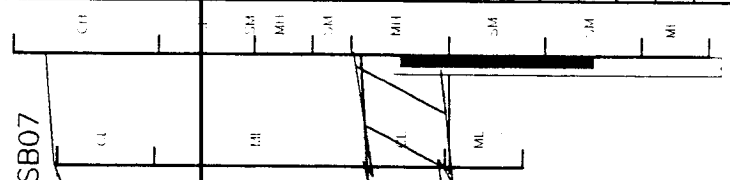
LEGEND

- CL UNIFIED SOIL CLASSIFICATION SYMBOL
- MONITORING WELL SCREEN INTERVAL
- MONITORING WELL FILTER SAND INTERVAL
- LOCALLY CONFINING LAYER
- GROUNDWATER POTENTIOMETRIC SURFACE

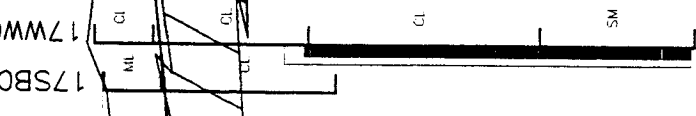
SCALE: HOR. 1"=100'
VER. 1"=10'



17SB07



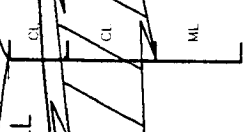
17WB01



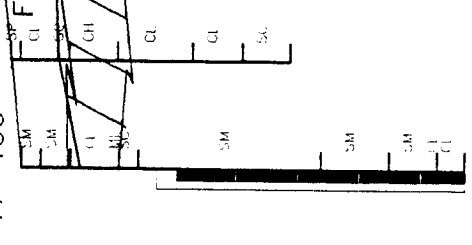
17SB03



17SB05



17-13017SB02



GROUND SURFACE

CORPS OF ENGINEERS, TULSA DISTRICT

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

LHAAP 17
BURNING GROUND NO. 2
FLASHING AREA
SOIL PROFILE A-A'

Sverdrup
Environmental FIGURE 3-6

NOTE: SOIL CONTACTS AND GROUNDWATER SURFACE ARE INTERPRETED.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 23 of 52

During the Phase 1 Remedial Investigation conducted by Sverdrup in 1993, groundwater, surface water, sediment, and soil samples were collected and analyzed for volatile, semi-volatile, explosives, metals, and anions. Seven soil borings (17-SB-01 through 17-SB-06 and 17-WW-01) were drilled approximately 2 ft into groundwater in the suspected burn trench locations within the previously fenced flashing area, the center of the previously fenced flashing areas, and the suspected burn pit or trench locations on the western half of the site. Background boring 17-SB-07 was drilled along Avenue Q to the south of LHAAP 17. Three surface water (17-SW-01, -02, and -03) and three sediment samples (17-SD-01, -02, and -03) were collected at locations downgradient from the burnpit trench area, upgradient of the site, and from the flashing area on the eastern side of the site. One monitoring well, 17-WW-01, was installed, and groundwater grab samples were obtained from the seven soil boring locations (17-SB-01 through 17-SB-07).

3.3.4 Assessment of Existing Data. Previous investigations by EPS and Thiokol indicated concentrations of explosives and chlorinated organic compounds in soils down to a depth of 5 feet. Results from groundwater, surface water, and sediment sampling indicated no contamination of these media.

011997

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 24 of 52

The Phase 1 Remedial Investigation provided soil samples containing trace concentrations of volatile organics, explosives, and/or heavy metals from all borings except 17-SB-05. Concentrations of explosives were detected in 6 of the 8 borings (17-WW-01, 17-SB-01, -02, -03, -04, -06) from the ground surface to depths of 5-7 ft, with the concentrations generally being the highest in the shallowest samples and decreasing with increasing depth. Detected explosives included 2,4,6-TNT ranging from 0.43 to 82 $\mu\text{g/g}$; 2,4-DNT ranging from 0.51 to 4000 $\mu\text{g/g}$; 2,6-DNT ranging from 0.75 to 500 $\mu\text{g/g}$; and 1,3,5-TNB ranging from 2.0 to 360 $\mu\text{g/g}$. Trace concentrations of volatiles, including methylene chloride, acetone, 1,1-DCE, 1,1-DCA, 1,2-DCA, 2-butanone, TCE, and PCE, were detected in soil samples from 17-WW-01. Elevated concentrations of acetone were detected in borings 17-SB-02, -03, -04, and -06. Metal concentrations in site soils were notably elevated above levels in background boring 17-SB-07, including barium in borings 17-SB-01, -03, and -04; chromium and silver in 17-SB-03 and -04; and lead in 17-SB-01 and -04.

Analyses of the three sediment samples detected no notable contamination. Surface water samples 17-SW-02 and 17-SW-03 contained lead at concentrations of 55.0 $\mu\text{g/l}$ and 38.8 $\mu\text{g/l}$, respectively. Thallium was also detected at 10.3 $\mu\text{g/l}$. Contaminants detected in groundwater exceeding

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 25 of 52

MCLs included 1,2-DCA at 29 $\mu\text{g/l}$, 1,1-DCE at 51 $\mu\text{g/l}$, and TCE at 4000 $\mu\text{g/l}$ in monitoring well 17-WW-01.

3.3.5 Potential Contaminants and Migration Pathways. Potential sources of contaminants at this site are explosive residues and ash resulting from burning and flashing operations in pits and trenches. Contamination is widespread within the shallow soils and present within the groundwater beneath the site. Low concentrations of explosives and chlorinated organic compounds have been identified in the soils down to a depth of 5 feet at a location suspected to be in the center of the western burn pit area at the site. Explosives were detected in soil samples from 6 of 8 borings. Groundwater samples from monitoring well 17-WW-01 contained concentrations of TCE, 1,2-DCA, and 1,1-DCE that exceeded MCLs. Borehole groundwater samples 17-GG-02 and 17-GG-06 also contained significant contamination with explosives.

Runoff across surface soils contaminated with explosive compounds and VOCs would follow surface drainage paths into Harrison Bayou and eventually into Caddo Lake. A high potential for the erosion of contaminated surface soils during flooding or heavy rainfall exists due to the site's location within the floodplain. Therefore, contaminated sediment could be carried

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 26 of 52

by surface water runoff into the surface drainage pathways leaving the site where it could be deposited or carried off to Harrison Bayou. Contaminants in subsurface soils appear to have migrated downward to the shallow groundwater beneath the site, and could eventually discharge to Harrison Bayou. Contaminant transport within the shallow aquifer was evaluated using slug test data onsite monitoring wells, which indicated a mean hydraulic conductivity (K) of $2E-04$ ft per min and a groundwater velocity ($v=Ki/n$) of 0.006 ft per day, using average hydraulic gradient (i) = 0.003 and aquifer porosity = 0.15. The total flow distance from the site to Caddo Lake is 1.5 miles.

3.3.6 Identification of Potential Receptors. The general public does not have ready access to the Burning Ground No.2/Flashing Area because the site is located within the confines of LHAAP boundaries. Access is further restricted by a locked gate on the entrance road to the site. Because the site is no longer active, installation personnel have little opportunity to visit the site. The population having direct use of the site is primarily limited to the occasional hunter.

Because groundwater occurs under unconfined conditions, discharge of contaminated groundwater to Harrison Bayou poses a potential threat. The

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 27 of 52

horizontal distance that contaminants must travel to the nearest public supply well, Well 902, is approximately 2.4 miles southwest of the site and upgradient of LHAAP 17. There are no public supply wells in the direction of regional groundwater flow towards Caddo Lake.

3.4 LHAAP 18/24: Burning Ground No.3/Unlined Evaporation Pond

3.4.1 Site History. Burning Ground No. 3 has been in operation since 1955.

The area has been used for the treatment, storage, and disposal of solid and liquid explosive, pyrotechnic, and combustible solvent wastes by open burning, incineration, evaporation, and burial. Historical waste management units include open burning pits, an unlined evaporation pond (UEP), stockpiles of solvent soaked sawdust, and suspected waste burial pits. The UEP, constructed at the burning ground in 1963, was originally utilized as a holding pond to store explosive wastes resulting from the washout of rocket motor casings, which was performed at the northern corner of the pond.

In 1973, the pond also began receiving wash water containing solvent residues and solids collected from LHAAP operations involving pyrotechnic material preparation and mixing. The washwater commonly contained metallic

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 28 of 52

cations, nonmetallic anions, and organic solvents. Sawdust, soaked with methylene chloride and other solvents used to clean and scour mixers used for mixing illuminants, was stockpiled along the southern berm of the pond and was burned in trenches in the western portion of the burning ground. Use of the UEP was discontinued in 1984. The UEP was closed as a RCRA interim status surface impoundment in 1986 by removing all waste and capping the impoundment. Current operations at LHAAP 18/24 now include treatment of explosives and explosives-contaminated wastes by burning in the Air Curtain Destructor (ACD), three open burning cages, one open burning pan, and a burn cage for Perching II motor elimination.

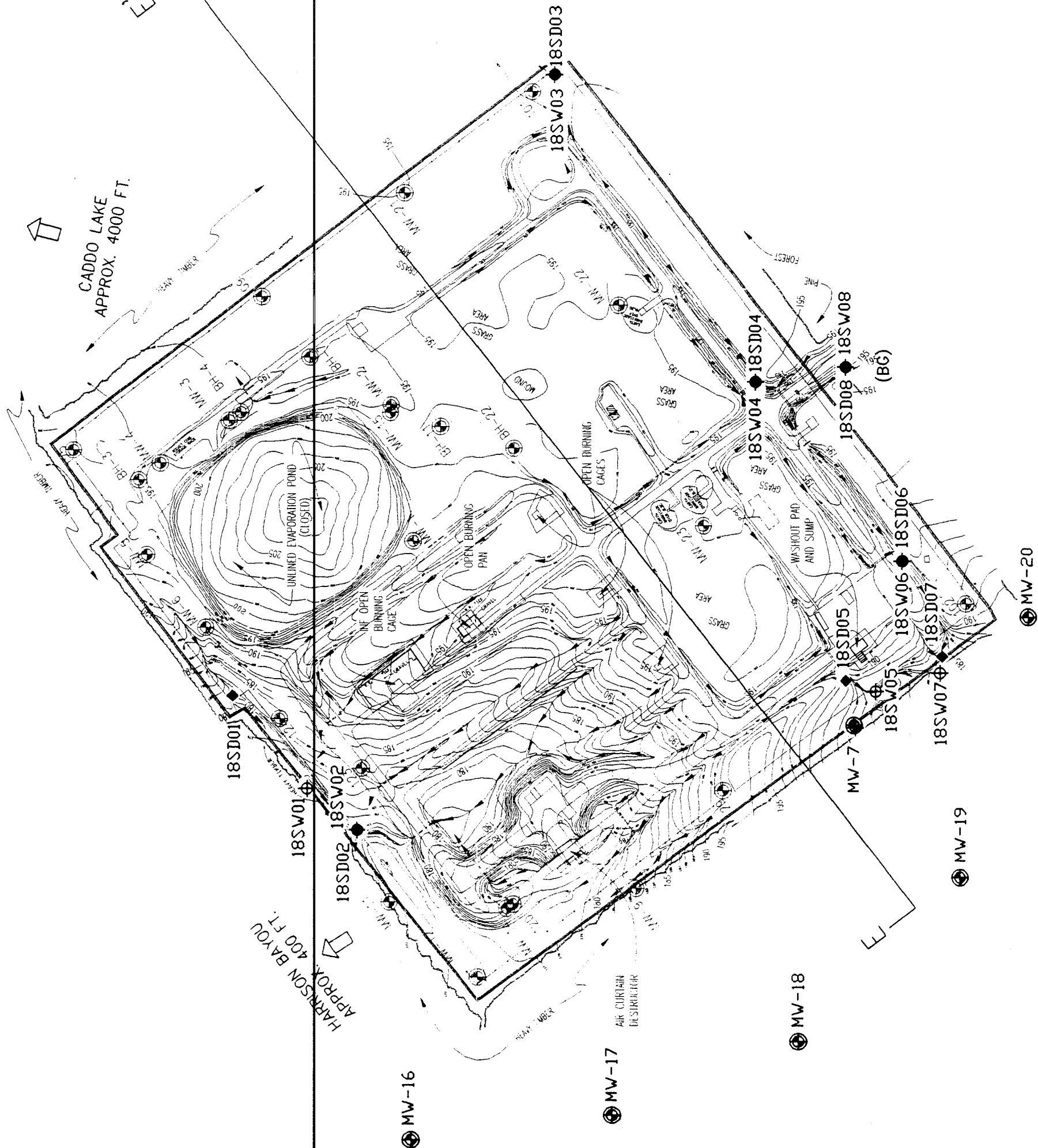
3.4.2 Site Description. Burning Ground No. 3 is a fenced 34.5-acre secured area located in the southeastern quadrant of LHAAP at the end of Avenue Q. The Unlined Evaporation Pond/Rocket Motor Washout Facility (UEP) site is located within the northern corner of the burning ground. Harrison Bayou flows within 1,000 feet of the western edge and within 500 feet of the northern edge of the burning ground site. A detailed map of the site showing current site conditions is provided as Figure 3-7.

The site is a cleared area within a heavily wooded section of LHAAP. The area is generally vegetated with grass and weeds and is dissected with

012002

LEGEND

- ◆ SURFACE SEDIMENT SAMPLE (RI PHASE 1)
- ⊕ SURFACE WATER SAMPLE (RI PHASE 1)
- ⊕ MONITORING WELL (PREVIOUS)
- ⊕ BKG BACKGROUND SAMPLE LOCATION
- SURFACE WATER FLOW DIRECTION
- APPROXIMATE LIMITS OF WASTE MANAGEMENT AREA
- E.F. SOIL PROFILE LOCATION



CORPS OF ENGINEERS, TULSA DISTRICT

LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

RI PHASE 2 WORK PLAN

LHAAP 18 AND 24

BURNING GROUND NO. 3 AND

UNLINED EVAPORATION POND

SITE LAYOUT & SAMPLE LOCATIONS

Sverdrup
Environmental

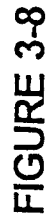
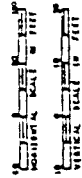
FIGURE 3-7

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 30 of 52

asphalt-paved roads. Topography of the site has been greatly altered by operations over the past 35 years. The burning ground is now mostly level with more relief near the western corner containing the ACD and near the northern corner containing the mounded surface of the former UEP site. Most of the fenced area of Burning Ground No. 3 is situated on an outcrop of the Wilcox Group, with a contact between the primary materials of the Wilcox and Recent alluvium located along the western corner of the site.

Surficial soils consist of a sandy/silty clay underlain by a sandy/silty stratum. A clay layer, varying from 5-15 ft thick, occurs from approximately El. 150 - 160 ft NGVD to El. 140 - 150 ft NGVD across the site. Depending on the particular location, the site is underlain by two or three possibly interlinked aquifers above the top of the Midway Formation. Figure 3-8 depicts a generalized soil profile across LHAAP 18/24.

3.4.3 Previous Investigations. USAEHA performed an investigation of the site in 1980 and installed 13 monitoring wells to monitor the UEP. The site was again investigated by EPS for USATHAMA, and a report was published in June of 1984. EPS installed nine monitoring wells within and around

[illegible]

NOTES

1. See above for what was found generally. Shells located approximately at the location shown will not be constructed, in any form, where it is not shown.

2. For LEGEND, SYMBOLIC, AND REMARKS, SEE SHEET II.

3. FOR SOILING LOCATIONS, SEE SHEET II.

4. Soil Contacts Are Interpreted.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 32 of 52

Burning Ground No. 3, and sampled them and the existing 13 USAEHA wells for explosives, metals, selected anions, and organic compounds. Results indicated nitrate, barium, cadmium, and chromium present in at least one of the monitoring wells at concentrations greater than the SDWA MCLs and SMCLs. Explosives were detected in many of the wells, including 1,3,5-TNB at 51 $\mu\text{g/l}$ and 2,5,6-TNT at 5.6 $\mu\text{g/l}$. The USACE performed investigations for the Phase 1 RI in which they analyzed soil and groundwater for chlorides, nitrates, TOX, explosive compounds, VOCs, and metals. Concurrent with the investigations being performed for the Phase 1 RI, Morton Thiokol, Inc. contracted with EPS to sample three existing monitoring wells at Burning Ground No. 3 and analyze the samples for explosives as part of a study to identify TNT burial sites at LHAAP.

Due to the extensive investigations of LHAAP since 1981, the Phase 1 Remedial Investigation conducted by Sverdrup in 1993 was limited to surface water and sediment sampling. Eight surface water (18-SW-01 through -08) and eight sediment (18-SD-01 through -08) samples were collected for the purpose of determining if contaminated runoff is being generated and leaving the area. Four of these samples targeted surface drainage pathways, three isolated the source of any contaminants that may be migrating from a given area, and one was used to determine background

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 33 of 52

concentrations. The samples were analyzed for VOCs, SVOCs, explosives, total metals, nitrates, chlorides, and sulfates.

3.4.4 Assessment of Existing Data. Previous investigations by the USACE indicated extensive contamination beneath large portions of the site, including concentrations of methylene chloride (MEC) and trichloroethene (TCE) as great as 17,800,800 $\mu\text{g/l}$ and 251,000 $\mu\text{g/l}$, respectively. In association with these contaminants were elevated concentrations of vinyl chloride at 25 $\mu\text{g/l}$ (MCL=2 $\mu\text{g/l}$), trichlorofluoromethane at 46,300 $\mu\text{g/l}$, and 1,2-dichloroethane at 180 $\mu\text{g/l}$ (MCL=5 $\mu\text{g/l}$). Concentrations of 1,3,5-TNB and 4-am-DNT were detected in monitoring well MW-2 at elevated levels. Chromium, lead, and nickel concentrations exceeded MCLs in scattered monitoring wells.

Elevated concentrations of volatile organic compounds were detected in a number of soil samples taken from former waste disposal trenches in the vicinity of the ACD. Particularly high concentrations of methylene chloride, TCE, 1,2-DCE, and styrene were also noted. Scattered soil samples from the drilling of site monitoring wells detected concentrations of volatile organic compounds.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 34 of 52

The Phase 1 Remedial Investigation detected 17 $\mu\text{g/l}$ of trichloroethene and 19 $\mu\text{g/l}$ of cis-1,2-dichloroethene in surface water sample 18-SW-02, and elevated concentrations of barium, chromium, lead, and nickel in 18-SW-05.

3.4.5 Potential Contaminants and Migration Pathways. Sources identified as contributing to groundwater contamination existing beneath the burning grounds area include the contaminated groundwater resulting from past operation of the UEP, remnants of trenches containing solvent soaked sawdust around the ACD, and contaminated soil from various burn pits and trenches. Contaminants identified in the groundwater are various VOCs, including very high concentrations of chlorinated solvents, metals, total nitrates, and chloride, all of which are consistent with the past waste management activities performed at the sites and the nature of the wastes treated and disposed there.

The potential for surface water contamination exists from runoff across any contaminated surface soils remaining at the site. Intermittent surface water flow along these drainage pathways leading from past open burning sites within the burning ground could continue to carry these contaminated solids and redeposit them further away from the site. Remaining contaminated soils and fills near the ACD and UEP appear to continue to be

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 35 of 52

leaching and contaminating the underlying groundwater. Groundwater contaminated with organic and inorganic compounds forms a single plume beneath Burning Ground No. 3 that appears to be migrating very slowly to the west towards Harrison Bayou and to the north towards Caddo Lake. The potential exists for contaminants to migrate along this pathway and eventually impact the surface water regime.

3.4.6 Identification of Potential Receptors. The general public does not have ready access to Burning Ground No. 3 and the UEP because the sites are confined within secured LHAAP boundaries. Access to both sites is further restricted by a locked gate on the entrance road and tall fencing around the burning ground area. The population having direct use of the immediate area is primarily limited to installation personnel conducting burning operations.

Because groundwater occurs under unconfined conditions, discharge of contaminated groundwater to the surface waters of Harrison Bayou poses a potential threat. The horizontal distance that contaminants must travel to the nearest public supply well, Well 902, is approximately 2.6 miles southwest of the site area and upgradient of the site. There are no public supply wells in the direction of regional groundwater flow toward Caddo Lake. It is not anticipated that groundwater downgradient of the site will be developed for future use.

012009

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 36 of 52

3.5 LHAAP 29: Former TNT Production Area

3.5.1 Site History. A TNT plant, consisting of six production lines, was operated in the former TNT Production Area from October 1942 until August 1945. The plant produced over 180 million kilograms of flake TNT from five regular production lines and one standby line. Each production line was essentially the same and consisted of four main elements: an unloading area where acids and toluene were unloaded and held in tanks until ready for use; a nitrating area where TNT flakes were produced by nitrating toluene with nitric acid; a wash area where the TNT flakes were washed to remove impurities and then dried; and a loading area where the cardboard-boxed TNT was loaded onto trucks.

A "yellow liquor" wastewater generated by the production plant and a "red liquor" generated at each of the wash areas was pumped through a 12-in underground wood stave pipeline to the TNT Waste Disposal Plant (LHAAP 32). Both the red and yellow wastewaters likely contained low concentrations of metals derived from the source water and picked up during the TNT purification and wastewater treatment processes.

The TNT production plant was inactive from August 1945 until 1959 when most of its buildings and above ground storage tanks were removed. There have been only limited activities at the site since World War II.

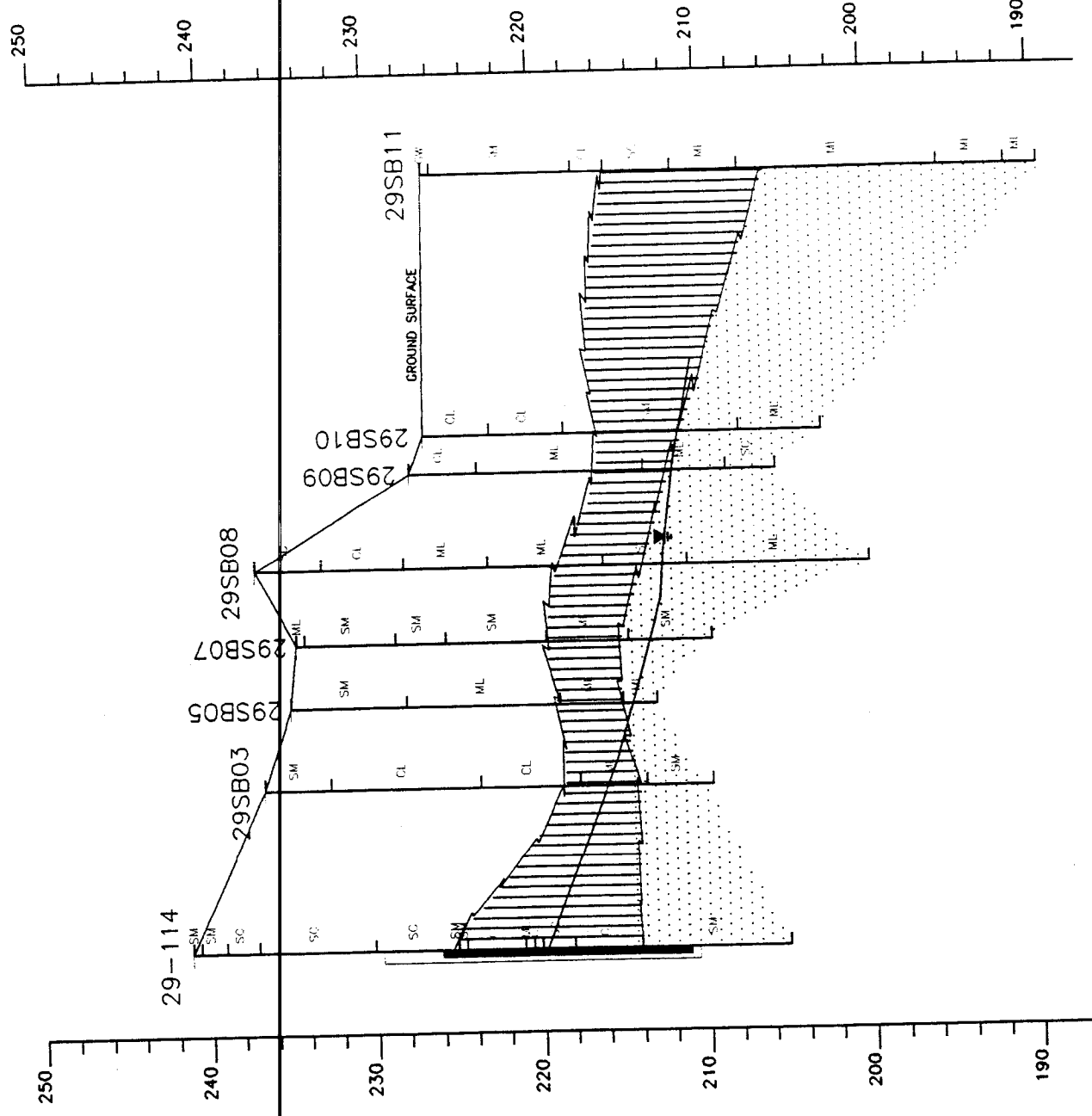
LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 37 of 52

3.5.2 Site Description. LHAAP 29 is a heavily wooded site located in the western central portion of the LHAAP 29. The site is bounded by Avenue E on the southwest, 1st Street on the northwest, 18th Street on the southeast, and Avenue D on the northeast. A portion of LHAAP, the Bulk Toluene Storage Area, is located in a wooded area across Avenue D from the production area. A detailed map of LHAAP 29 showing current site conditions is provided as Figure 3-9.

Surficial soils typically consist of predominantly medium plasticity clays with some high plasticity zones to depths of 15-20 ft. Below this and extending to depths in excess of 25 ft, the soils are typically low plasticity silts or silty clayey sands and contain some medium to high plasticity clay zones within a very dense dark gray sand and silt layer. Groundwater is generally found confined within thin sand lenses within thicker silt layers. Figures 3-10 and 3-11 depict generalized soil profiles across LHAAP 29.

NW
ELEV.
(FT NGVD)

SE
ELEV.
(FT NGVD)
A' ↓



CL	UNIFIED SOIL CLASSIFICATION SYMBOL
	MONITORING WELL SCREEN INTERVAL
	MONITORING WELL FILTER SAND INTERVAL
	LOCALLY CONFINING LAYER
	DENSE GRAY SAND AND SILT
	GROUNDWATER POTENTIOMETRIC SURFACE

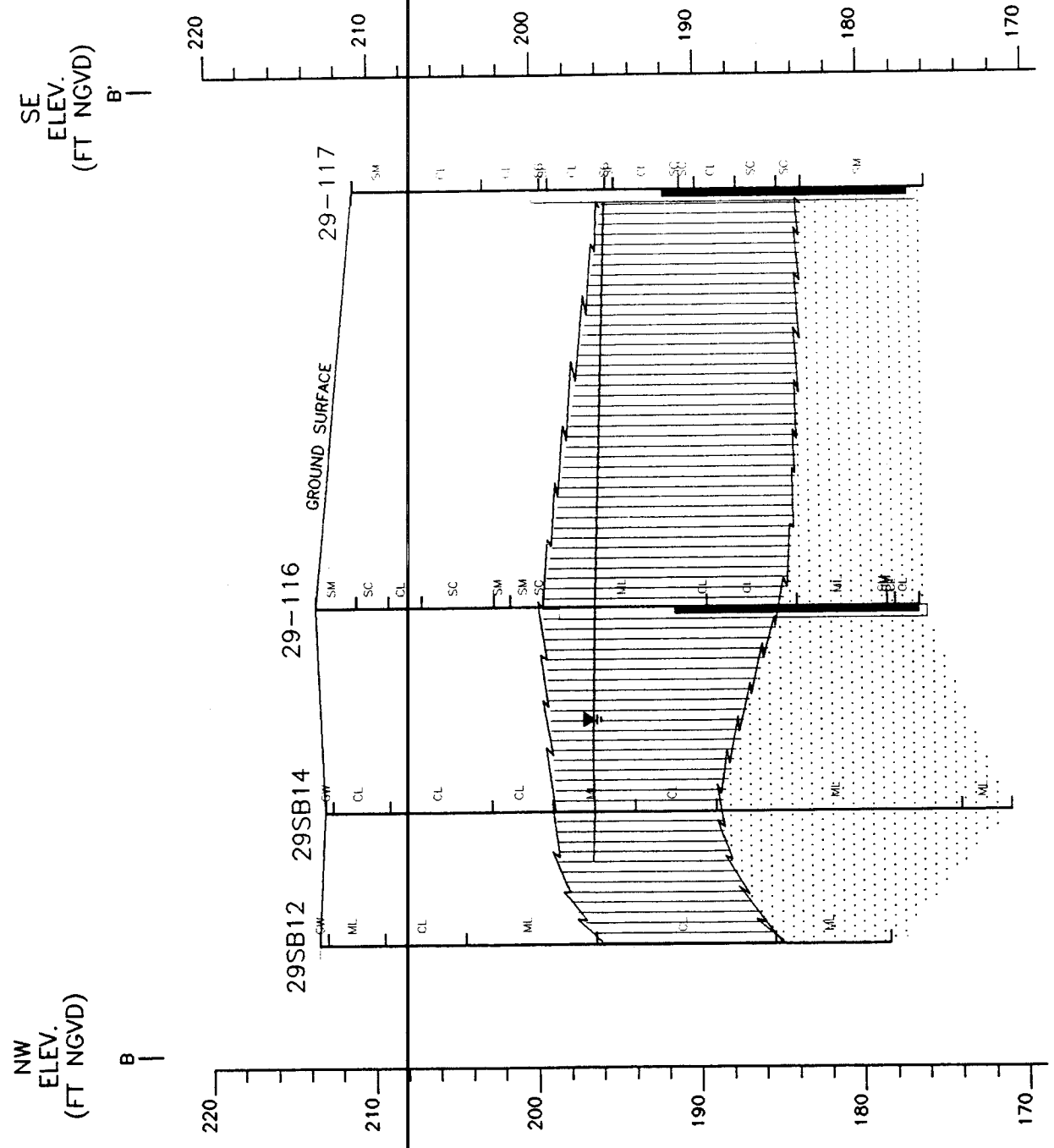
NOTE: SOIL CONTACTS AND GROUNDWATER SURFACE ARE INTERPRETED.

**Sverdrup
Environmental**

FIGURE 3-10

000088-3/45-8

012013



LEGEND

- CL UNIFIED SOIL CLASSIFICATION SYMBOL
- MONITORING WELL SCREEN INTERVAL
- MONITORING WELL FILTER SAND INTERVAL
- LOCALLY CONFINING LAYER
- DENSE GRAY SAND AND SILT
- GROUNDWATER POTENTIOMETRIC SURFACE

SCALE: HOR. 1"=300'
VER. 1"=10'



NOTE: SOIL CONTACTS AND GROUNDWATER SURFACE ARE INTERPRETED.

CORPS OF ENGINEERS, TULSA DISTRICT	
LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 29 FORMER TNT PRODUCTION AREA SOIL PROFILE B-B'	
Sverdrup Environmental	FIGURE 3-11

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 41 of 52

3.5.3 Previous Investigations. The Former TNT Production Area was investigated as a potentially contaminated site by EPS for USATHAMA, as documented in reports dated June 1984 and May 1988. Six monitoring wells were installed to sample the groundwater for explosive compounds and VOCs. All surface water, sediment, and soil analyzed for explosive compounds.

During the Phase 1 Remedial Investigation conducted by Sverdrup in 1993, sources, groundwater, surface water, sediment, and soil samples were analyzed for volatiles, semi-volatiles, explosives, metals, and anions. Trenches were excavated to expose the red and yellow liquor wastewater pipeline at four locations designated 29-WL-01 through 29-WL-04. Sixteen of the seventeen surface water (29-SW-01 through -17) and sediment samples (29-SD-01 through -17) were collected within ditches that collect surface water runoff. Samples 29-SW-14 and 29-SD-14 were collected in the pond at the discharge point of the former TNT production wastewater pipeline. Fifteen soil borings were drilled to approximately 2 ft below the water table in TNT Production Line A to represent conditions within all six production lines. Groundwater grab samples were obtained from the 15 soil borings.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 42 of 52

3.5.4 Assessment of Existing Data. Previous investigations by EPS confirmed 2,4,6-TNT in surface soils at the site and in surface water and sediments leaving the site. The highest concentration of 2,4,6-TNT identified in soils was 2,057 $\mu\text{g}/\text{kg}$. Surface water samples SS1 and SS2 contained 2,4,6-TNT at concentrations of 11 $\mu\text{g}/\text{l}$ and 116 $\mu\text{g}/\text{l}$, respectively. Groundwater samples from the monitoring wells 114 and 118 revealed 1.4 $\mu\text{g}/\text{l}$ of 1,3,5-TNB.

The Phase 1 Remedial Investigation detected elevated concentrations of metals in sediment samples, including chromium, ranging from 12.5-63.3 mg/kg; lead, ranging from 10.5-88.2 mg/kg; and mercury at 0.22 mg/kg. The background sediment sample LH29-SD-13 also contained notable concentrations of 2,4,6-TNT, 4-am-DNT, and 2-am-DNT. Other contaminants detected in sediment included acetone (112 $\mu\text{g}/\text{kg}$), toluene (31 $\mu\text{g}/\text{kg}$), di-n-butyl phthalate (11,000 $\mu\text{g}/\text{kg}$), and 2,4,6-TNT (51 $\mu\text{g}/\text{kg}$). Surface water analyses detected bis(2-ethylhexyl)phthalate (DEHP) at 45 $\mu\text{g}/\text{l}$ in LH29-SW-13. Soil contamination was limited to explosives and DEHP. 2,4,6-TNT was detected at 110 $\mu\text{g}/\text{g}$ and DEHP was detected in the range of 3,000-4,000 $\mu\text{g}/\text{kg}$. Soil samples taken from the surrounding soil beneath the pipeline detected no contamination with VOCs or explosives. Groundwater sampling of the existing monitoring well network detected contamination with 2,6-

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 43 of 52

dinitrotoluene (2,6-DNT) and 2-nitrotoluene (2-NT) in well 29-116. The groundwater sample from Well 29-118 contained mercury and selenium above MCLs at 3.0 and 162 $\mu\text{g}/\text{l}$, respectively. Cadmium was detected above the MCL in Well 29-119. Low concentrations of barium, chromium, lead, and nickel were also observed.

3.5.5 Potential Contaminants and Migration Pathways. The potential source of contaminants are the residues of explosive compounds and explosives manufacturing wastes scattered over the site and possibly concentrated in some of the lower lying portions of the site. Groundwater sampling of the monitoring well network detected contamination with 2,6-DNT, 2-NT, and mercury, selenium, and cadmium above MCLs. Borehole water data indicated potential groundwater contamination with 1,3,5-trinitrobenzene (1,3,5-TNB), 2,4,6-trinitrotoluene (2,4,6-TNT), 2,4-DNT, 2-NT, and 4-NT.

Migration pathways include the surface water, groundwater, sediment, and soil. The potential for surface water contamination exists from runoff across contaminated surface soils. Erosion of contaminated surface soils during heavy rainfall could produce contaminated sediment that would be carried by surface water runoff into the ditches on the site where it could deposit in these ditches or in the pond at the former pumphouse

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 44 of 52

location. Contaminated surface soils could contaminate surface water runoff. Water percolating downward through contaminated soils could also eventually leach explosives or organic contaminants into the groundwater, which occurs about 20 ft beneath the site.

Contaminant transport within the shallow aquifer was estimated using slug test data from the site monitoring wells, which indicated a mean hydraulic conductivity (K) of $7E-05$ ft per min and a resultant groundwater flow velocity of 0.005 ft per day for the western portion of the site and 0.0015 ft per day for the eastern portion, using average hydraulic gradients (i) of 0.007 and 0.002, respectively, and an aquifer porosity of 0.15. Contaminated groundwater could be discharged to surface water flow downstream from the site.

3.5.6 Identification of Potential Receptors. The general public does not have ready access to the Former TNT Production Area because the site is confined within secured LHAAP boundaries. Access to the site is not restricted except by one locked gate on the main entrance road to the site. The site is no longer active. Therefore, installation personnel have little opportunity to visit the site. The population having direct use of the site is primarily limited to the occasional hunter.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 45 of 52

Because groundwater occurs under unconfined conditions over much of the installation, discharge of contaminated groundwater to the many surface water channels bisecting the installation poses a much greater threat. There are no public supply wells in the direction of regional ground flow towards Caddo Lake. The horizontal distance that contaminants must travel to the nearest public supply well, Well 504, is approximately 0.9 mile west and upgradient of the site.

3.6 LHAAP 32: Former TNT Disposal Plant

3.6.1 Site History. The former TNT Waste Disposal Plant was constructed in 1942 to treat and dispose of wastewaters generated at the nearby former TNT Production Area (LHAAP 29). Wastewater resulting from the production of 180 million kilograms of TNT was disposed of through the plant. The wastewaters were transferred to the disposal area through a 6-in wooden pipeline and stored in holding tanks until treatment. During operation of the disposal plant, leakage from its many tanks and pipelines was reportedly a constant problem. Because of the large volumes of wastes that were handled, there were probably occasional spills resulting from the overflow of tanks and manual handling of wastes.

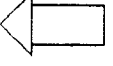
LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 46 of 52

Wastewaters were pumped to the Settling Tanks then piped to the Evaporator Building where pH was increased by mixing in sodium hydroxide from the Caustic Soda Storage Tanks. The mixture was returned to the Evaporator Building for water content reduction. Condensate was collected and stored in the Condensate Storage Tank, and eventually released via the blue water ditch to Goose Prairie Creek.

A blue water ditch, which appears to have had its upstream terminus at the detention pond, carried acidic cooling water from the disposal plant to the Neutralization Plant located next to the Bulk Toluene Storage Area in LHAAP 29. The plant was not operated after 1945. In 1959, most of the buildings and tanks used in the disposal process were removed and the debris burned at LHAAP 17.

3.6.2 Site Description. LHAAP 32 is located in the west central portion of LHAAP. The site entrance is on Avenue C about 0.2 miles northwest of its intersection with 1st Street. The site covers approximately 9 acres and is covered extensively with trees and brush that have grown over the site since the 1940s. A detailed map of LHAAP 32 showing current site conditions is provided as Figure 3-12.

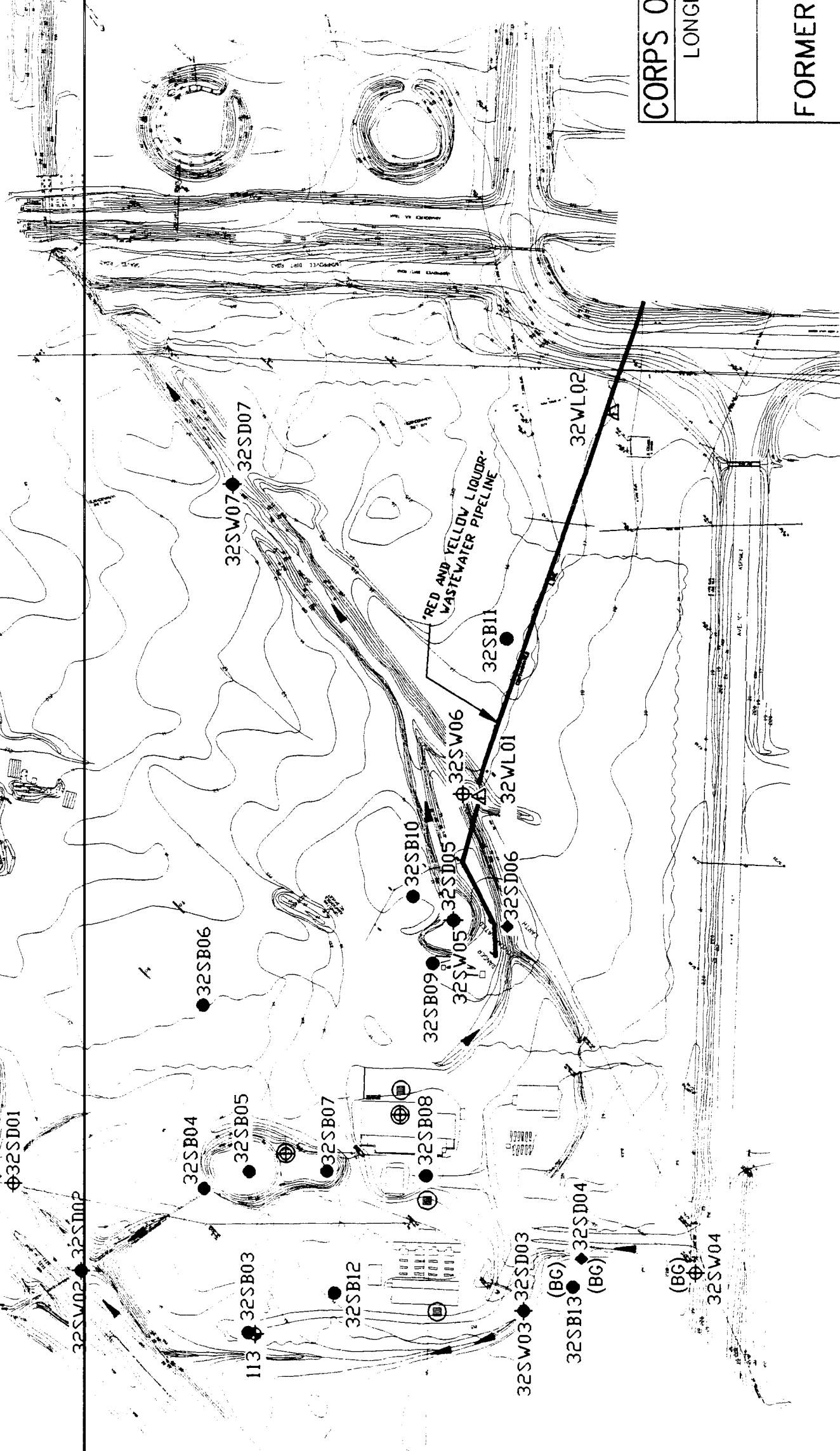
CADDO LAKE
APPROX. 8000 FT



LEGEND

- ◆ SEDIMENT SAMPLE (RI PHASE 1)
- ⊕ SURFACE WATER SAMPLE (RI PHASE 1)
- ⊕ SURFACE WATER/SEDIMENT SAMPLE (PREVIOUS)
- ⊕ SURFACE SOIL SAMPLE (PREVIOUS)
- ⊕ MONITORING WELL (PREVIOUS)
- SOIL BORING (RI PHASE 1)
- SURFACE WATER FLOW DIRECTION
- ▲ WASTEWATER LINE SAMPLE (RI PHASE 1)
- BACKGROUND SAMPLE LOCATION

012020



CORPS OF ENGINEERS, TULSA DISTRICT	
LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 32	
FORMER TNT WASTE DISPOSAL SITE SITE LAYOUT AND SAMPLE LOCATIONS	
Sverdrup <i>Environmental</i>	FIGURE 3-12

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 48 of 52

General soil and geologic maps indicate that the site is located on an outcrop of the Wilcox Group of sediments. These sediments appear to be overlain by a few feet of residually-derived soils or fill materials. The fill materials are restricted to a few scattered small areas and resulted from grading operations during construction of the disposal plant. Yellowish brown, medium plastic, and silty clay is encountered to a depth of 10 to 15 ft. Gray, low plasticity silt is encountered from 5 to 15 ft depth. Underlying the low plasticity silt is very dense, dark gray sand, and silt, occasionally containing lignite lenses. Groundwater is generally observed within the very dense and silt below a depth of 25 to 30 ft in depth.

3.6.3 Previous Investigations. The site was investigated by EPS for USATHAMA, as presented in a report published in June 1984. EPS installed one monitoring well 113; groundwater samples were analyzed for explosives. Surface water, sediment, and shallow soil samples were collected in Goose Prairie Creek and analyzed for explosives.

During the Phase 1 Remedial Investigation conducted by Sverdrup in 1993, surface water, groundwater, sediment, and soil samples were analyzed for VOCs, SVOCs, explosives, metals, nitrates, and sulfates. Seven surface

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 49 of 52

water (32-SW-01 through -07) and seven sediment (32-SD-01 through -07) samples were collected from the detection pond, former settling tank locations, and surface water runoff collection ditches. Trenches were excavated to expose the red and yellow liquor wastewater pipeline at two locations designated 32-WL-01 and 32-WL-02. The pipeline contents were analyzed for explosives and VOCs. Thirteen soil borings were drilled and designated 32-SB-01 through 32-SB-13. Five of these borings were taken to a depth of 5 ft to characterize suspected shallow soil contamination. Groundwater grab samples were obtained from each of the eight deeper soil borings.

3.6.4 Assessment of Existing Data. Results from previous investigations by EPS indicated that, with the exception of 2,4,6-TNT found in surface water sample 3919 at 7.6 $\mu\text{g/l}$, explosives were below detection limits. Surface water analyses indicated concentrations of aluminum, chromium, lead manganese, and nickel above local background levels.

The Phase 1 Remedial Investigation indicated no contamination of the pipeline contents and surrounding soil with explosives or volatile organic compounds. Surface water sample 32-SW-06 contained a lead concentration of 252 $\mu\text{g/l}$. Sediment samples LH32-SD-06 and LH32-SD-07, taken within the

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 50 of 52

blue water ditch, contained lead concentrations at 62 and 324 mg/kg, respectively. Sample 32-SD-07 contained mercury at 0.36 mg/kg. Arsenic, chromium, and nickel were detected in 32-SD-02 and 32-SD-03 at concentrations greater than background concentrations (32-SD-04).

Soil samples from boring 32-SB-10 detected notable concentrations of metals including silver at 8.78 mg/kg and mercury at 0.19 mg/kg. Other metals detected included barium, chromium, and nickel. Elevated chloride concentrations greater than 500 mg/kg were detected in samples from borings 32-SB-03 and 32-SB-07.

Analyses of a groundwater sample from existing Well 113 detected concentrations of chromium at 58.8 $\mu\text{g/l}$ (MCL=100 $\mu\text{g/l}$), lead at 18.6 $\mu\text{g/l}$ (MCL=15 $\mu\text{g/l}$), and nickel at 75 $\mu\text{g/l}$ (MCL=100 $\mu\text{g/l}$). No organics, explosives, pesticides, herbicides, or PCBs were detected, however.

3.6.5 Potential Contaminants and Migration Pathways. The primary sources of potential contamination at this site are the explosive compounds and residues contained in the red and yellow liquor wastewaters and sludges that were treated and disposed at the site and the ashes resulting from incineration of the sludges produced by evaporating the wastewaters.

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 51 of 52

Analyses of the pipeline contents and surrounding soil revealed no contamination with explosives or volatile organic compounds. Surface water and sediment within the blue water ditch contained elevated lead concentrations. Groundwater sampling in Well 113 detected a lead concentration in excess of the SDWA MCL.

Migration pathways include surface water, sediment, soil, and groundwater. Runoff from surficial soils and fill materials could transport contaminants to collection ditches or streams. These ditches and streams would then carry the contaminated surface water into Goose Prairie Creek and Caddo Lake. Erosion of contaminated soils and fill materials during heavy rainfall could produce contaminated sediment that would be carried by surface water runoff to receiving ditches and streams. Water percolating downward through contaminated soils may leach contaminants and carry them into underlying soils where they could eventually reach groundwater.

Groundwater is a significant pathway for contaminant migration due to the relative shallowness of the water table and its expected seasonal fluctuation. Contaminant transport within the shallow aquifer was evaluated using slug test data from the aquifer, which indicated a mean

LHAAP Group 2 RI Phase 2 WP
Section: 3
Revision: 3
Date: December 1994
Page: 52 of 52

hydraulic conductivity (K) of $8E-06$ ft per min, and a resultant groundwater velocity ($v=Ki/n$) of 0.004 ft per day, using an average hydraulic gradient (i) = 0.005 and an aquifer porosity = 0.15. Contaminated groundwater could discharge to surface drainage, where all drainage would eventually enter Caddo Lake via Goose Prairie Creek. The total flow distance from the site to Caddo Lake is about 2.3 miles.

3.6.6 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, and adjoining areas are enclosed by a fence with a locked access gate. The site is seldom visited because it is not being used for anything except occasional hunting.

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. 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. The nearest public water supply well, Well 504, is approximately 1.4 miles southwest of and hydraulically upgradient of the site.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 1 of 27

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, surface water, and groundwater samples: pH; specific conductance; volatile organic compounds (VOCs); high explosives; antimony; arsenic; barium; cadmium; chromium; lead; mercury; nickel; selenium; silver; and thallium. 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 12: Active Landfill

Site LHAAP 12 began operation in 1963 and used intermittently for the disposal of industrial solid wastes, and possibly hazardous waste, generated at LHAAP. The landfill was used for disposal of nonhazardous industrial solid waste until it was closed in April, 1994.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 2 of 27

Previous investigations by EPS in 1984 included the installation of two monitoring wells (103 and 121) to monitor shallow groundwater. Groundwater analysis indicated the presence of cadmium and elevated levels of manganese. The only explosive detected was a trace of 1,3-DNB. The groundwater samples also contained methylene chloride at 45 $\mu\text{g/l}$, exceeding the SDWA MCL of 5 $\mu\text{g/l}$.

The 1993 Phase 1 Remedial Investigation conducted by Sverdrup detected contaminants in groundwater, including concentrations exceeding SDWA MCLs for lead, chromium, and nickel in well 12-WW-03 and TCE in wells 12-WW-01 and -03. Varying concentrations of bis(2-ethylhexyl) phthalate (DEHP) as high as 5,000 $\mu\text{g/kg}$ were detected in soil samples collected from 5 to 17 feet in depth in boring 12-WW-07. Soil samples taken from landfill materials detected trace concentrations of VOCs, primarily acetone, toluene, ethylbenzene, and xylene.

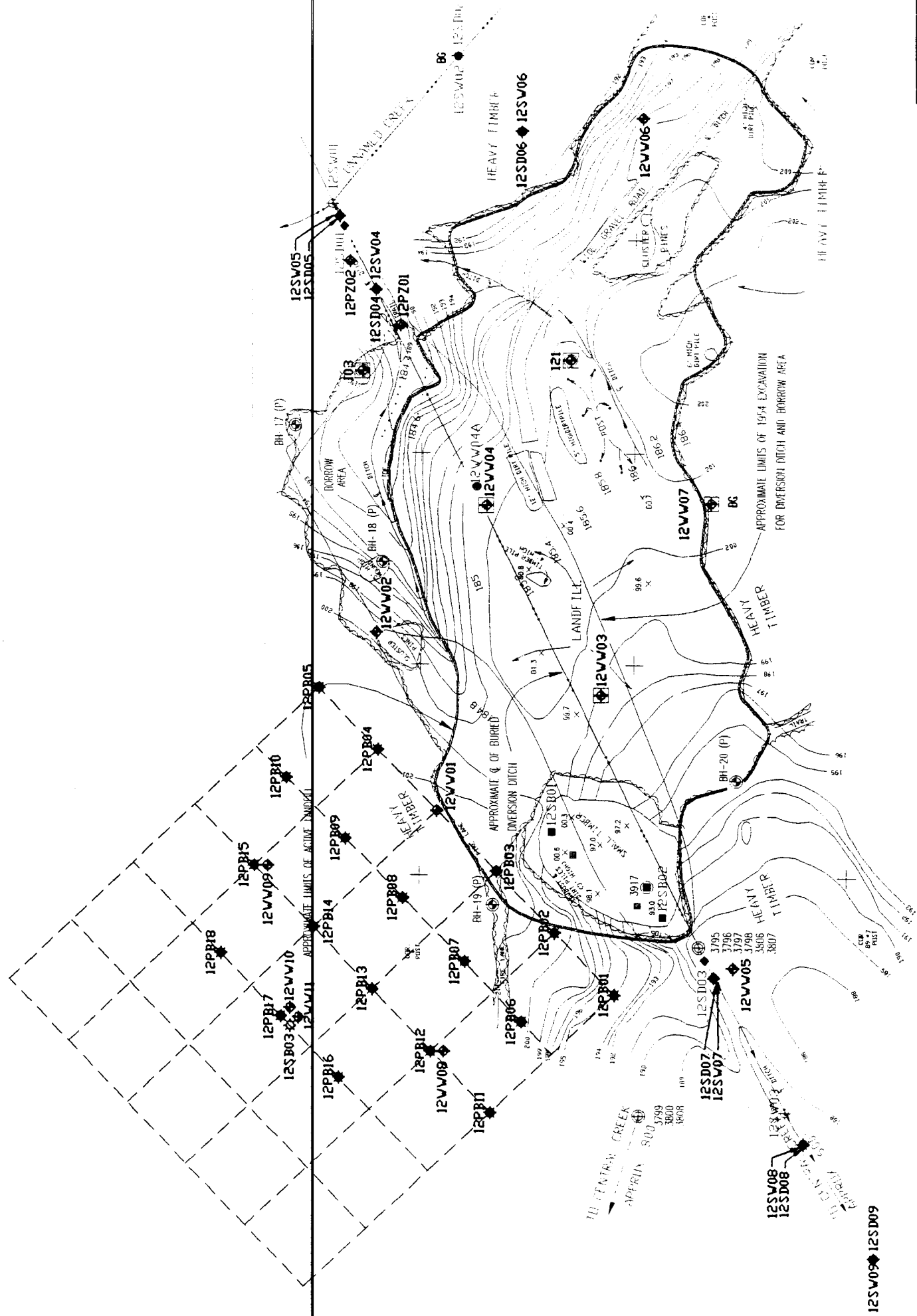
To further investigate observed groundwater contamination with VOCs, explosives, and metals, the Phase 2 RI includes the following: collection of eighteen (18) Geoprobe samples of the shallow groundwater to evaluate the potential TCE plume detected within the shallow aquifer; drilling and geotechnical sampling of one stratigraphic boring being approximately 200 ft deep; installation of three (3) shallow (<40 ft), downgradient monitoring wells outside of the plume perimeter; installation of one (1) deep (>100 ft) monitoring well clustered with a shallow

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 3 of 27

well downgradient of the plume; installation of two piezometers near the old diversion ditch to evaluate groundwater flow gradient within the landfill; confirmation groundwater sampling of nine existing wells (12-WW-01, 12-WW-02, 12-WW-03, 12-WW-04, 12-WW-05, 12-WW-06, 12-WW-07, 103, and 121) and four (4) new wells; and plugging of five (5) existing monitoring wells (12-WW-03, 12-WW-04, 12-WW-07, 103, and 121). Eleven (11) surface water and sediment samples will be taken at locations representing drainage pathways from the site toward Central Creek to the north and the unnamed creek to the south. Proposed sampling locations are shown on Figure 4-1. Five (5) additional sediment and surface water sampling locations in Harrison Bayou are shown in Figure 4-7.

After completion of the Geoprobe sampling, a brief, site-specific sampling plan will be prepared that presents the results of the Geoprobe sampling and provides recommendations for placement of shallow and deep monitoring wells outside of the perimeter of any identified plume.

Groundwater is anticipated to be encountered at depths of 15-25 ft. In order to detect the presence of any DNAPLs, all wells (shallow, intermediate, or deep) will be placed at the bottom of the water-bearing stratum, such that the bottom



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LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 12 ACTIVE LANDFILL SAMPLE LOCATIONS	
Sverdrup <i>Environmental</i>	FIGURE 4-1

RI PHASE 2 LEGEND

- PROBE BORING (18)
- SHALLOW MONITORING WELL (3)
- DEEP MONITORING WELL (1)
- DEEP STRATIGRAPHIC BORING (1)
- PIEZOMETER (2)
- SEDIMENT/SURFACE WATER SAMPLE (6)
- MONITORING WELL TO BE PLUGGED DURING PHASE 2 (5)

LEGEND

- SURFACE SEDIMENT SAMPLE (PHASE 1)
- SURFACE WATER SAMPLE (PHASE 1)
- SURFACE SOIL SAMPLE (PHASE 1)
- SURFACE SOIL SAMPLE (PHASE 2)
- SHALLOW MONITORING WELL (PHASE 1)
- MONITORING WELL TO BE PLUGGED DURING PHASE 2
- PIEZOMETER (PHASE 1)
- PIEZOMETER (PHASE 2)
- DEEP MONITORING WELL (PHASE 1)
- DEEP MONITORING WELL (PHASE 2)
- DEEP MONITORING WELL (PHASE 3)
- DEEP MONITORING WELL (PHASE 4)
- DEEP MONITORING WELL (PHASE 5)
- DEEP MONITORING WELL (PHASE 6)
- DEEP MONITORING WELL (PHASE 7)
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- DEEP MONITORING WELL (PHASE 11)
- DEEP MONITORING WELL (PHASE 12)
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- DEEP MONITORING WELL (PHASE 90)
- DEEP MONITORING WELL (PHASE 91)
- DEEP MONITORING WELL (PHASE 92)
- DEEP MONITORING WELL (PHASE 93)
- DEEP MONITORING WELL (PHASE 94)
- DEEP MONITORING WELL (PHASE 95)
- DEEP MONITORING WELL (PHASE 96)
- DEEP MONITORING WELL (PHASE 97)
- DEEP MONITORING WELL (PHASE 98)
- DEEP MONITORING WELL (PHASE 99)
- DEEP MONITORING WELL (PHASE 100)

NOTE: CONTOURS ARE STRICTLY INTERPOLATED.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 5 of 27

4 to 6 inches of slotted screen is installed below the observed top of the low permeability (clay) confining layer. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. The deep stratigraphic boring will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. The deep well will be installed with its screen placed immediately above the top of the Midway Formation. Well screen lengths will not exceed ten (10) ft.

One groundwater sample will be collected from each Geoprobe boring, new well, and existing well scheduled for confirmation sampling, and analyzed for volatiles, explosives, and metals. Sediment and surface water samples will be analyzed for volatiles, explosives, and metals. Three of the surface water samples obtained from Central Creek will also be analyzed for total hardness. Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 6 of 27

4.2 LHAAP 16: Old Landfill

Site LHAAP 16 was originally used from 1942 to 1944 for the disposal of TNT red water ash generated from the TNT Waste Disposal Plant (LHAAP 32). Burn pits and waste storage were common waste disposal activities conducted at the site during the history of its operation. The site continued to be used for a variety of waste disposal and treatment activities into the 1980s.

Previous investigations by EPS in 1984 confirmed low concentrations of explosives and organic compounds in the surface soils of the landfill, in the soils at depth within the landfill, and the groundwater downgradient of the landfill. Contaminants 2,6-DNT and vinyl chloride were detected at concentrations of 8.6 $\mu\text{g/l}$ and 10.5 $\mu\text{g/l}$, respectively, in groundwater. 2,6-DNT was also detected in soil samples as high as 73 $\mu\text{g/kg}$.

The 1993 Phase 1 Remedial Investigation conducted by Sverdrup detected no contamination in the five surface water and sediment samples. Soil samples taken within landfilled materials detected notable concentrations of TCE, methylene chloride, cis-1,2-DCE, and vinyl chloride. Groundwater contaminants, detected in 6 of the 11 new wells, included TCE, methylene chloride, cis-1,2-DCE, nitrobenzene, nickel, and cadmium.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 7 of 27

To further investigate potential contamination with VOCs, explosives, and metals, the Phase 2 RI includes the following: collection of fifteen (15) Geoprobe samples of the shallow groundwater to evaluate the volatile contaminants detected within the shallow aquifer; drilling and geotechnical sampling of one stratigraphic boring approximately 200 feet deep; installation of three (3) shallow (<40 ft), downgradient monitoring wells outside of the plume perimeter; installation of one (1) deep (>100 ft) monitoring well clustered with a shallow well downgradient of the plume; confirmation groundwater sampling of twelve (12) existing wells (16-WW-01, 16-WW-02, 16-WW-03, 16-WW-04, 16-WW-05, 16-WW-06, 16-WW-07, 16-WW-08, 16-WW-09, 16-WW-10, 16-WW-11, and 122) and four (4) new wells; and collection of fifteen (15) surface water and sediment samples. Proposed sampling locations are shown in Figure 4-2. Nine (9) additional sediment and surface water sampling locations in Harrison Bayou are shown in Figure 4-7.

After completion of the Geoprobe sampling, a brief, site-specific sampling plan will be prepared that presents the results of the Geoprobe sampling and provides recommendations for placement of shallow and deep monitoring wells outside of the perimeter of any identified plume.

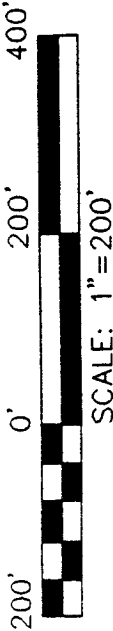
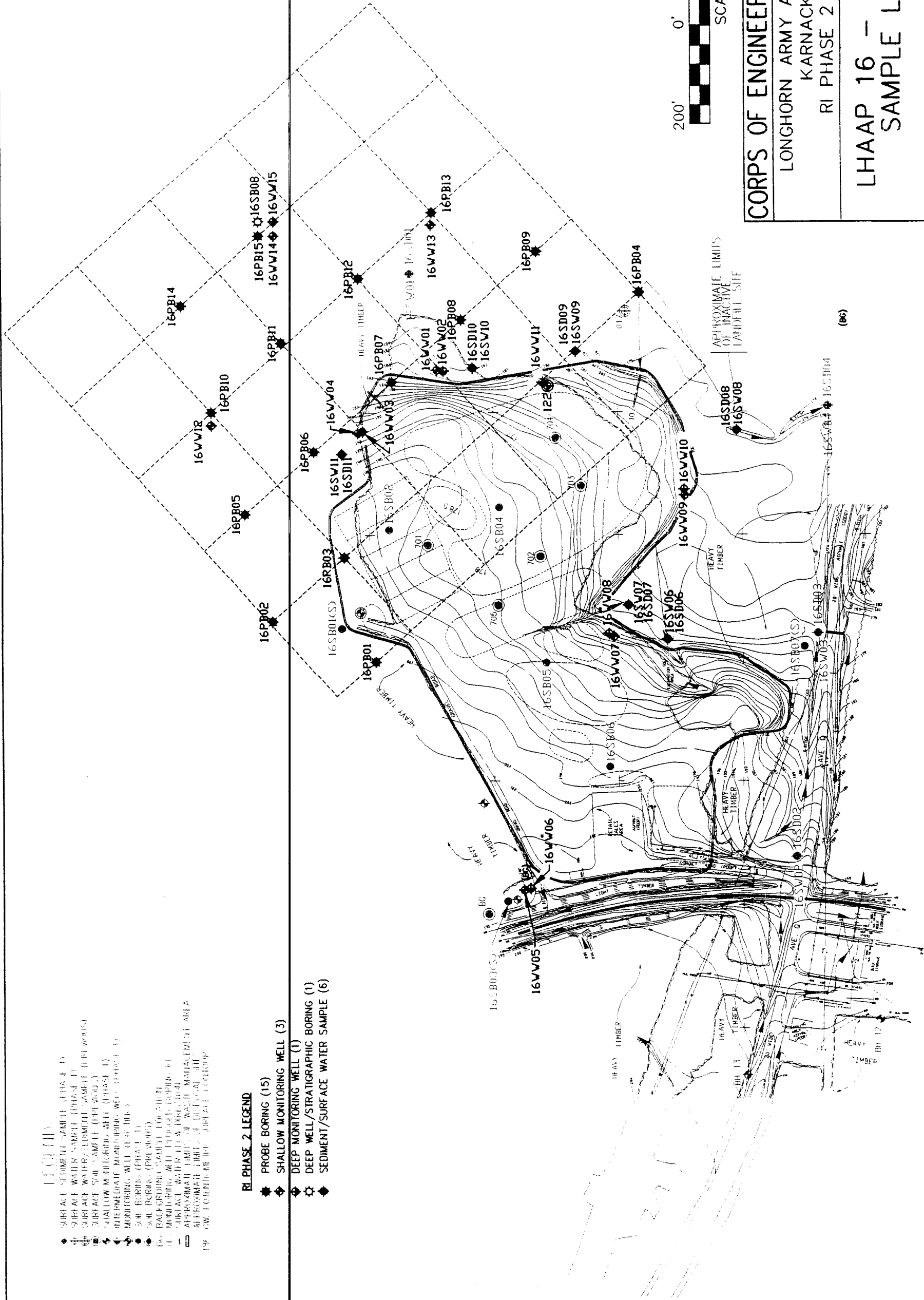
Groundwater is anticipated to be encountered at depths of 0-10 ft. In order to detect the presence of any DNAPLs, all wells (shallow, intermediate, or deep)

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- LEGEND
- SURFACE SEDIMENT SAMPLE (PHASE 1)
 - ◆ SURFACE WATER SAMPLE (PHASE 1)
 - ◆ SURFACE WATER/SUBMITT SAMPLE (PHASE 1)
 - ◆ SURFACE SOIL SAMPLE (PHASE 1)
 - ◆ SHALLOW MONITORING WELL (PHASE 1)
 - ◆ INTERMEDIATE MONITORING WELL (PHASE 1)
 - ◆ MONITORING WELL (PHASE 1)
 - ◆ SOIL BORING (PHASE 1)
 - ◆ SOIL BORING (PREVIOUS)
 - ◆ BACKGROUND SAMPLE LOCATION
 - ◆ MONITORING WELL THROUGH DITCH
 - ◆ SURFACE WATER FLOW DIRECTION
 - APPROXIMATE LIMIT OF WASTE MANAGEMENT AREA
 - APPROXIMATE LIMIT OF DITCHAL AREA
 - LOW FORTIFICATION AREA

RI PHASE 2 LEGEND

- ◆ PROBE BORING (15)
- ◆ SHALLOW MONITORING WELL (3)
- ◆ DEEP MONITORING WELL (1)
- ◆ DEEP WELL/STRATIGRAPHIC BORING (1)
- ◆ SEDIMENT/SURFACE WATER SAMPLE (6)



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

LHAAP 16 - OLD LANDFILL
SAMPLE LOCATIONS

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NOTE:
CONTOURS ARE STRICTLY INTERPOLATED.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 9 of 27

will be placed at the bottom of the water-bearing stratum, such that the bottom 4 to 6 inches of slotted screen is installed below the observed top of the low permeability (clay) confining layer. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. The deep stratigraphic boring will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. The deep well will be installed with its screen placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

One groundwater sample will be collected from each Geoprobe boring, new well, and existing well scheduled for confirmation sampling and analyzed for volatiles, explosives, and metals. Sediment and surface water samples will be analyzed for volatiles, explosives, and metals. Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 10 of 27

4.3 LHAAP 17: Burning Ground No.2

Site LHAAP 17 was used for burning bulk TNT, photo flash powder, and reject material when LHAAP was operated by Universal Match Corporation. In 1959, all of the materials removed from the TNT Production Area (LHAAP 29) and the TNT Waste Disposal Plant (LHAAP 32) during razing were reportedly burned and/or flashed at this site. The site was then used until 1980's as a flashing area to decontaminate recoverable metal by-products. The site is presently inactive.

Previous investigations by EPS in 1984 included seven 5 feet deep soil borings and several surface soil samples. Analytical results indicated concentrations of explosives and chlorinated organic compounds. Analytical results from groundwater, surface water, and sediment sampling indicated no contamination of these media.

The 1993 Phase 1 Remedial Investigation detected trace concentrations of volatile organics, explosives, and/or heavy metals from all borings except 17-SB-05. Explosives compounds were detected in soil samples collected from 6 of 8 borings, with the highest concentrations generally occurring in the surficial samples (0-2 ft) and decreasing with increasing depth. Concentrations of TCE, 1,1-DCE, and 1,2-dichloroethane (1,2-DCA) exceeding MCLs were detected in well 17-WW-01.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 11 of 27

To further investigate potential contamination with VOCs, explosives, and metals, the Phase 2 RI includes the following: collection of sixteen (16) Geoprobe samples of the shallow groundwater to evaluate volatile organics detected within the shallow aquifer; drilling and geotechnical sampling of one (1) stratigraphic boring approximately 200 feet deep; installation of three (3) shallow (<40 ft), downgradient monitoring wells outside of the plume perimeter; installation of one (1) deep (>100 ft) monitoring well clustered with the shallow well downgradient of the plume; confirmation groundwater sampling of two (2) existing wells (17-WW-01 and 130) and four (4) new wells; and collection of six (6) surface water and sediment samples. Twenty (20) surface (<6 inches) soil samples will be taken at random locations, including three samples at 100, 200, and 300 foot intervals downwind of the site. Proposed sampling locations are shown on Figure 4-3.

After completion of the Geoprobe sampling, a brief, site-specific sampling plan will be prepared that presents the results of the Geoprobe sampling and provides recommendations for placement of shallow and deep monitoring wells outside of the perimeter of any identified plume.

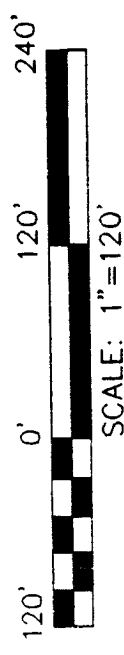
Groundwater is anticipated to be encountered at depths of 0-10 ft. In order to detect the presence of any DNAPLs, all wells (shallow, intermediate, or deep) will be placed at the bottom of the water-bearing stratum, such that the bottom

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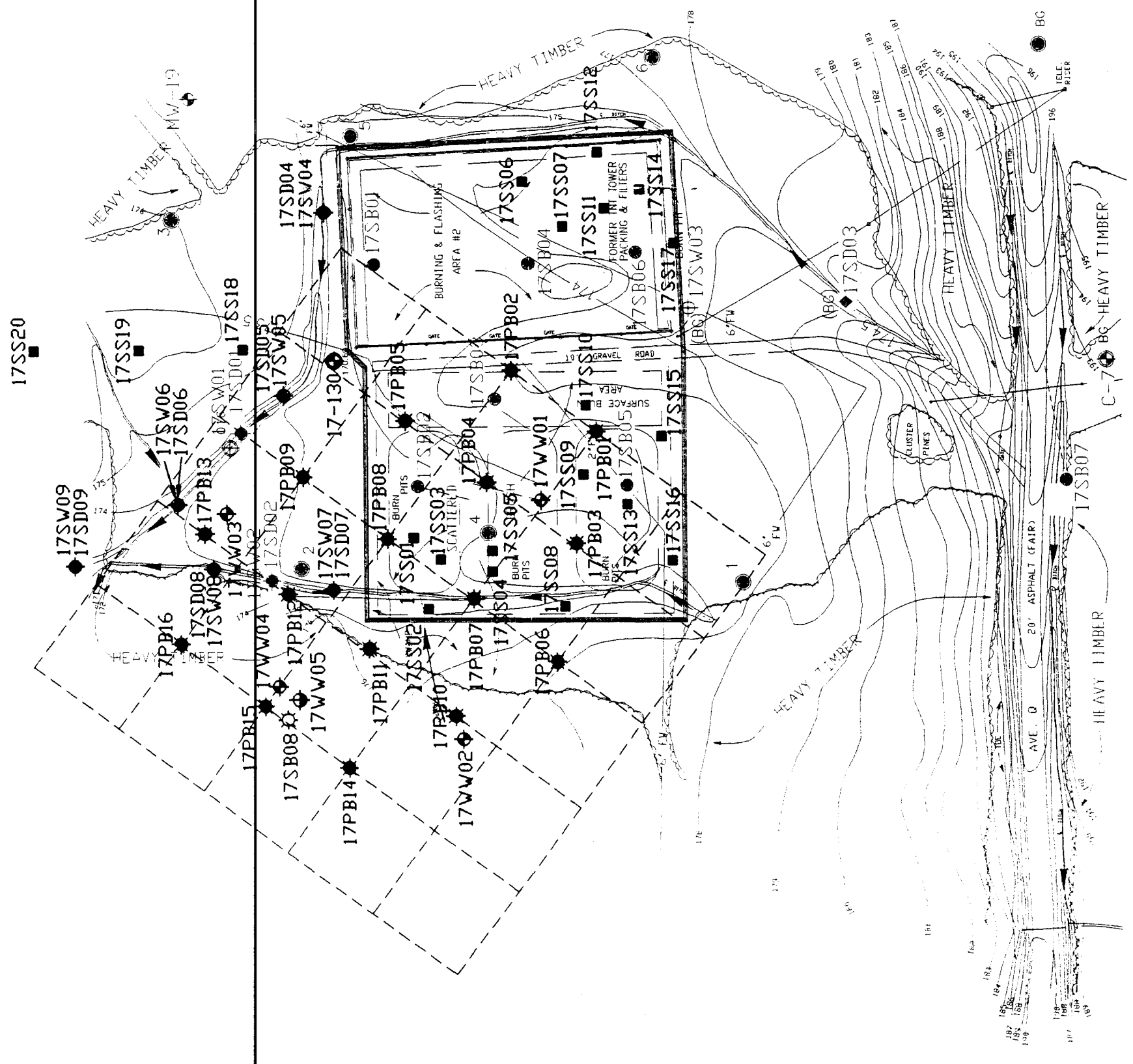
- ◆ SURFACE SEDIMENT SAMPLE (PHASE 1)
- ⊕ SURFACE WATER SAMPLE (PHASE 1)
- ⊕ SURFACE WATER/SUBMITTAL SAMPLE (PREVIOUS)
- ⊕ SURFACE SOIL SAMPLE (PREVIOUS)
- ⊕ SHALLOW MONITORING WELL (PHASE 1)
- ⊕ MONITORING WELL (PREVIOUS)
- ⊕ SOIL BORING (PHASE 1)
- ⊕ SOIL BORING (PREVIOUS)
- ⊕ BACKGROUND SAMPLE LOCATION
- BC BACKGROUND SAMPLE LOCATION
- SURFACE WATER FLOW DIRECTION
- APPROXIMATE LIMITS OF WASTE MANAGEMENT AREA
- APPROXIMATE LIMITS OF BURIED PITS/TRENCHES

RI PHASE 2 LEGEND

- ◆ PROBE BORING (16)
- ⊕ SHALLOW MONITORING WELL (3)
- ⊕ DEEP MONITORING WELL (1)
- ⊕ DEEP STRATIGRAPHIC BORING (1)
- ⊕ SEDIMENT/SURFACE WATER SAMPLE (6)
- SURFACE SOIL SAMPLE (20)



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LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS RI PHASE 2 WORK PLAN	
LHAAP 17 BURNING GROUND NO. 2 SAMPLE LOCATIONS	
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LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 13 of 27

4 to 6 inches of slotted screen is installed below the observed top of the low permeability (clay) confining layer. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. The deep stratigraphic boring will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. The deep well will be installed with its screen placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

One groundwater sample will be collected from each Geoprobe boring, new well, and existing well scheduled for confirmation sampling and analyzed for volatiles, explosives, and metals. Groundwater samples from new wells will also be analyzed for the anions chloride, nitrate, and sulfate. Sediment and surface water samples will be analyzed for volatiles, explosives, metals, and anions. Surface soil samples will be analyzed for volatiles, explosives, and metals. Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples obtained from borings.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 14 of 27

4.4 LHAAP 18/24: Burning Ground No.3/Unlined Evaporation Pond

Burning Ground No. 3 has been in operation since 1955. The area has been used for treatment, storage, and disposal of solid and liquid explosive, pyrotechnic, and combustible solvent wastes by open burning, incineration, evaporation, and burial. The Unlined Evaporation Pond (UEP) was constructed at the burning ground in 1963 and utilized as a holding pond to store explosive wastes resulting from the washout of rocket motor casings. Current operations at LHAAP 18/24 now include treatment of explosives and explosive-contaminated wastes by burning in the Air Curtain Destructor (ACD), three open burning cages, one open burning pan, and a burn cage for Perching II motor elimination.

Previous investigations by USAEHA and EPS included the installation of 13 and 9 monitoring wells, respectively, to monitor the site. Results from the November 1992 sampling indicated extensive contamination beneath large portions of the site including concentrations of methylene chloride (MEC) and trichloroethene (TCE) as great as 17,800,800 $\mu\text{g/l}$ and 251,000 $\mu\text{g/l}$, respectively. In association with these contaminants were elevated concentrations of vinyl chloride, trichlorofluoromethane, and 1,2-DCA that exceeded MCLs. Chromium, lead, and nickel concentrations exceed MCLs in a number of monitoring wells scattered across the site. Elevated concentrations of explosives compounds were detected in monitoring well MW-2.

LHAAP Group 2	RI Phase 2 WP
Section:	4
Revision:	3
Date:	December 1994
Page:	15 of 27

To further investigate potential contamination with VOCs and metals, the Phase 2 RI includes the following: collection of twenty-five (25) surface (<6 inches) soil samples at random locations - fifteen (15) samples shall be analyzed for volatile organics and all 25 samples shall be analyzed for metals; collection of a minimum of thirty (30) Geoprobe groundwater samples; drilling and geotechnical sampling of five (5) stratigraphic borings; installation of five (5) deep monitoring wells with screens immediately above the top of the Midway; installation of eight (8) monitoring wells in the shallow aquifer; installation of six (6) monitoring wells in the intermediate aquifer; and collection of eighteen (18) surface water and sediment samples. Proposed sampling locations are indicated on Figures 4-4A and 4-4B. Ten (10) of the eighteen (18) sediment and surface water sampling locations proposed to be collected in LHAAP 18/24 are shown in Figure 4-7. These samples are to be collected in Harrison Bayou and Saunder's Branch.

It should be noted that only the first line of Geoprobe sampling locations is shown in the figure. These locations are approximate and will be adjusted based on field results. After completion of the Geoprobe sampling, a brief, site-specific sampling plan will be prepared that presents the results of the Geoprobe



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

LHAAP 18 AND 24
BURNING GROUND NO. 3 AND
UNLINED EVAPORATION POND
SAMPLE LOCATIONS

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PROBE BORING (70)
SHALLOW MONITORING WELL (8)
INTERMEDIATE MONITORING WELL (6)
DEEP MONITORING WELL (5)
DEEP STRATIGRAPHIC BORING (5)
SEDIMENT/SURFACE WATER SAMPLE (8)
SURFACE SOIL SAMPLE (25)

-

NOTE:
ADDITIONAL PROBE BORINGS WILL BE LOCATED AS NECESSARY
TO DEFINE ANY GROUNDWATER CONTAMINATION DETECTED IN
THE FIRST LINE OF PROBE BORINGS.

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

LHAAP 18 AND 24
BURNING GROUND NO. 3 AND
UNLINED EVAPORATION POND
GEOPROBE BORINGS AND WELLS

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FIGURE 4-4B

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 18 of 27

sampling and provides recommendations for placement of shallow and deep monitoring wells outside of the perimeter of any identified plume.

Groundwater is anticipated to be encountered at depths of 0-10 ft. In order to detect the presence of any DNAPLs, all wells (shallow, intermediate, or deep) will be placed at the bottom of the water-bearing stratum, such that the bottom 4 to 6 inches of slotted screen is installed below the observed top of the low permeability (clay) confining layer. Such a clay layer must be confirmed to have a minimum thickness of two (2) ft, such that it separates the shallow aquifer from deeper aquifers. Intermediate wells will be installed at locations clustered with a shallow well. Deep stratigraphic borings will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. Deep wells will be installed with screens placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

One groundwater sample will be collected from each Geoprobe boring and analyzed for volatiles. One groundwater sample will be collected from each new well and analyzed for volatiles and metals. Sediment and surface water samples will be analyzed for volatiles and metals. Three (3) surface water samples obtained from Harrison Bayou, and three from Saunder's Branch, will also be analyzed for total

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 19 of 27

hardness. Surface soil samples will be analyzed for metals, and fifteen (15) samples will also be analyzed for volatiles.

Soil samples will be collected for physical analysis from approximately every 5 ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples obtained from borings.

4.5 LHAAP 29: Former TNT Production Area

Site LHAAP 29 was operated in the former TNT Production Area from October 1942 until August 1945. The plant produced over 180 million kilograms of flake TNT from five regular production lines and one standby line. The TNT "red liquor" generated at each of the wash areas and the "yellow liquor" wastewater generated by the production plant was pumped through a 12-in underground wood stave pipeline to the TNT Waste Disposal Plant (LHAAP 32). The TNT production plant was inactive from August 1945 until 1959 when most of its building and above ground storage tanks were removed. There have been only limited activities at the site since World War II.

012045

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 20 of 27

Previous investigations by EPS included the installation of six monitoring wells to sample the groundwater for explosives compounds and VOCs. Results detected 2,4,6-TNT in surface soils, surface water, and sediments.

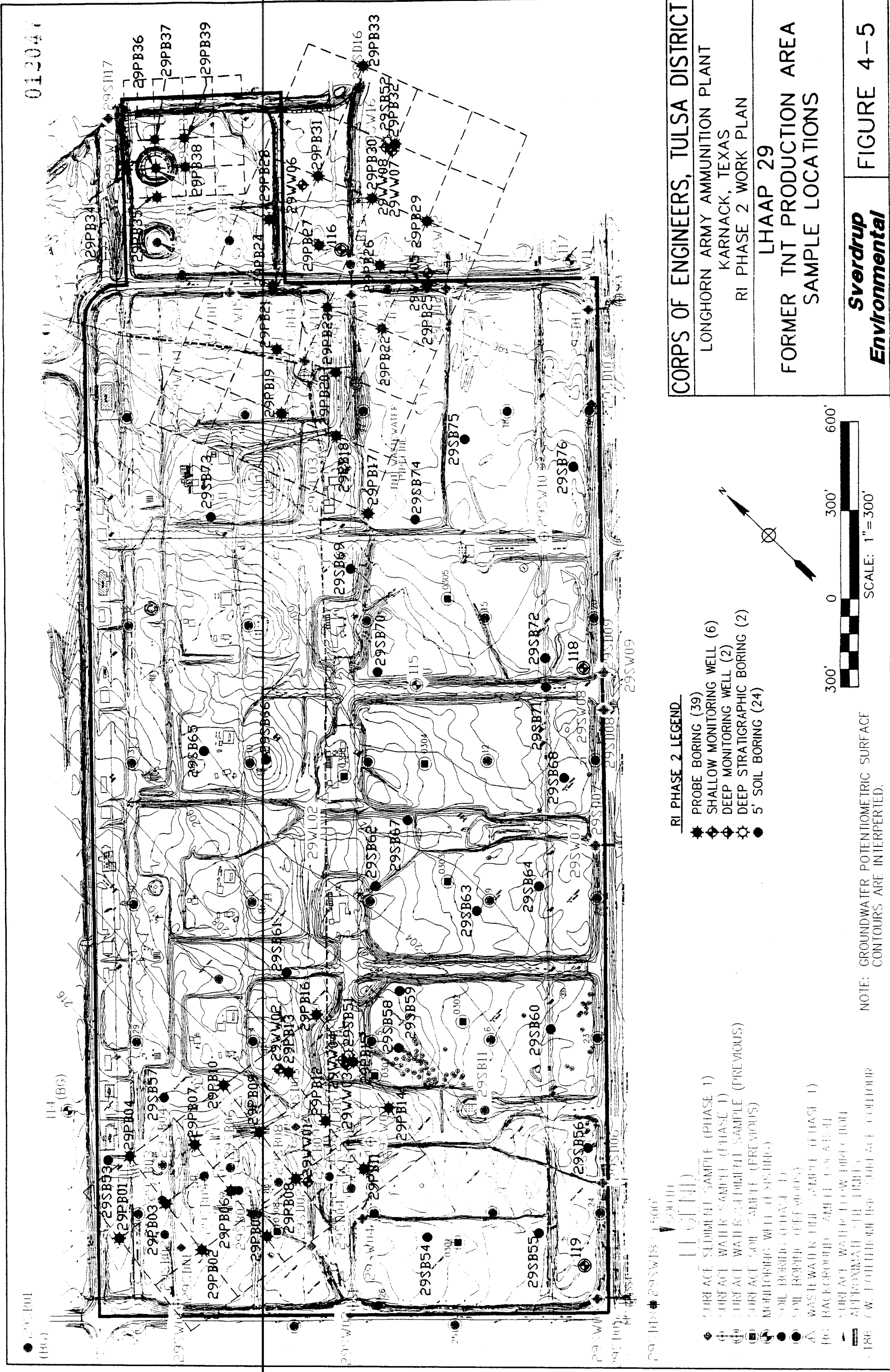
The 1993 Phase 1 Remedial Investigation conducted by Sverdrup detected no contamination with volatile organic or explosives compounds in soil samples taken from the surrounding soil beneath the pipeline. Groundwater sampling of the existing monitoring well network detected contamination with 2,6-dinitrotoluene (2,6-DNT) and 2-nitrotoluene (2-NT) in excess of the SDWA MCLs in Well 116, which is located within 50 ft of the former cooling water ditch and directly downgradient from the central portion of the site. The groundwater sample from Well 118 contained mercury and selenium above the MCL. The groundwater sample from Well 119 contained cadmium above the MCL. Borehole water data indicated potential groundwater contamination with 1,3,5-trinitrobenzene (1,3,5-TNB), 2,4,6-trinitrotoluene (2,4,6-TNT), 2,4-DNT, 2-NT, and 4-NT at LHAAP 29.

To further investigate potential contamination with explosives and metals, the Phase 2 RI includes the following: collection of twenty-four (24) surface (<6 inches) soil samples at random locations - four samples shall be taken at each of the six production line areas; 24 soil samples at a depth of 4-5 feet taken at the same locations as the surface soil samples; confirmation groundwater

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 21 of 27

sampling of three (3) existing monitoring wells (116, 118, and 119); collection of sixteen (16) Geoprobe groundwater samples in the Line A Production Area; drilling and geotechnical sampling of one (1) stratigraphic boring being approximately 200 ft deep in the Line A Production Area; installation of three (3) shallow, downgradient monitoring wells in the shallow aquifer in the Line A Production Area; installation of one (1) monitoring well (>100 feet) in the deeper aquifer in the Line A Production area; collection of seventeen (17) Geoprobe groundwater samples in the cooling water ditch area; drilling and geotechnical sampling of one stratigraphic boring being approximately 200 feet deep in the cooling water ditch area; installation of three (3) downgradient monitoring wells in the shallow aquifer in the cooling water ditch area; installation of one (1) monitoring well (>100 feet) in the deeper aquifer in the cooling water ditch area; and collection of six (6) Geoprobe groundwater samples in the area of the Bulk Toluene Storage Tanks. Proposed sampling locations are included on Figure 4-5. Three (3) additional sediment and surface water sampling locations in Central Creek are shown in Figure 4-7.

After completion of the Geoprobe sampling in each area (Line A Production Area, the cooling water ditch, and the Bulk Toluene Tanks), a brief, area-specific sampling plan will be prepared that presents the results of the Geoprobe sampling and provides recommendations for placement of shallow and deep monitoring wells outside of the perimeter of any identified plume.



LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 23 of 27

Groundwater is anticipated to be encountered at depths of 20-40 ft. In order to detect the presence of any DNAPLs, all wells (shallow, intermediate, or deep) will be placed at the bottom of the water-bearing stratum, such that the bottom 4 to 6 inches of slotted screen is installed below the observed top of the low permeability (clay) confining layer. Deep stratigraphic borings will be drilled to identify the depth to the top of the Midway Formation, which represents the base of fresh groundwater beneath the site. Deep wells will be installed with their screens placed immediately above the top of the Midway Formation. Well screen lengths should not exceed ten (10) ft.

One groundwater sample will be collected from each Geoprobe/Hydropunch boring and new well and analyzed for explosives and metals. Geoprobe/Hydropunch groundwater samples collected from the Bulk Toluene Storage Tanks area will also be analyzed for toluene. Groundwater samples from existing Well 116 will be analyzed for explosives, Well 118 for selenium and mercury, and Well 119 for cadmium. Sediment and surface water samples will be analyzed for explosives and metals. In addition, three (3) surface water samples obtained from Central Creek will be analyzed for total hardness. The twenty-four (24) surface soil samples and soil samples from 4-5 ft depth will be analyzed for explosives and metals.

Soil samples will be collected for physical analysis from approximately every 5

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 24 of 27

ft depth of the deep stratigraphic boring and the new well borings. Physical analyses consist of moisture content, Atterberg limits, and combined washed sieve and hydrometer gradation analysis. Chemical analyses will not be performed on soil samples obtained from borings.

4.6 LHAAP 32: Former TNT Waste Disposal Plant

Site LHAAP 32 was constructed in 1942 to treat and dispose of wastewaters generated at the nearby former TNT Production Area (LHAAP 29). Wastewater resulting from the production of 180 million kilograms of TNT was disposed of through the plant. Because of the large volumes of wastes that were handled, there were probably occasional spills resulting from the overflow of tanks and manual handling of wastes. The plant was not operated after 1945. In 1959, most of the buildings and tanks used in the disposal process were removed and the debris burned at LHAAP 17.

Previous investigations by EPS included sampling of surface soils, surface water, sediment; and the installation of one monitoring well (113). Results indicated that, with the exception of 2,4,6-TNT found in surface water sample No. 3919 at 7.6 $\mu\text{g/l}$, explosives concentrations were below detection limits.

LHAAP Group 2 RI Phase 2 WP
Section: 4
Revision: 3
Date: December 1994
Page: 25 of 27

The 1993 Phase 1 Remedial Investigation conducted by Sverdrup detected no contamination of the pipeline contents and surrounding soils with explosives or volatile organic compounds. Surface water and sediment within the blue water ditch contained elevated lead concentrations. Groundwater sampling in Well 113 contained a lead concentration in excess of the MCL.

To further investigate potential contamination with explosives and metals, the Phase 2 RI includes the following: collection of nine (9) surface water and sediment samples - three (3) locations in Goose Prairie Creek and six (6) locations representing drainage pathways toward Goose Prairie Creek. Proposed sampling locations are included on Figures 4-6 and 4-7. Sediment and surface water samples will be analyzed for explosives and metals. In addition, the three (3) surface water samples obtained from Goose Prairie Creek will be analyzed for total hardness.

LEGEND

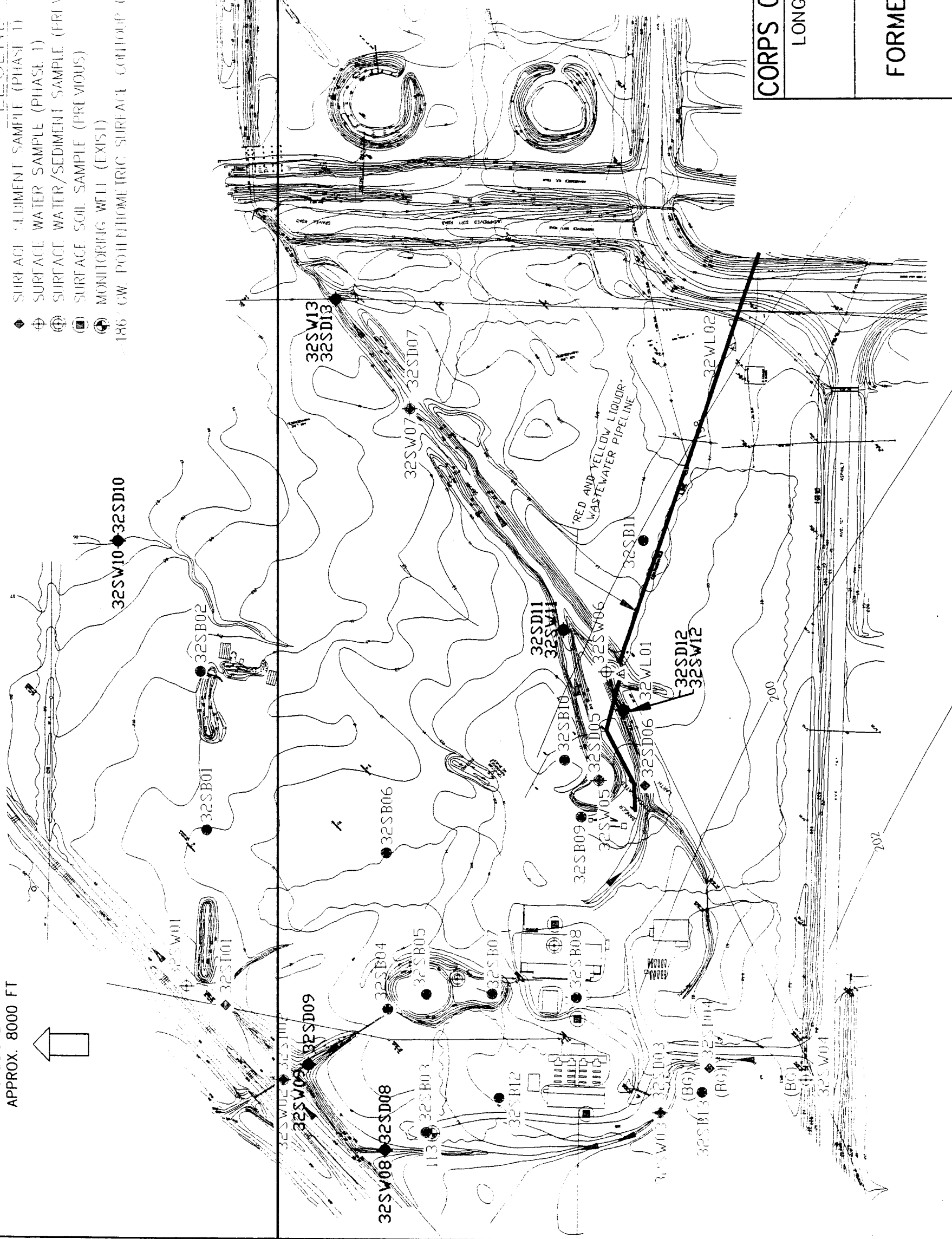
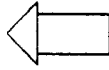
- ◆ SURFACE SEDIMENT SAMPLE (PHASE 1)
- ⊕ SURFACE WATER SAMPLE (PHASE 1)
- ⊕ SURFACE WATER/SEDIMENT SAMPLE (PREVIOUS)
- ⊕ SURFACE SOIL SAMPLE (PREVIOUS)
- ⊕ MONITORING WELL (EXIST)
- 186' CW POTENTIOMETRIC SURFACE CONTOUR (1116-VD)

- SOIL BORING (PHASE 1)
- SOIL BORING (PREVIOUS)
- △ WASTEWATER LINE SAMPLE
- BG BACKGROUND SAMPLE LOCATION

RI PHASE 2 LEGEND

- ◆ SEDIMENT/SURFACE WATER SAMPLE (6)

CADDO LAKE
APPROX. 8000 FT



CORPS OF ENGINEERS, TULSA DISTRICT

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

LHAAP 32
FORMER WASTE DISPOSAL PLANT
SAMPLE LOCATIONS

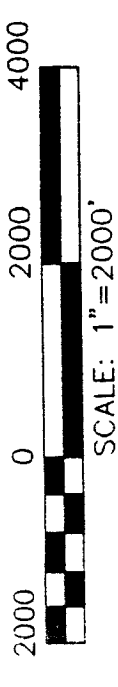
Sverdrup
Environmental

NOTE: GROUNDWATER POTENTIOMETRIC SURFACE
CONTOURS ARE INTERPERTED.

FIGURE 4-6

RI PHASE 2 LEGEND

A horizontal line with an arrowhead pointing to the left. The letter 'N' is placed at the tail of the arrow. A circle with a cross inside is centered on the line.



LONGHORN ARMY AMMUNITION PLANT

KARNACK, TEXAS

GROUP 2 SITES

ADDITIONAL

SAMPLE LOCATIONS

**Sverdrup
Environmental**

FIGURE 4-7



DEPARTMENT OF THE ARMY
LONGHORN LOUISIANA ARMY AMMUNITION PLANTS
MARSHALL TEXAS 75671-1059

012053



December 14, 1994

REPLY TO
ATTENTION OF

SMCLO-EN

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

SUBJECT: Draft Final Soil Background Concentration Report for
Longhorn Army Ammunition Plant in Karnack, Texas

Dear Ms. Price:

Enclosed is one copy of the Draft Final Soil Background
Concentration Report for Longhorn Army Ammunition Plant in Karnack,
Texas.

Please review and send your comments back to us by 16 January
1995.

If you have any questions, please contact Mr. David Tolbert, at
903-679-2728.

Sincerely,

David Tolbert

for Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer

Enclosure

012054



*Texas Natural Resource
Conservation Commission*

Superfund Investigation Section

P.O. Box 13087

Austin, Texas 78711-3087

FACSIMILE COVER PAGE

To: Lisa Price (6H-ET)
Time: 08:03:09
Pages (including cover): 4

From: Michael Moore
Date: 12/19/94

Steve Ligon sent me the attached message regarding the formula that I sent to to last week. I plan to be in this week Monday thru Wednesday. It's usually easier to catch me during the morning; otherwise, leave a message and I'll call you back.

Copies to: David, Amine, Kevin, and Lisa

012053

From: Steve Ligon (SLIGON)
To: WQ:IR:WM1:MAMOORE
Date: Thursday, 15 December 94 1610
Subject: Longhorn AAP - WQ criteria -Reply

There is one correction to the file that you showed me. The variable that is labeled "TDS ambient - 10 mg/l" should refer to Chloride. It's corrected on the attached file.

I'll be out tomorrow, but will check in sometime around mid-morning to check the telephone and push some deadlines. Catch me if you need to!

THANKS

Files: I:\wq\ind\stephen\lhaaplim

012056

This formula may be used for both chlorides and sulfates. For chlorides, use 100 mg/l. For sulfates, use 50 mg/l (see attached page for appropriate criteria data).

$$C_C \geq \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$$

Where:

Q_S = Harmonic Mean = 0.47

C_A = Chloride_(ambient) = 10 mg/l (from State Water Quality Inventory)

Q_E = 0.25 MGD - 0.40 MGD or 0.39 cfs - 0.62 cfs

C_E = X

C_C = 100 mg/l (chlorides) (from State Water Quality Inventory)

012057

Examples:

@250,000 gpd:

$$100 \text{ mg/l} = \frac{(0.47)(10) + (0.39)(X)}{0.39 + 0.47}$$

$$100 \text{ mg/l} = \frac{4.7 + 0.39X}{0.86}$$

$$(0.86) 100 \text{ mg/l} = 4.7 + 0.39X$$

$$86 - 4.7 = 0.39X$$

$$81.3 / 0.39 = X$$

$$208 \text{ mg/l} = X$$

@400,000 gpd:

$$100 \text{ mg/l} = \frac{(0.47)(10) + (0.62)(X)}{0.62 + 0.47}$$

$$104.3 = 0.62X$$

$$168 \text{ mg/l} = X$$

012058



*Texas Natural Resource
Conservation Commission*

Superfund Investigation Section

P.O. Box 13087

Austin, Texas 78711-3087

FACSIMILE COVER PAGE

To: Lisa Price (6H-ET)
Time: 17:18:30
Pages (including cover): 4

From: Michael Moore
Date: 12/15

Here is the formula for calculating discharge limits for chlorides and sulfates based on discharge rates, along with a couple of examples for chlorides using 250,000 gpd and 400,000 gpd. Also included is a copy of the water quality criteria for Caddo Lake. I'll be out of the office until Monday, so call me then if you need to discuss.

I'm sending this to Lisa, David, Kevin, and Amine.

012059

This formula may be used for both chlorides and sulfates. For chlorides, use 100 mg/l. For sulfates, use 50 mg/l (see attached page for appropriate criteria data).

$$C_C \geq \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$$

Where:

Q_S = Harmonic Mean = 0.47

C_A = TDS_(ambient) = 10 mg/l (from State Water Quality Inventory)

Q_E = 0.25 MGD - 0.40 MGD or 0.39 cfs - 0.62 cfs

C_E = X

C_C = 100 mg/l (chlorides) (from State Water Quality Inventory)

012060

Examples:

0250,000 gpd:

$$100 \text{ mg/l} = \frac{(0.47)(10) + (0.39)(X)}{0.39 + 0.47}$$

$$100 \text{ mg/l} = \frac{4.7 + 0.39X}{0.86}$$

$$(0.86) 100 \text{ mg/l} = 4.7 + 0.39X$$

$$86 - 4.7 = 0.39X$$

$$81.3 / 0.39 = X$$

$$208 \text{ mg/l} = X$$

0400,000 gpd:

$$100 \text{ mg/l} = \frac{(0.47)(10) + (0.62)(X)}{0.62 + 0.47}$$

$$104.3 = 0.62X$$

$$168 \text{ mg/l} = X$$

12/15/94 18:07 512 9 4444

TNRCC-Watershed

002

Segment 0401 of the Cypress Creek Basin

012061

NAME: Caddo Lake

DESCRIPTION: from the Louisiana State Line in Harrison/Marion County to a point 12.3 kilometers (7.6 miles) downstream of SH 43 in Harrison/Marion County, up to the normal pool elevation of 168.5 feet (impounds Big Cypress Creek)

SEGMENT CLASSIFICATION: Water Quality Limited

LENGTH: 12 miles (19 kilometers)

SURFACE AREA: 26,810 acres

DESIGNATED WATER USES: Contact Recreation
High Quality Aquatic Habitat
Public Water Supply

MONITORING STATIONS: 0401.0100

INTENSIVE SURVEYS: 20 Feb 1975 Q,F,C,S,P,B,A IMS-50 (Kirkpatrick: Apr 1977)

PERMITTED FACILITIES (FINAL):

Domestic	2 outfalls	0.25 MGD
Industrial	4 outfalls	0.54 MGD
Total	6 outfalls	0.79 MGD

SEGMENT SUMMARY:

There are no significant water quality problems in the segment.

WATER QUALITY STATUS: THE FOLLOWING TABLE ILLUSTRATES THE LAST FOUR YEARS (SEPT. 1, 1987 THRU AUG. 31, 1991) OF WATER QUALITY INFORMATION FOR SEGMENT 0401.

PARAMETER	CRITERIA	NUMBER SAMPLES	MINIMUM	MAXIMUM	MEAN	NUMBER OF VALUES OUTSIDE CRITERIA.	MEAN VALUES OUTSIDE CRITERIA
DISSOLVED OXYGEN (MG/L)	5.0	11	3.9	9.6	7.3	1	3.9
TEMPERATURE (F)	90.0	11	57.4	90.2	77.9	1	90.2
PH	6.0-8.5	11	5.8	8.2	7.1	1	5.8
CHLORIDE (MG/L)	100	7	4	19	10	0	0
SULFATE (MG/L)	50	7	8	17	10	0	0
TOTAL DISSOLVED SOLIDS (MG/L)	300	12	35	94	73	0	0
FECAL COLIFORMS (#/100 ML)	200	9	1	15	3	0	0

TOTAL DISSOLVED SOLIDS WERE ESTIMATED BY MULTIPLYING SPECIFIC CONDUCTANCE BY .50



DEPARTMENT OF THE ARMY
LONGHORN/LOUISIANA ARMY AMMUNITION PLANTS
MARSHALL TEXAS 75871-1069

012062



REPLY TO
ATTENTION OF

December 19, 1994

SMCLO-EN

Ms. Lisa Price
Superfund Enforcement
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

SUBJECT: Revised Proposed Plan for the Interim Action at Sites
12 and 16 (Landfills) for Longhorn Army Ammunition Plant in
Karnack, Texas

Dear Ms. Price:

The subject document was forwarded to you under separate
cover on December 16, 1994. Initial comments from the U.S.
Environmental Protection Agency and the Army Environmental Center
have been incorporated into the text. Cost data for the
additional remedial alternatives is being developed.

Please refer any questions to the Longhorn Installation
Restoration Program Manager, Mr. David Tolbert, at 903-679-2728.

Sincerely,

Lawrence J. Sowa
Lieutenant Colonel, U.S. Army
Commanding Officer