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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 123

Operable Unit 1
Field Sampling Plan

for

Defense Distribution Depot Memphis

September 1995

Prepared for

U.S. Army Corps of Engineers
Huntsville Division

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Operable Unit 1
Field Sampling Plan
Executive Summary

Introduction

In October 1992, the Defense Depot Memphis, Tennessee was placed on the National Priorities List by the U.S. Environmental Protection Agency. Therefore, Defense Depot Memphis, Tennessee must fulfill requirements under the Comprehensive Environmental Response, Compensation, and Liability Act and National Oil and Hazardous Substance Contingency Plan. A Remedial Investigation/Feasibility Study will be conducted to evaluate the nature and extent of contamination, to evaluate the risk to human health and the environment, and to screen potential cleanup actions. The *Generic Remedial Investigation/Feasibility Study Work Plan* was prepared to show how the investigation and study will be accomplished. This field sampling plan was prepared for Operable Unit 1 as a supplement to the *Generic Remedial Investigation/Feasibility Study Work Plan*. The objective of this *Operable Unit 1 Field Sampling Plan* is to present a detailed description of the proposed sampling and analysis activities that will be performed for characterization of the remedial investigation sites in Operable Unit 1 at Defense Depot Memphis, Tennessee.

The ultimate goal of the Remedial Investigation/Feasibility Study is to select cost-effective cleanup actions that provide protection of public health and the environment. To accomplish this goal, the nature and extent of the release of hazardous substances must be identified, the source of release must be determined, and proposed cleanup actions must be evaluated. By implementing the field investigation strategies described in the Field Sampling Plans, the quantity and quality of data collected will aid in achieving the goal of the Remedial Investigation/Feasibility Study at Defense Depot Memphis, Tennessee.

Site Background and Location

Defense Depot Memphis, Tennessee receives, warehouses, and distributes supplies common to all U.S. military services and some civil agencies, located primarily in the southeastern United States, Puerto Rico, and Panama. The installation covers 642 acres of land in Memphis, Shelby County, Tennessee, in the extreme southwestern portion of the state. The installation contains approximately 110 buildings, 26 miles of railroad track, and 28 miles of paved streets. Approximately 5.5 million square feet of storage space is open. Stored items include food, clothing, electronic equipment, petroleum products, construction materials, and industrial, medical, and general supplies used by all military branches of the U.S. government.

Description of Operable Units

Defense Depot Memphis, Tennessee is divided into four operable units for evaluation purposes. Operable Unit 1, north of the Main Installation, is called Dunn Field. The Main Installation is divided into three areas: the southwestern quadrant, Operable Unit 2; the southeastern quadrant including Lake Danielson and the golf course area, Operable Unit 3; and the north-central area, Operable Unit 4. Sites identified in Operable Unit 1 for investigation resulted from use of the area for landfill operations, mineral stockpiles, pistol range use, and materials storage. Potential contamination of Operable Unit 2 may have resulted from spills or releases from the hazardous material storage and repouring area, sandblasting and painting activities, or both. Storage of polychlorinated biphenyls and the use of pesticides and herbicides are potential sources of contamination for Operable Unit 3. Principal contamination in Operable Unit 4 probably resulted from a wood treatment operation and hazardous material storage.

Soil samples taken in Operable Unit 1 near a pesticide storage area during previous investigations indicated the presence of pesticides. Other samples from Operable Unit 1 yielding positive results for the presence of contaminants include the open burning area, which had evidence of petroleum products and chlorinated solvents; a sample collected in the south-central portion of Operable Unit 1, which had volatile organic compounds, pesticides, and metals; and the bauxite storage area, which exhibited solvents and pesticides.

Groundwater analyses in the Fluvial Aquifer reveal contaminant migration beyond Dunn Field's boundaries. Contaminants of concern are chromium, lead, mercury, arsenic, barium, and solvents. A groundwater interim remedial action is being implemented to address the groundwater contamination.

Summary of Field Sampling Plan

This Field Sampling Plan describes the Defense Depot Memphis, Tennessee facility and individual operable unit history and data gaps, locations, geography, surface water hydrology, geology, hydrogeology, land use, and Operable Unit 1 data needs. Additionally, this Field Sampling Plan describes the sampling strategy and sampling plan for the remedial investigation sites at Operable Unit 1. The final section of the plan describes the data needs required to propose remedial alternatives for Operable Unit 1. The purpose of this effort is to characterize potential releases from the site, to delineate the nature and extent of soil and groundwater contamination attributable to past operations, and to gather data to evaluate the feasibility of remedial actions for this site.

Sampling Strategy

A cost-effective, quality sampling strategy has been developed to perform an Remedial Investigation/Feasibility Study at Defense Depot Memphis, Tennessee. This Field Sampling Plan uses an observational approach to field data collection and making field-based decisions to achieve the goals of the facility. The approach presented is intended to support a recommendation of one of the following options for each remedial investigation site:

- Site upgrade (FS, Remedial Design, and Remedial Action)
- Site downgrade (support No Further Action)
- Interim Remedial Action (IRA) or Early Removal

To support recommendations in a timely manner, soil and water samples will be collected at Operable Unit 1 and analyzed using Level 2 methods in a fixed-based laboratory.

Ten percent of the Level 2 samples will be sent to an offsite laboratory for Level 3 confirmational analysis. On the basis of Level 2 and Level 3 data, a comparison of regulatory levels and calculated risk levels of contamination will aid in supporting the appropriate recommendation.

Proposed Sampling

The *Operable Unit 1 Field Sampling Plan* describes remedial investigation sites that have been identified on the basis of their potential for contamination as a result of past practices. Surface and subsurface soil samples have been proposed for each site. Soil borings will be installed surrounding and within the proposed site locations. Soil samples will be collected at regular intervals from each boring to assess the vertical extent of contamination. Surface and subsurface soil samples will be collected and analyzed to assess the possibility of existing soil contamination.

Four data quality levels are used at the facility. Level 1 data are gross data for field screening purposes, such as pH, temperature, and organic vapor analyzers and readings. Level 2 and Level 3 data are used for making field decisions, describing the nature and extent of contamination, and for risk assessment. The differentiating criteria (between Level 2 and 3) are the amount of laboratory documentation required and cost. Level 4 data are used primarily for legal arbitration, and the cost for developing these data is excessive. Therefore, Level 4 is not currently proposed. A more complete discussion of data quality levels is presented in Section 8.0 of the *Quality Assurance Project Plan*.

If Level 2 soil boring data indicate that a release of contaminants has potentially occurred to groundwater, monitoring well(s) may be installed adjacent to site(s). The decision to install wells will be made on a site-by-site basis. The decision to install monitoring well(s) will be made after Level 2 soil boring data have been discussed with Defense Depot Memphis, Tennessee personnel and remedial options have been considered.

By implementing the *Operable Unit 1 Field Sampling Plan*, the Remedial Investigation/Feasibility Study can be conducted in a cost-effective, timely manner. Additionally, data will be obtained that will aid in supporting an evaluation of remedial alternatives for cleanup of Operable Unit 1 at Defense Depot Memphis, Tennessee.

Chemical Warfare

Historical disposal of chemical warfare material (CWM) has occurred in the western portion of Dunn Field. Because there is a potential that CWMs may be encountered during intrusive investigations at the western portion of Dunn Field, DDMT has requested assistance from the U.S. Army Corps of Engineers—Huntsville Division, Ordnance and Explosives Division, to prepare a site safety submission. This document is being prepared so that the investigation in the Dunn Field area will be performed safely and with appropriate engineering controls to protect onsite workers and nearby residents. Investigation activities presented in this Field Sampling Plan will not be performed until the site safety submission is approved by the Department of Health and Human Services.

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Acronyms

AOC	Area of concern
ARAR	Applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
bls	Below land surface
BRA	Baseline risk assessment
BRAC	Base Realignment and Closure
CAIS	Chemical agent identification set
CEHND	U.S. Army Corps of Engineers—Huntsville Division
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CL	Low plasticity clay
COC	Contaminant of concern
COE	U.S. Army Corps of Engineers
CWA	Chemical warfare agent
CWM	Chemical warfare materials
CWMP	*Chemical Warfare Management Plan*
DANC	Decontamination agent—non-corrosive
DDD	Dichlorodiphenyldichloroethane
DDE	1,1,1-Dichloro-2,2-bis(4-chlorophenyl)ethylene
DDMT	Defense Depot Memphis, Tennessee
DDT	Dichlorodiphenyltrichloroethane
DHHS	Department of Health and Human Services
DLA	Defense Logistics Agency
DOD	Department of Defense
DOI	Department of Interior
DQO	Data quality objective
DRMO	Defense Reutilization and Marketing Office
EPA	U.S. Environmental Protection Agency
ER	Early removal
ESE	Environmental Science & Engineering, Inc.
FBL	Fixed-based laboratory
FFA	Federal Facilities Agreement
FR	*Federal Register*
FRL	Final remediation level
FS	Feasibility study
FSP	Field Sampling Plan
ft^2/min	Feet squared per minute
FTL	Field team leader
GC	Gas chromatograph
gpm/ft	Gallons per minute per foot
HASP	*Health and Safety Plan*

HRS	Hazardous ranking system
HQ/HI	Hazard quotient/hazard index
HTW	Hazardous and toxic waste
ID	Inside diameter
IRA	Interim remedial action
μg/L	Micrograms per liter
ML	Low plasticity silt
mL	Milliliter
MS/MSD	Matrix spike/matrix spike duplicate
MW	Monitoring well
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No further action
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
OE	CEHND Ordnance and Explosives Division
OU	Operable unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCOC	Potential contaminants of concern
PCP	Pentachlorophenol
PID	Photoionization detector
PM	Project manager
PPM	Priority pollutant metals
PRG	Preliminary remediation goal
PVC	Polyvinyl chloride
QAPP	*Quality Assurance Project Plan*
QA/QC	Quality assurance/quality control
RA	Remedial Action
RAGS	*Risk Assessment Guidance for Superfund*
RAL	Removal action level
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA facility assessment
RFI	RCRA facility investigation
RGO	Remedial goal option
RI	Remedial investigation
RI/FS WP	*Generic RI/FS Work Plan*
ROD	Record of decision
SMP	*Site Management Plan*
SOW	Statement of work
STB	Stratigraphic test boring
SVOC	Semivolatile organic compound

Acronyms (cont'd.)

TCL/TAL	Target compound list/target analyte list
TCLP	Toxicity characteristic leachate procedure
TDEC	Tennessee Department of Environment and Conservation
TEU	U.S. Army Technical Escort Unit
THI	Target hazard index
TOC	Total organic compound
TRL	Target risk level
UCL	Upper confidence limit
USACDRA	U.S. Army Chemical Demilitarization Activity
USAEHA	U.S. Army Environmental Hygiene Agency
USGS	United States Geological Survey
VOC	Volatile organic compound

TAB

Section 1 - Introduction

1.0 Introduction

1.1 Objective

The objective of this Field Sampling Plan (FSP) for Operable Unit (OU) 1 is to present a detailed description of the proposed sampling and analysis activities that will be performed for characterization of the remedial investigation (RI) sites in OU-1 at the Defense Depot Memphis, Tennessee (DDMT). Dunn Field, the area north of the Main Installation, has been designated by the U.S. Environmental Protection Agency (EPA) and DDMT as OU-1.

The purpose of this effort is to characterize potential releases from the site, to evaluate the nature and extent of soil and groundwater contamination attributable to past operations, and to gather data to evaluate the feasibility of remedial actions for this site.

Once the site has been characterized, the data collected will be evaluated and used to make decisions concerning this OU. Possible decisions include downgrading the site to a no further action (NFA) site, recommending the site for early removal (ER), or selecting a remedial alternative to address contamination at the site.

1.2 Regulatory Requirements

DDMT was issued a Resource Conservation and Recovery Act (RCRA) Part B permit (No. TN4 210 020 570) by the EPA, Region IV, and the Tennessee Department of Environment and Conservation (TDEC) on September 28, 1990. Subsequently, and in accordance with Section 120(d)(2) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9620(d)(2), EPA prepared a final Hazard Ranking System (HRS) Scoring Package for DDMT. On the basis of the final HRS score of 58.06, EPA added DDMT to the National Priorities List (NPL) by publication in the *Federal Register*, 57FR47180 No. 199, on October 14, 1992. The RI investigation presented herein, and future investigations, are intended to satisfy the requirements of CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the RCRA Part B permit.

DDMT has entered into a Federal Facilities Agreement (FFA) between the Defense Logistics Agency (DLA), EPA, and TDEC. This agreement establishes a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at DDMT in accordance with existing regulations and for achieving RCRA/CERCLA integration. As a result of DDMT's status as an NPL site, it was agreed that the investigation of all applicable sites would proceed under the CERCLA process for remediation (remedial investigation, feasibility study (FS), proposed plan, record of decision (ROD), remedial design, remedial action, or NFA).

As established in the NCP (40 *Code of Federal Regulations* [CFR] Part 300.120), the Department of Defense (DOD) is the lead agency at NPL sites involving federal facilities. Accordingly, EPA and TDEC have been identified as regulatory enforcement agencies in this process.

1.3 Facility and Site Status

As a result of the NPL status, the required site-specific investigations, and the FFA, DDMT has been geographically delineated into four OUs. OU-specific FSPs are being prepared for OUs-1, 2, 3, and 4. These OU-specific FSPs will provide guidelines for conducting the RI/FSs for each of the OUs. The OU-specific plans will address sites that have been known to have past releases as a result of facility operations. Schedules for completing specific tasks during the process have been submitted separately in the *Site Management Plan* (SMP).

DDMT is conducting RI/FS activities at OU-1 in conformance with the requirements of CERCLA and the FFA. In addition, elements of DDMT's RCRA permit dictate that DDMT undertake a study to confirm the absence or presence of contamination at locations where hazardous or toxic wastes were managed or disposed. This FSP addresses the sites within OU-1 that have been previously identified as requiring an RI. The remainder of the identified sites within OU-1 are proposed for one of the following four status categories:

- Screening site
- Chemical warfare site (to be investigated separately)
- NFA site
- ER site

Activities related to these sites will be addressed in the *Screening Sites FSP*, *NFA Report*, *Chemical Warfare Management Plan* (CWMP), *ER Memorandum*, or other future work plans. Each of these documents will be submitted to TDEC and EPA for review. Table 1-1 presents a summary of the sites at OU-1.

1.4 Elements of the Field Sampling Plan

This FSP is written as a supplement to the generic (facilitywide) work plans for DDMT. Information not included in this plan can be found in the generic work plans. These work plans were provided as separate documents and are listed below:

- *Generic RI/FS Work Plan (RI/FS WP)*
- *Generic Quality Assurance Project Plan (QAPP)*
- *Generic Health and Safety Plan (HASP)*

Table 1-1
OU-1 (Dunn Field)
Site Status (February 21, 1995)
Defense Depot Memphis, Tennessee

Site Number	Description	SWMU Number	LAW Number	RFA Status	Current Status
1	Mustard and Lewisite Training Sets (6) Burial Site (1955)	1	1	PRFI	CWMP
9	Ashes and Metal Burial Site (burning pit refuse) (1955)	9	10	PRFI	CWMP
24	Former Burn Site (1946)	24	31	PRFI	CWMP
86	Food Supplies (Dunn Field)	-	29	-	CWMP
2	Ammonia Hydroxide (7 lbs) and Acetic Acid (1 gal.) Burial (1955)	2	2	PRFI	ER
3	Mixed Chemical Burial Site (orthotoluidine dihydrochloride, 1955)	3	3	PRFI	ER
4	POL Burial Site (13, 55-gal. drums of oil, grease, and paint: date unknown)	4	4	PRFI	ER
4.1	POL Burial Site (32, 55-gal. drums of oil, grease, and thinner, 1955)	-	5	PRFI	ER
5	Methyl Bromide Burial Site A (3 cubic feet) (1955)	5	6	PRFI	ER
7	Nitric Acid Burial Site (1,700 bottles) (1954)	7	8	PRFI	ER

RFA - RCRA Facility Assessment
NFA - No Further Action
PA/SI - Preliminary Assessment/Site Investigation
PRFI - Preliminary RCRA Facility Investigation
RFI - RCRA Facility Investigation
Screening - Screening Sites Field Sampling Plan
ER - Early Removal Site
RI - Remedial Investigation Site
SWMU - Solid Waste Management Unit
CWMP - Chemical Warfare Management Plan

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Table 1-1
OU-1 (Dunn Field)
Site Status (February 21, 1995)
Defense Depot Memphis, Tennessee

Site Number	Description	SWMU Number	LAW Number	RFA Status	Current Status
8	Methyl Bromide Burial site B (3,768 - 1-gal. cans) (1954)	8	9	PRFI	ER
11	Trichloroacetic Acid Burial Site (1,433 - 1-oz bottles) (1965)	11	11	PRFI	ER
12 and 12.1	Sulfuric and Hydrochloric Acid Burial unknown quantity (1967)	12	12	PRFI	ER
13	Mixed Chemical Burial (Acid, 900 lbs., Deter., 7,000 lbs., AL2S04, and 200 lbs. Na)	13	13	PRFI	ER
16	Unknown Acid Burial Site (1969)	16	16	PRFI	ER
16.1	Acid, date unknown	-	18	PRFI	ER
17	Mixed Chemical Burial Site C (1969)	17	17	PRFI	ER
60	Pistol Range Impact Area/Bullet Shop	-	24	-	ER
62	Bauxite Storage (Eastern Half Quadrant of Dunn Field)	-	27	-	ER
85	Old Pistol Range Bldg. 1184/Temporary Pesticide Storage	-	25	-	ER

RFA - RCRA Facility Assessment
NFA - No Further Action
PA/SI - Preliminary Assessment/Site Investigation
PRFI - Preliminary RCRA Facility Investigation
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Screening - Screening Sites Field Sampling Plan
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SWMU - Solid Waste Management Unit
CWMP - Chemical Warfare Management Plan

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Table 1-1
OU-1 (Dunn Field)
Site Status (February 21, 1995)
Defense Depot Memphis, Tennessee

Site Number	Description	SWMU Number	LAW Number	RFA Status	Current Status
18	Plane Crash Residue (Dunn Field)	18	-	NFA	NFA
22	Hardware Burial Site (Nuts and Bolts) (Dunn Field)	22	19	NFA	NFA
23	Construction Debris and Food Burial Site (Dunn Field)	23	30	NFA	NFA
63	Fluorspar Storage (Southeastern Quadrant of Dunn Field)	-	28	-	NFA
6	40,037 units ointment (eye) Burial Site (1955)	6	7	PRFI	RI
10	Solid Waste Burial Site (near MW-10) (metal, glass, trash, etc.)	10	74	PRFI	RI
14	Municipal Waste Burial Site B (near MW-12) (food, paper products)	14	75	PRFI	RI
15	Sodium Burial Sites (1968)	15	14	PRFI	RI
15.1	Sodium Phosphate Burial (1968)	-	15	PRFI	RI
15.2	14 Burial Pits: Na2PO4, Na, Acid, Medical Supplies, and Chlorinated Lime	-	33	PRFI	RI

RFA - RCRA Facility Assessment
NFA - No Further Action
PA/SI - Preliminary Assessment/Site Investigation
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Screening - Screening Sites Field Sampling Plan
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SWMU - Solid Waste Management Unit
CWMP - Chemical Warfare Management Plan

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Table 1-1
OU-1 (Dunn Field)
Site Status (February 21, 1995)
Defense Depot Memphis, Tennessee

Site Number	Description	SWMU Number	LAW Number	RFA Status	Current Status
19	Former Tear Gas Canister Burn Site (Dunn Field)	19	21	PRFI	Screening
20	Probable Asphalt Burial Site (Dunn Field)	20	20	PRFI	Screening
21	XXCC-3 Burial Site (Dunn Field)	21	22	PRFI	Screening
50	Dunn Field Northeastern Quadrant Drainage Ditch	AOC-A	23	PRFI	Screening
61	Buried Drain Pipe (Northwestern Quadrant of Dunn Field)	-	26	-	Screening
64	Bauxite Storage (Southwestern Quadrant of Dunn Field) (1942 through 1972)	-	32	-	Screening

RFA - RCRA Facility Assessment
NFA - No Further Action
PA/SI - Preliminary Assessment/Site Investigation
PRFI - Preliminary RCRA Facility Investigation
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Screening - Screening Sites Field Sampling Plan
ER - Early Removal Site
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CWMP - Chemical Warfare Management Plan

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The FSP characterizes DDMT by providing information about the facility location, topography, meteorology, surface and subsurface hydrology, geology, surrounding and site-specific land use, history, and data gaps within each site. The sampling strategy in Sections 3.0 through 3.4 illustrates the structure of the investigation, the objectives of data quality, preliminary remediation goals (PRGs), and the applicable or relevant and appropriate requirements (ARARs). The FSP will provide site-by-site information concerning the rationale behind sampling locations and methods. The FSP also will provide information about the Fluvial Aquifer (if necessary) and will describe preliminary remedial alternatives. The *QAPP* (ref. 15) will present methods for providing quality assurance to the proposed RI activities at OU-1 by documenting the procedures for well installation; development and sampling; soil, sediment and surface water sampling methods; analytical methods; abandonment methods for borings and wells; type of sampling equipment; and handling of equipment. Numbers of quality assurance/ quality control (QA/QC) samples and types are presented in Section 3.

1.5 Chemical Warfare Materials Investigation Requirements

Chemical warfare materials (CWM) have historically been disposed at the facility. There are four documented locations at Dunn Field where CWM have been disposed. The list of documented CWM sites of concern at Dunn Field is as follows:

- Mustard bomb decommissioning site (Site 24)
- Ashes and metals burial site (Site 9)
- Chemical Agent Identification Sets (CAISs) burial site (Site 1)
- Food burial site (reported to contain CAISs, Site 86)

As a result of the known CWM disposal at Dunn Field, the potential of encountering CWM in unknown locations, and the proximity to residences in the Dunn Field area, DDMT has requested assistance from agencies responsible for CWM activities. Three agencies are responsible for CWM investigation and disposition: the U.S. Army Corps of Engineers–Huntsville Division (CEHND), United States Army Chemical Demilitarization Activity (USACDRA), and the U.S. Army Technical Escort Unit (TEU).

The CEHND Ordnance and Explosives Division (OE) is responsible for conducting CWM investigations within the context of government requirements and safety requirements. In particular, the CEHND-OE is responsible during investigation and excavation of CWM sites. USACDRA is responsible for providing guidance on Interim Holding Plans and Transportation and Disposal Plans for CWM materials. The TEU is responsible for CWM assessment investigations, field CWM analytical procedures, packaging and transportation, and technical advice to CEHND.

These three agencies and DDMT have developed a strategy to evaluate the presence of CWM at the facility and to investigate sites at the facility where the potential for CWM exists. The strategy selected to accommodate both the CWM and the hazardous and toxic waste (HTW) components of the project includes a three-phased approach. All three phases are proposed to begin simultaneously as a result of schedule efficiency and the need for ultimate removal of the CWM sites as a result of the facility's Base Realignment and Closure (BRAC) status. These three phases are discussed below.

1. Conduct an initial investigation focused on the known CWM sites at the facility. The purpose of the investigation is to evaluate the presence of and to delineate the nature and extent of potential CWM contamination at Dunn Field. These activities will be conducted by CEHND-OE.

2. Prepare a Site Safety Submission for review by the Department of Health and Human Services (DHHS). The CEHND-OE Division will prepare the Site Safety Submission.

3. Conduct necessary CWM removal actions based on the results of the field investigations. Field monitoring and screening will be performed during the field activities and appropriate control measures will be implemented to minimize the occurrence of releases of CWM.

A key component to the removal actions will include field monitoring using quick turnaround methods for identifying contaminated media. These field activities will also be used during the HTW investigation to confirm that CWM are not present during the investigation at other non-CWM sites. Additionally, these monitoring activities will provide real-time results to monitor the health and safety of the workers and the nearby residences.

As a result of the known potential for encountering CWM during the intrusive sampling at Dunn Field, a strategy will be developed to investigate Dunn Field sites in a safe and effective manner. However, this SSFSP does not include all of the necessary components to conduct investigations in the potentially contaminated Dunn Field area (western half).

Before conducting any intrusive investigation in the western half of Dunn Field, the initial investigation must be completed by CEHND-OE, the Site Safety Submission must be approved, and the monitoring and analytical requirements for CWM monitoring must be provided. Investigations in the western half of Dunn Field are delayed until these tasks are completed. Investigations in the western half of Dunn Field will be performed using the monitoring and control procedures identified in the CWM Site Safety Submission.

TAB

Section2 - Facility and Operable Units Description

2.0 Facility and Operable Unit Description

2.1 Location

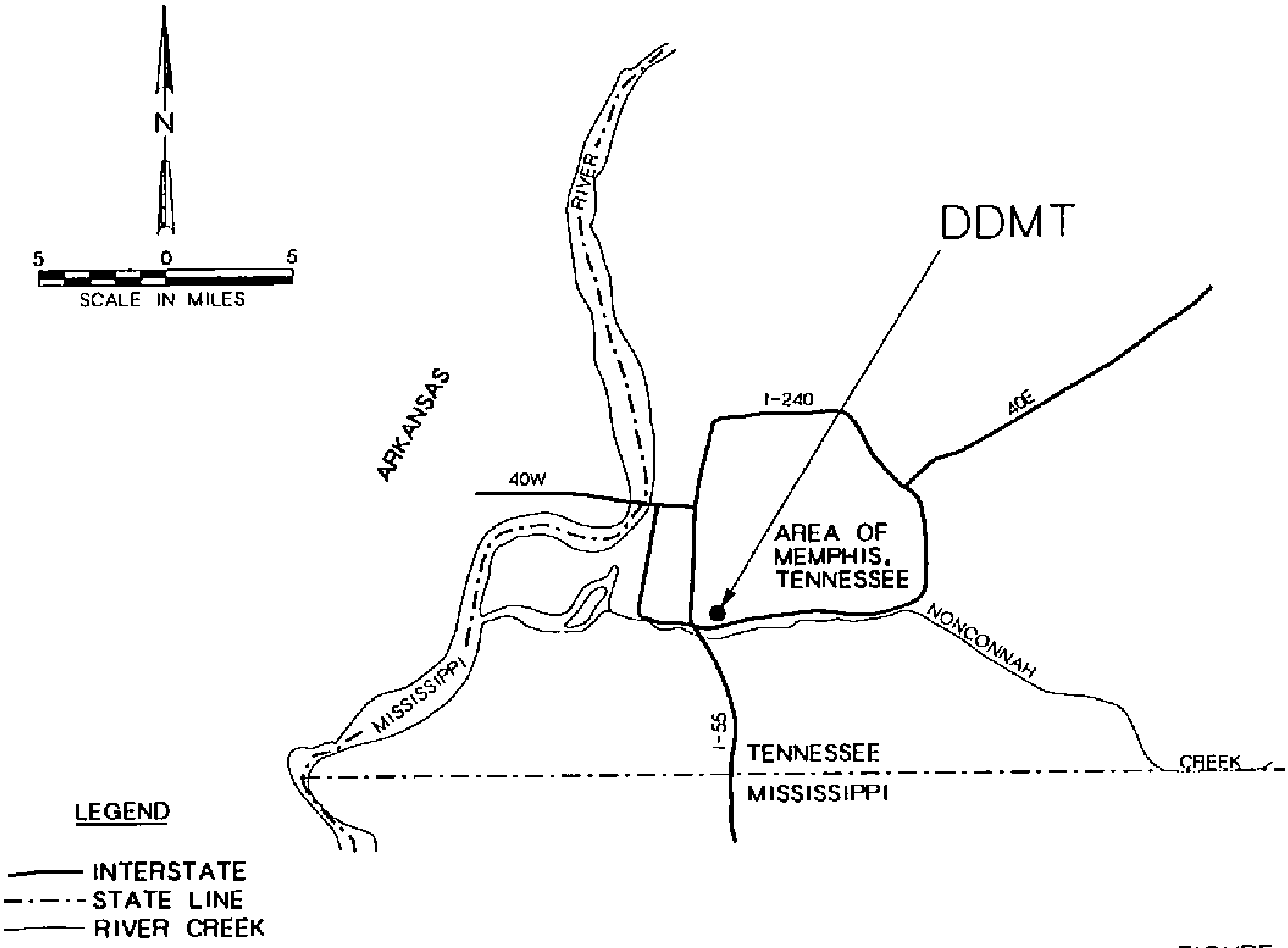
DDMT covers 642 acres of land in Memphis, Shelby County, Tennessee, in the extreme southwestern portion of the state. Approximately 5 miles east of the Mississippi River and just northeast of the Interstate 240—Interstate 55 junction, DDMT is in the south-central section of Memphis, approximately 4 miles southeast of the Central Business District and 1 mile northwest of Memphis International Airport. Airways Boulevard borders DDMT on the east and provides primary access to the installation. Dunn Avenue, Ball Road, and Perry Road serve as the northern, southern, and western boundaries, respectively. Figure 2-1 shows the installation's location within the Memphis area.

OU-1 is located north of the Main Installation and is separated from the installation by Dunn Road. It is bounded by the Illinois Central Gulf Railroad and Person Avenue to the north, Hays Road to the east, and Dunn Avenue to the south, and is partially bounded by Kyle Street to the west. The location of OU-1 is shown in relation to the entire DDMT facility and other proposed OUs in Figure 2-2.

2.2 Operable Unit Description

OU-1 is geographically separated from the Main Installation and contains the only known and documented burial area on DDMT. OU-1 includes 6 RI/FS sites, 17 ER sites, 6 screening sites, 4 CWMP sites, and 4 proposed NFA sites. OU-1 was used intermittently for burial of wastes. Disposal records and interviews with facility personnel indicate specific instances when burial of material occurred. The earliest records of burial date back to 1946. The most recent burial occurred in September 1984. Table 1-1 presents the current disposition of each site, as well as a short description including the nature of items buried at the seven burial sites. The following RI sites are addressed in this FSP:

- Site 6, burial site of 40,037 units of eye ointment
- Site 10, which was discovered during the installation of MW-10, *RI Report* (ref. 5), and consists of buried glass, metal, and trash
- Site 14, municipal waste burial site
- Sites 15, 15.1, and 15.2, burial sites of sodium, sodium phosphate, and chlorinated lime



Source: Engineering-Science, 1983

FIGURE 2-1
DDMT LOCATION IN MEMPHIS METROPOLITAN AREA
Defense Depot Memphis, Tennessee

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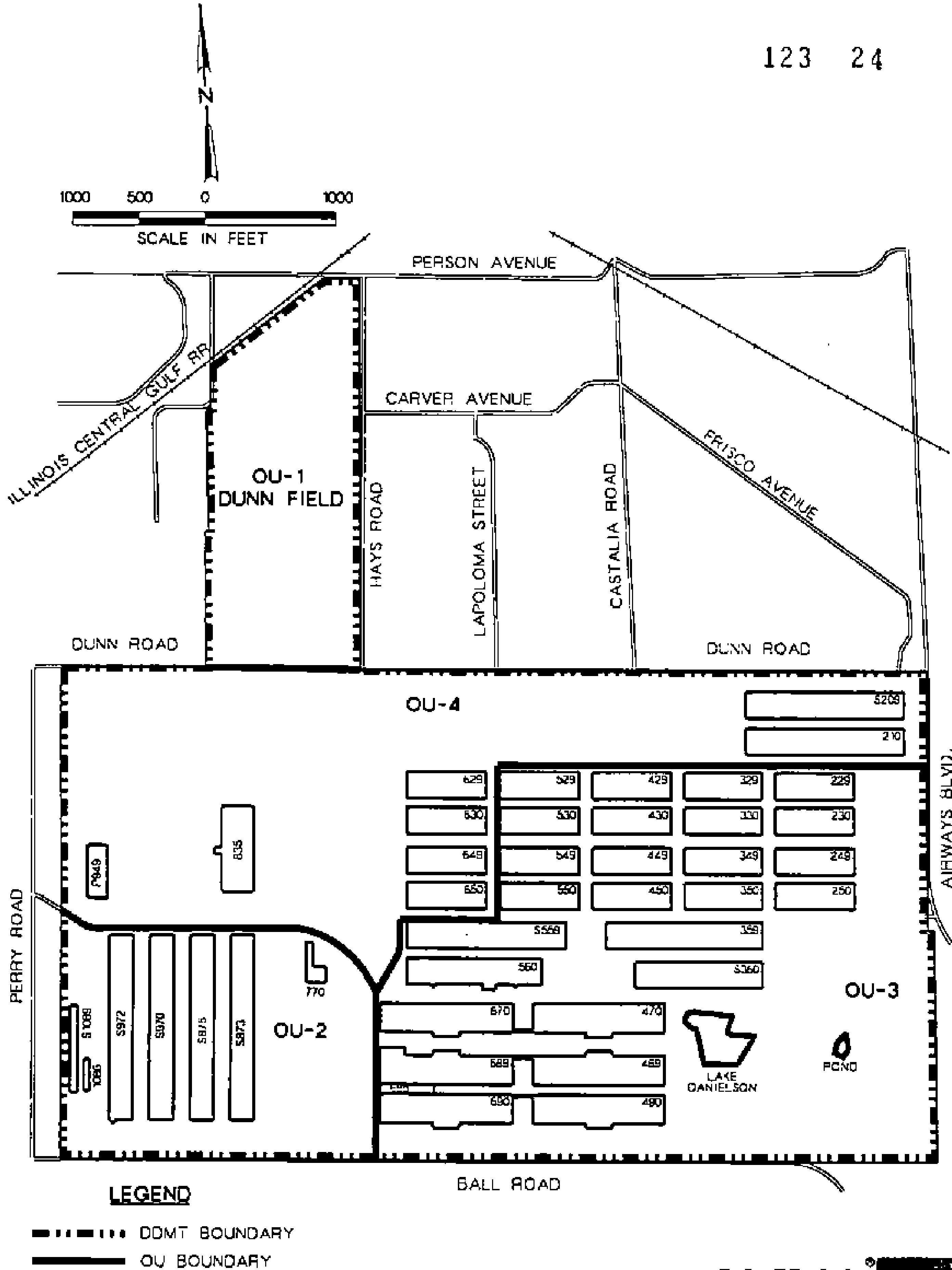


FIGURE 2-2
OPERABLE UNIT LOCATIONS
Defense Depot Memphis, Tennessee

Source: Engineering-Science, 1993

The burial sites have not been individually investigated. DDMT has recorded the site locations through the years using dimensions from known landmarks, and the sites were summarized in the *RFA Report* (ref. 12). Drawing 1 (located at the end of this document) shows the location and the status of each of the identified sites in OU-1. A brief description of each of the sites, along with this site's status, is also listed in Table 1-1.

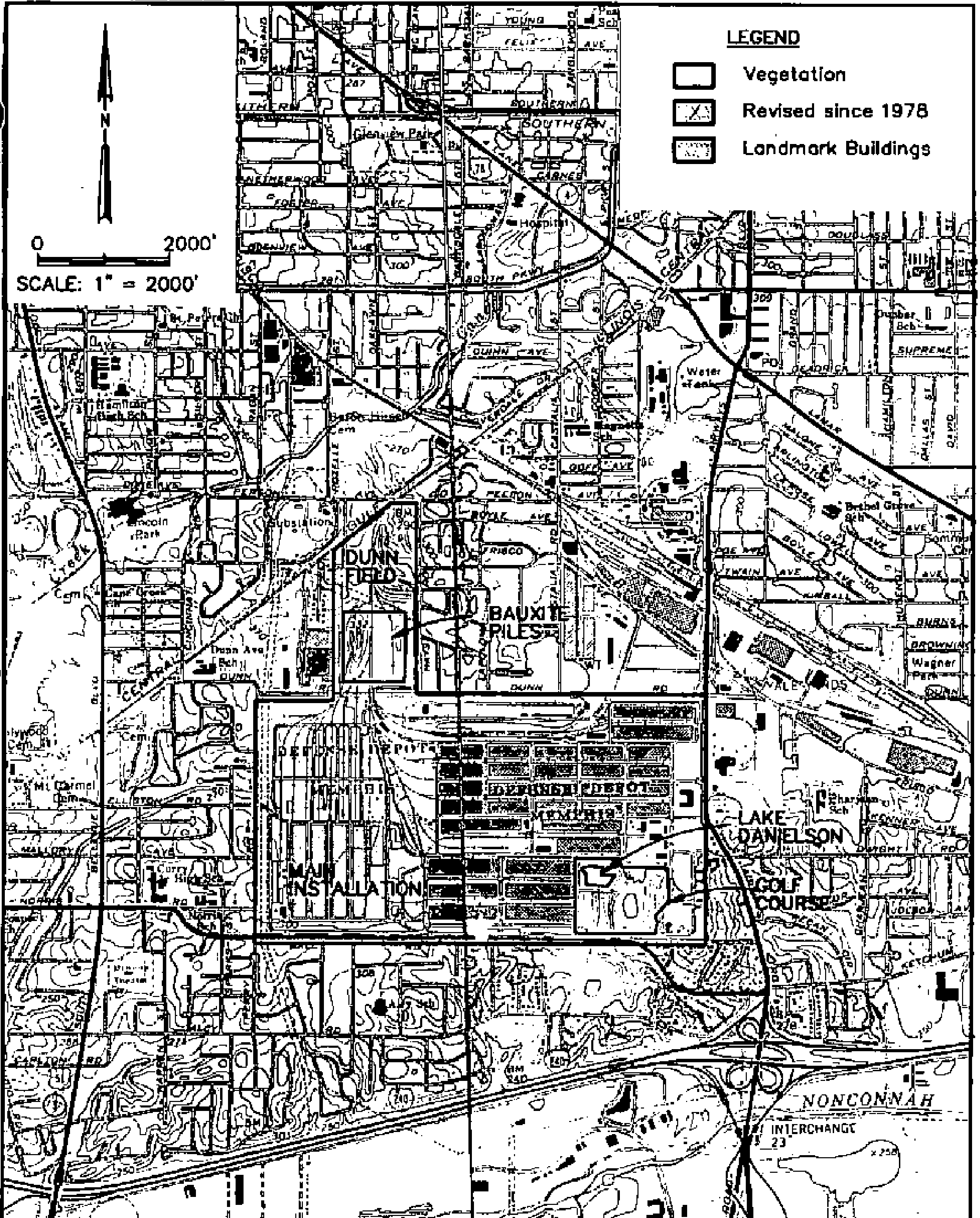
2.3 Geography/Topography

DDMT is located in the southwestern corner of the Memphis area, a few miles north of the Memphis International Airport. The east-to-west flowing Nonconnah Creek lies approximately 3,000 ft south of the installation at its closest point. Cane Creek, which enters Nonconnah Creek from the northeast, is approximately 1,500 ft from the northernmost boundary of Dunn Field. Nonconnah Creek drains into Lake McKellar, a tributary of the Mississippi River.

DDMT's surface features (natural and manmade) and DDMT's relationship to surrounding areas were investigated by onsite visual reconnaissance, U.S. Army Corps of Engineers (COE) historical (comparative) aerial imagery, U.S. Geological Survey (USGS) 7.5 Minute Series Topographic Quadrangle maps, and installation topographic maps prepared by the COE, Mobile District, dated February 1989.

DDMT is divided into two areas, Dunn Field and the Main Installation, each with its own distinct land surface and use-related features. Dunn Field lies just north of the Main Installation and Dunn Avenue, and consists of approximately 64 acres of undeveloped land. Most of Dunn Field is unpaved. About one-half the area is grassed; the remaining area contains crushed rock and paved surfaces. Dunn Field's terrain is level to gently rolling. The land appears to slope to the west from the bauxite piles in the center of the field. Surface elevations range from a low of 273 ft, National Geodetic Vertical Datum of 1929 (NGVD), at the north outfall/installation boundary fenceline to 315 ft NGVD in the field's approximate center. Figure 2-3 shows the topographic features of DDMT and surrounding areas.

The Main Installation consists primarily (approximately 57 percent) of developed land. Most of the Main Installation's land area has been graded, paved, and built up. Some of the few remaining unpaved areas are used for open storage of various materials and equipment. The only significant grassed, treed area is the golf course, located in the Main Installation's southeastern sector. The Main Installation's topography is nearly level. Surface elevations range from approximately 316 ft NGVD in the Defense Reutilization and Marketing Office (DRMO) storage yard adjacent to Dunn Avenue to 267 ft NGVD in the low area below Lake Danielson's earthen dam. More detailed information on the geography and topography of DDMT facility can be found in the *Generic RI/FS WP* (ref. 1).



Source:: USGS 7.5 Series Topographic Quadrangle Maps - South West Memphis Tenn. - Ark. and South-east Memphis, Tenn,.

FIGURE 2-3
SURFACE TOPOGRAPHY OF DDMT AND SURROUNDING AREA OF MEMPHIS, TENNESSEE
Defense Depot Memphis, Tennessee

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2.4 Meteorology

Information describing study area meteorological conditions was obtained from various USGS reports and from the *Climatic Atlas of the United States*, National Oceanic and Atmospheric Administration (NOAA) (ref. 7).

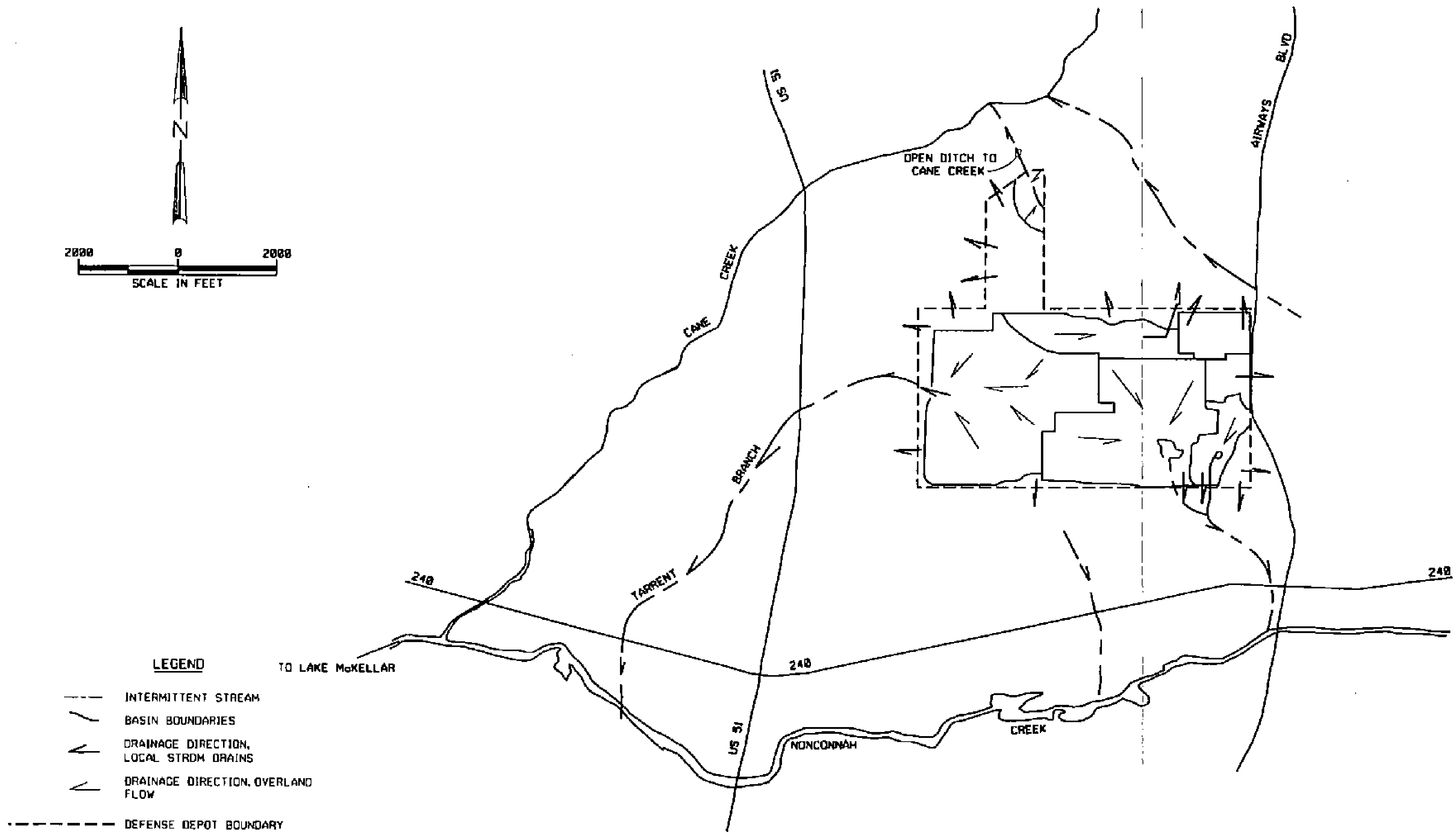
This area of Tennessee has a typical continental type of climate with humid, warm summers and cold winters. The Memphis area receives an annual average of 50 inches of precipitation (30-year period of record). Total annual rainfall was reported to vary from 30.54 inches (1941) to 76.85 inches (1957). Normally, precipitation is heaviest during the winter and early spring. The net annual precipitation (derived from gross annual precipitation less evaporation and runoff) estimated for the Memphis area is 9 inches (ref. 7).

2.5 Surface Water Hydrology

Installation surface drainage is accomplished by overland flow to swales, ditches, concrete-lined channels, and a storm drainage system. Figure 2-4 illustrates the study area's surface drainage features, installation drainage areas, and local streams. There are no year-round surface water features in OU-1.

Most of DDMT is level with, or above, surrounding terrain; therefore, DDMT receives little runoff from adjacent areas. DDMT does receive runoff from the property to the northeast of Dunn Field. Property to the southwest of OU-2 is also at a higher elevation than DDMT, but storm water drainage systems along the roadway capture the majority of runoff. Most OU-1 drainage is achieved by overland flow to the adjacent properties to the north and west. The northeastern quadrant of OU-1 drains eastward to a concrete-lined channel, or to adjacent properties to the north. The concrete-lined channel consists of two separate segments that join approximately 200 ft north of Building 1184. Both channel segments convey adjacent residential neighborhood storm water through the northeastern quadrant of OU-1. The concrete-lined channel directs flow northward to Cane Creek. As discussed in Section 2.3, Cane Creek drains into Nonconnah Creek at a point several miles southwest of DDMT. The Main Installation's surface drainage is achieved by overland flow to a storm drainage system. The primary drainage directions and outfall locations are to the west (Tarrent Branch), to the east (unnamed ephemeral stream), and to the south (unnamed ephemeral stream).

The potential for flooding of DDMT is relatively low. DDMT surface elevations (276 to 316 ft NGVD) are well above the average Mississippi River alluvial valley flood levels (185 to 230 ft NGVD) and are equal to or higher than elevations of adjacent properties. Two permanent surface waters exist at DDMT. The larger body of water is Lake Danielson, which is about 4 acres; it receives a significant amount of installation storm water runoff. The smaller water area is the Golf Course Pond. Overflow from both water bodies eventually discharges into Nonconnah Creek.



SOURCE: MODIFIED FROM DDMT, 1982. DRAFT SPILL PREVENTION, CONTROL AND COUNTERMEASURES PLAN.
MODIFIED FROM HARLAND, BARTHOLOMEW & ASSOCIATES, INC., 1988. MASTER PLAN REPORT, DDMT.
MODIFIED FROM DDMT, 1992. NPDES STORM DRAINAGE SAMPLING MAP, DRAWING NUMBER 45-90.

Source: RI Report, 1990

FIGURE 2-4
STUDY AREA SURFACE DRAINAGE
Defense Depot Memphis, Tennessee

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2.6 Geology

2.6.1 Regional Geology

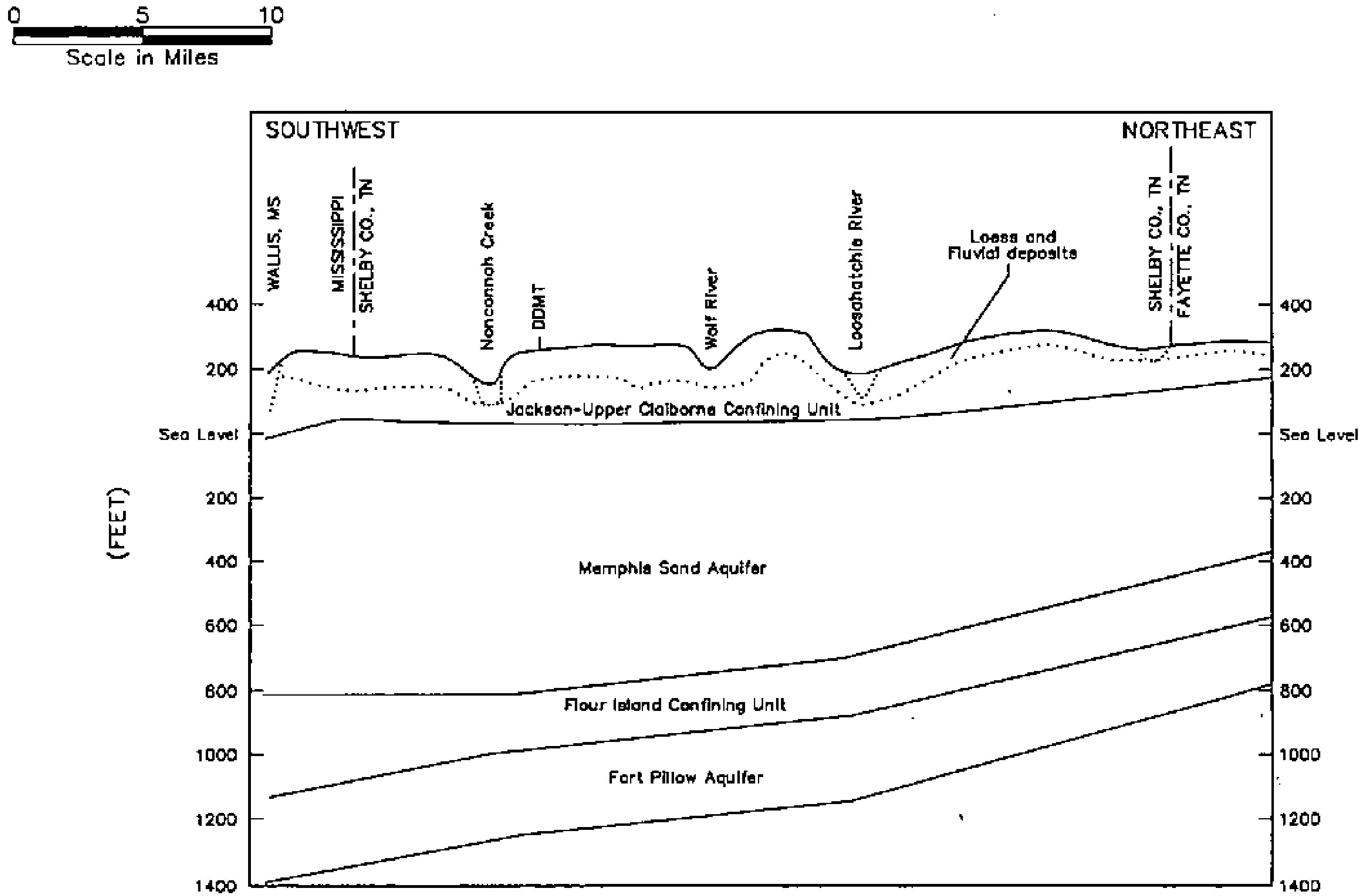
The Memphis, Tennessee, area straddles two major subdivisions of the Atlantic Coastal Plain Physiographic Province. Figure 2-5 shows a general geologic cross section of the Memphis area. DDMT is situated within a major structural feature termed the Mississippi Embayment, a wedge-shaped, down-warped structure composed of stratified sediments. This area is described as a youthful to mature, belted coastal plain (ref. 3).

Information describing major regional geologic units has been obtained from Wells (ref. 13), Moore (ref. 6), Nyman (ref. 8), and Graham and Parks (ref. 3). The Quaternary and Tertiary strata in the Memphis area are composed of loosely consolidated deposits of marine, fluvial, fluvioglacial, and deltaic sediments. In Tennessee, unconsolidated sediments (Cretaceous through Quaternary) reach their maximum thickness at Memphis, where they range from 2,700 to 3,000 ft. Further information on regional geology can be found in the *Generic RI/FS WP* (ref. 1).

2.6.2 DDMT Geology

The geology of DDMT was evaluated by reviewing the existing published geologic information and work performed during the RI (ref. 5). On the basis of the soil borings and monitoring wells installed during the RI, cross sections were developed (by others) that illustrate the postulated occurrence, attitude, and relationships of the geologic units encountered. The cross sections are generalizations, and local variations in subsurface conditions should be expected. The strata encountered during the performance of the study conducted by Law Environmental in 1990 (ref. 5) included loess, fluvial deposits, Jackson Formation/Upper Claiborne Group clays (based on interpretation), and what has been interpreted to be the Memphis Sand. Figures 2-6 through 2-9 illustrate the geologic cross sections of DDMT that transect OU-1.

The uppermost geologic unit at or near ground surface in the study area is loess—eolian deposits consisting of brown silty clay, clayey silt, and fine sandy clayey silt. The loess was encountered at all drilling locations. This unit is described as a brown to yellowish, low plasticity silt (ML) or low plasticity clay (CL). Loess tends to retard downward movement of water.



123 30

Source: Parks, 1990

FIGURE 2-5
GENERAL GEOLOGIC CROSS SECTION OF THE MEMPHIS AREA
Defense Depot Memphis, Tennessee

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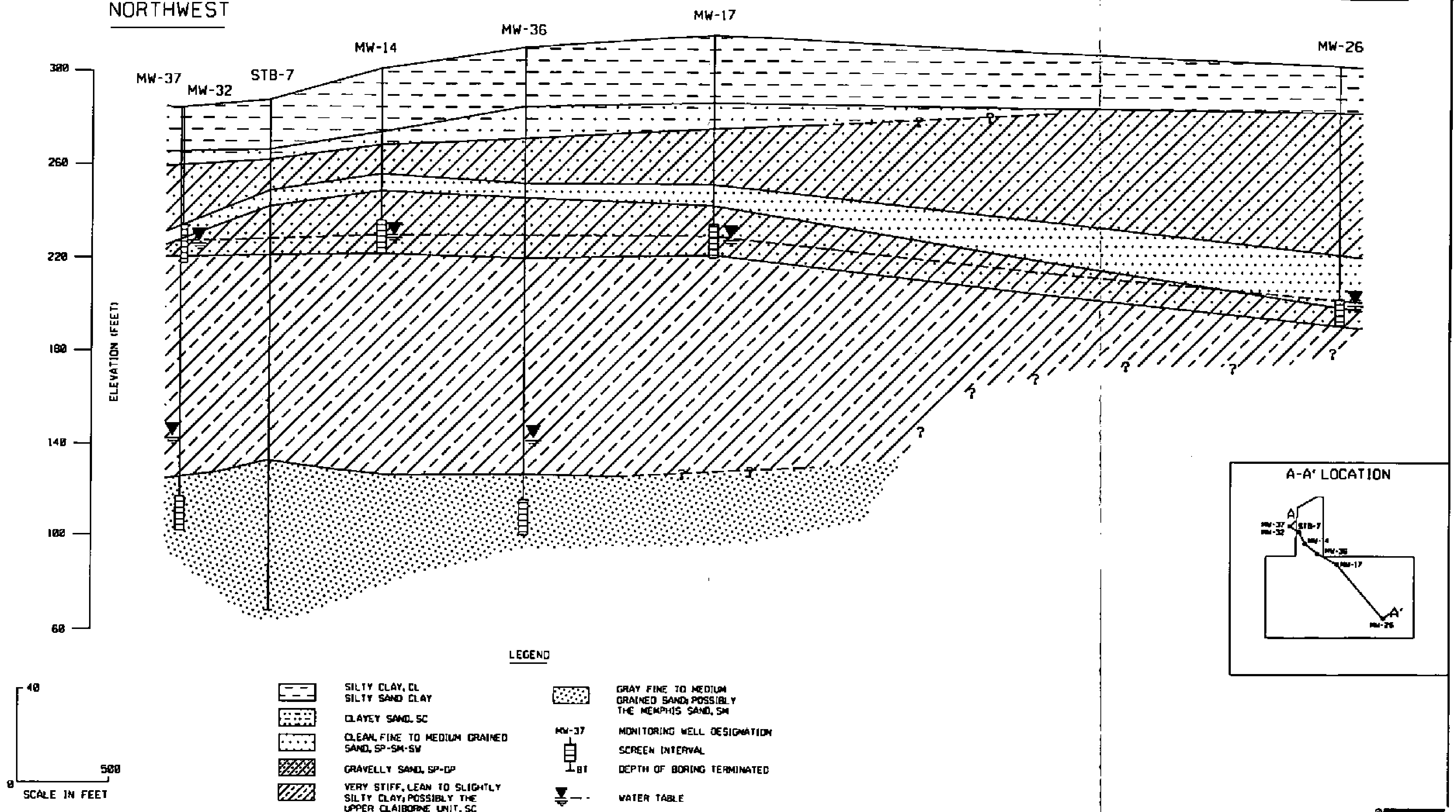
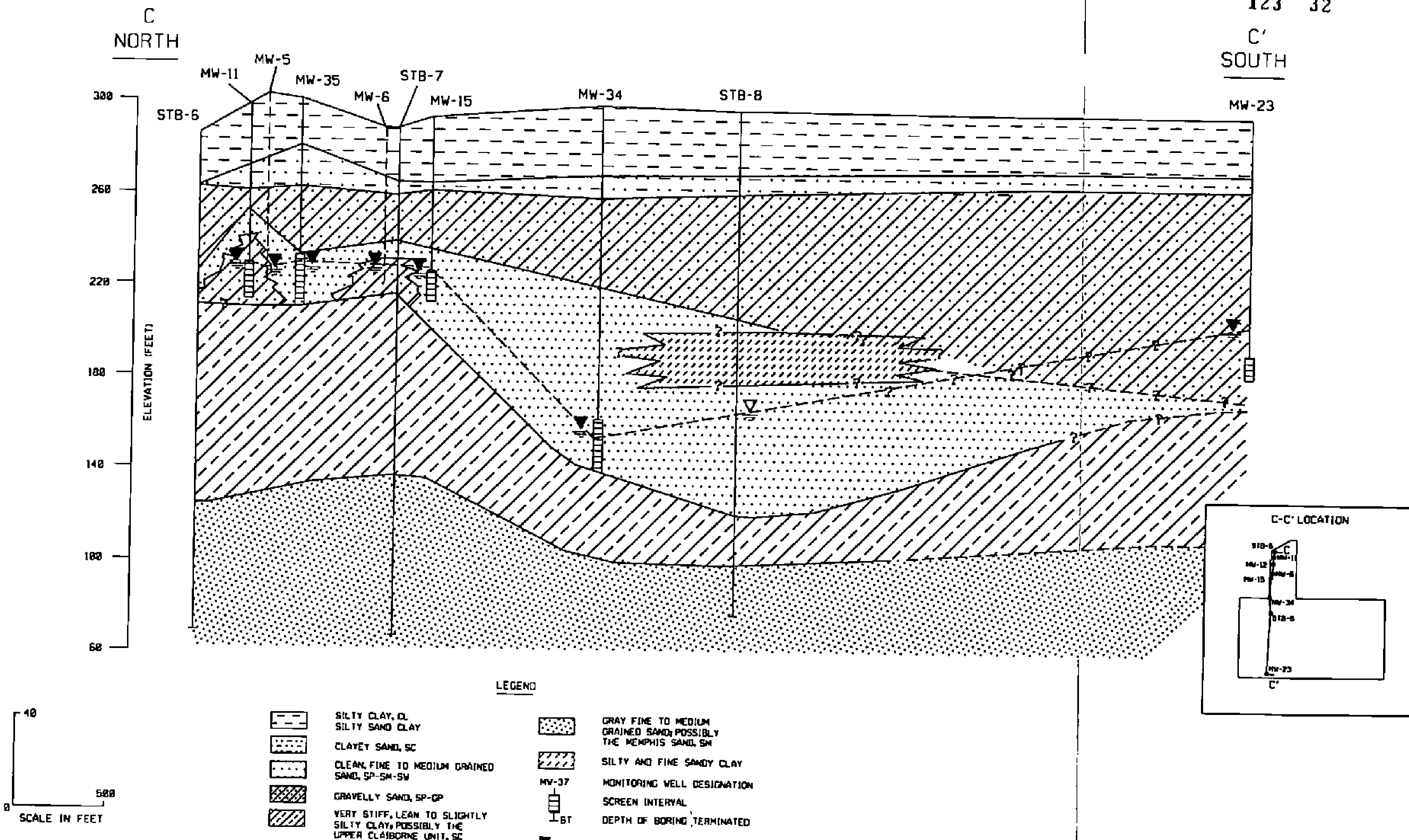


NOTE: THIS ILLUSTRATION REPRESENTS AN INTERPRETATION OF NATURAL CONDITIONS.

Source: RI Report, 1990

FIGURE 2-6
CROSS SECTION A-A', NORTHWEST TO SOUTHEAST
Defense Depot Memphis, Tennessee



Source: RI Report, 1990

NOTE: THIS ILLUSTRATION REPRESENTS AN INTERPRETATION OF NATURAL CONDITIONS.

FIGURE 2-7
CROSS SECTION C-C', NORTH TO SOUTH
Defense Depot Memphis, Tennessee

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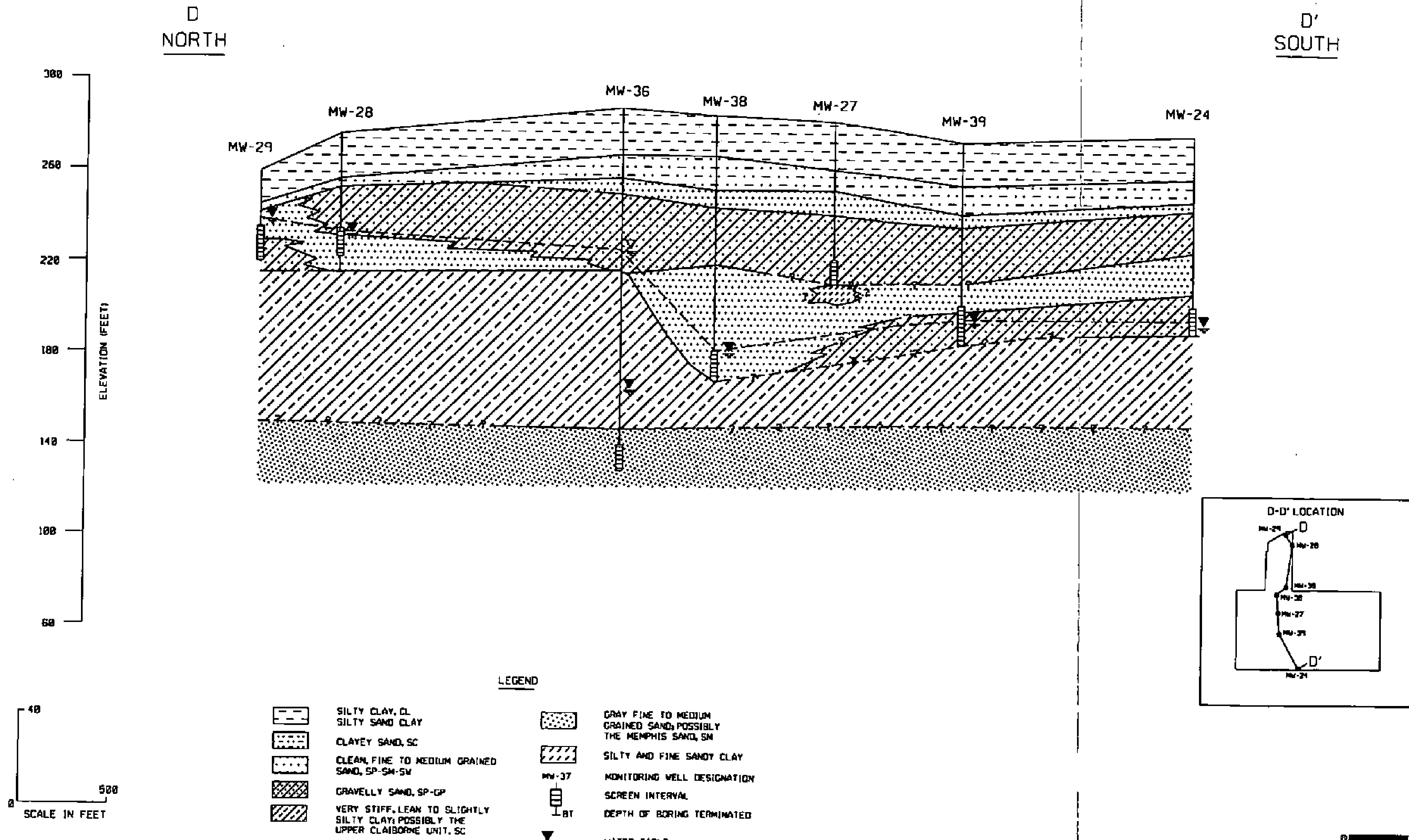

Source: RI Report, 1990

NOTE: THIS ILLUSTRATION REPRESENTS AN INTERPRETATION OF NATURAL CONDITIONS.

FIGURE 2-8
CROSS SECTION D-D', NORTH TO SOUTH
Defense Depot Memphis, Tennessee

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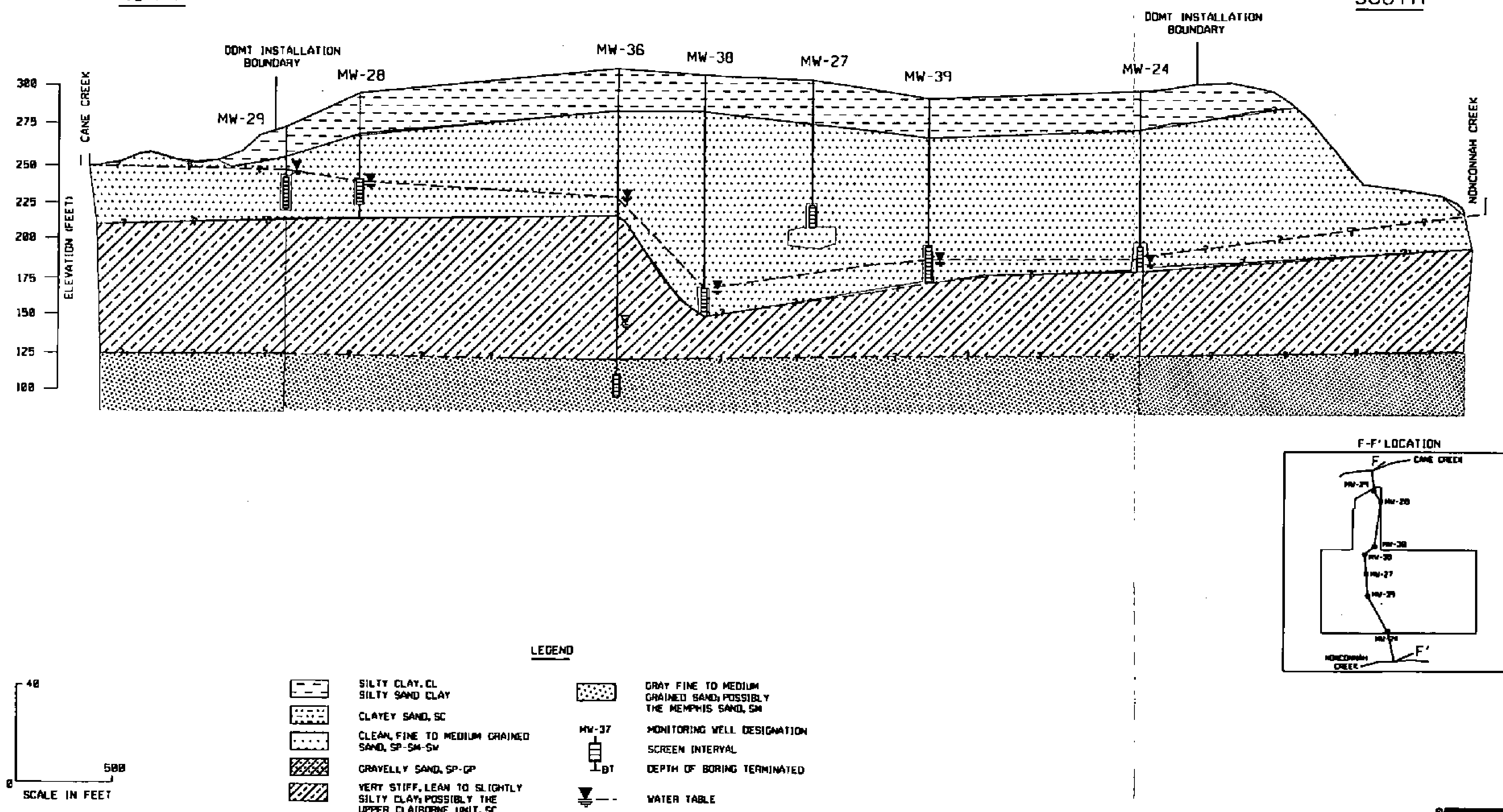

Source: RI Report, 1990

FIGURE 2-9
CROSS SECTION F-F', NORTH TO SOUTH
Defense Depot Memphis, Tennessee

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Fluvial deposits underlie the loess and were encountered at all drilling locations during the RI (ref. 5). The unit is composed of three generalized members that can be traced through the study area:

- Silty clay, silty sandy clay, or clayey sand (upper layer)
- Poorly graded (less than 5 percent silt or clay), fine- to medium-grained sand
- Gravelly sand

Beneath the silty clay, sandy clay/clayey sand are layers of sand and sandy gravel. These layers may alternate. The sand layers range from poorly graded to well-graded, fine- to coarse-grained, very well sorted to poorly sorted quartz grains. The lower sand layers are poorly graded and are tan to white. The sand layers show a coarsening downwards into a gravelly sand, with chert being the primary gravel constituent. The thickness of this unit varies greatly because of erosional features at its top and base. The unit provides water to many domestic and farm wells in rural areas.

Clayey soils that have been interpreted as the Jackson Formation/Upper Claiborne Group were penetrated in three soil borings and two monitoring wells. This unit is represented in the study area by a distinctive stiff gray or orange, low to high plasticity lignitic clay. This member underlies the fluvial deposits and is a regionally significant confining bed for the Memphis Sand Aquifer.

The upper portion of the Memphis Sand Formation was encountered in the same five borings as was the Jackson Formation/Upper Claiborne Group. This Formation is represented in the study area by a gray, very fine-grained, silty sand. It is the principal aquifer providing water for municipal and industrial supplies east of the Mississippi River.

Additional information regarding the geology found at DDMT is available in Section 2.4.5.2 of the *Generic RI/FS WP* (ref. 1).

2.7 Hydrogeology

The Memphis area is located within a region where several aquifers of local and regional importance exist. These aquifers are identified in descending order by their geologic names:

- Alluvium
- Fluvial (Terrace) Aquifer
- Memphis ("500-foot") Sand Aquifer
- Fort Pillow ("1400-foot") Sand Aquifer

The Alluvial Aquifer's distribution is limited to the channels of primary streams; therefore, it does not occur at DDMT. The Fluvial, Memphis Sand, and Fort Pillow Sand Aquifers underlie the installation.

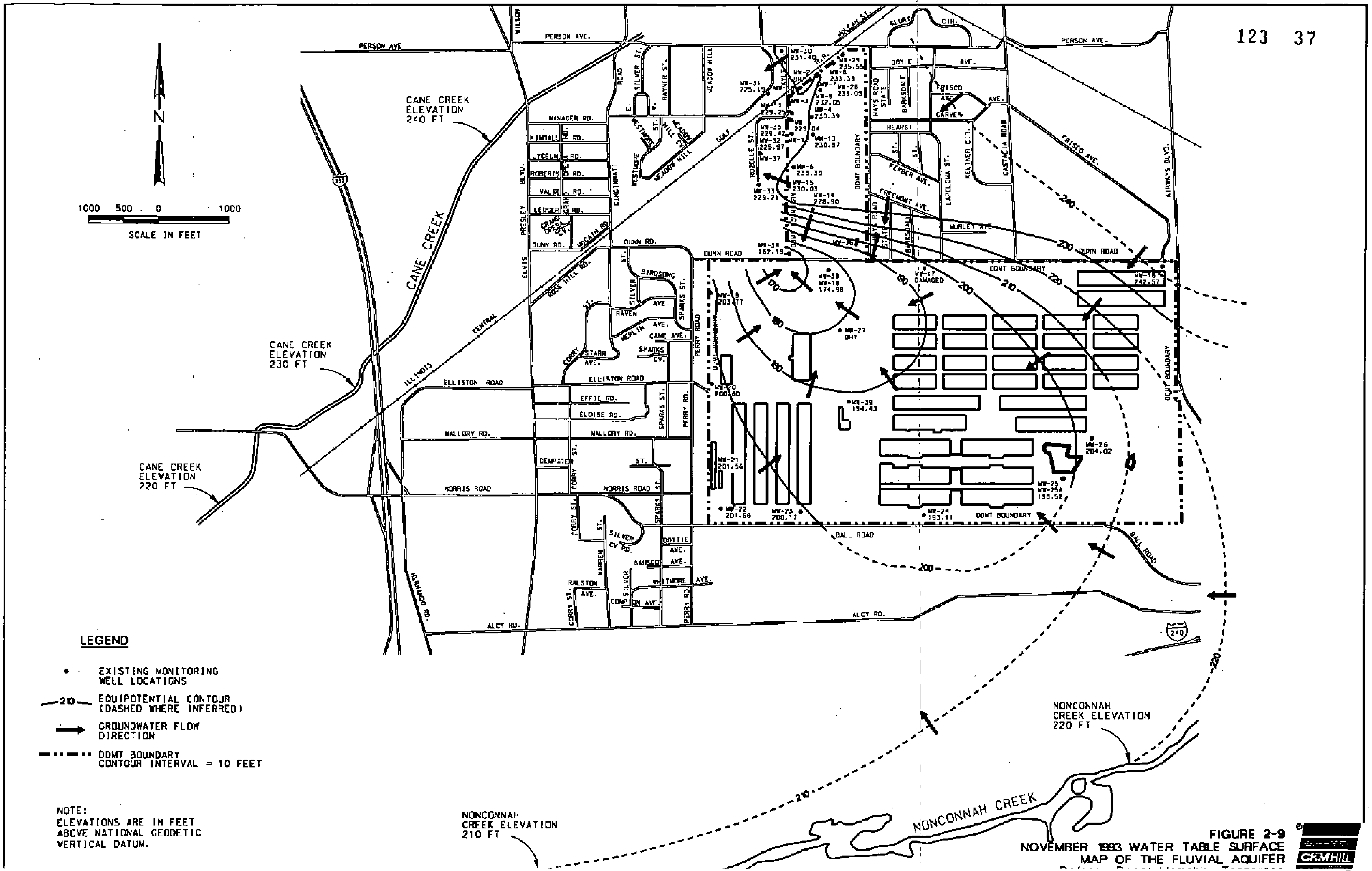
Site-specific hydrogeologic conditions were investigated by physical inspection, test borings, groundwater quality, monitoring well installation, and direct measurement of in-situ hydraulic properties during the RI (ref. 5).

The uppermost hydrogeologic unit encountered at DDMT is the loess. While not usually a water-bearing unit, this material is of interest to this investigation because it tends to limit precipitation infiltration (recharge) to significant underlying aquifers where the loess remains intact and undisturbed. Sandy zones occurring within the loess may become seasonal "perched" water-bearing zones that contain water for short periods after rainfall events. Typically, the perched zone consisted of a fine sandy layer enclosed within the loess, approximately 20 ft below land surface (bls).

Fluvial (Terrace) deposits underlie the loess within the study area. The fluvial deposits form the site's shallow (water table) aquifer. It ranges in thickness from 40 to 131 ft at DDMT. Recharge to this unit is primarily from the infiltration of rainfall (ref. 3). According to the water levels measured in the monitoring wells during the RI (ref. 5), only the base of the unit is saturated. Published seasonal water levels indicate that the groundwater levels fluctuate by several feet.

Water level data from DDMT wells were used to prepare a water table surface map (ref. 5) of the Fluvial Aquifer underlying DDMT (Figure 2-10). This figure represents an interpolation of the water level information obtained from widely spaced monitoring wells and is an interpretation of natural conditions on the date of measurement. Figure 2-11 presents the interpretation of the water table surface within OU-1. A westerly flow is apparent in this portion of the shallow aquifer.

The Jackson Formation/Upper Claiborne Group was encountered at more than half of the monitoring well and soil boring installation locations. The unit is significant because it is a regionally important confining bed that separates shallow water-bearing zones from underlying major aquifers (ref. 8). Where encountered, the elevation of the confining unit's upper surface ranges from 223 ft NGVD at monitoring well (MW)-14 to 118 ft NGVD at stratigraphic test boring (STB)-8. An investigation to evaluate the presence of the confining unit and hydraulic communication (if any) between the water table aquifer and the Memphis Sand Aquifer is planned during the OU-4 RI activities. The continuity and thickness of the confining unit can only be estimated from the available information. The Jackson Formation/Upper Claiborne Group appears to be laterally persistent and fairly uniform in thickness in most of the Dunn Field area. In the southwestern portion of Dunn Field and on the Main Installation, this unit both deepens and thins (see Figure 2-7, specifically STB-7 and STB-8).



LEGEND

- EXISTING MONITORING WELL LOCATIONS
- 210 EQUIPOTENTIAL CONTOUR (DASHED WHERE INFERRED)
- GROUNDWATER FLOW DIRECTION
- DDMT BOUNDARY

CONTOUR INTERVAL = 10 FEET

NOTE:
ELEVATIONS ARE IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM.

FIGURE 2-9
NOVEMBER 1993 WATER TABLE SURFACE MAP OF THE FLUVIAL AQUIFER

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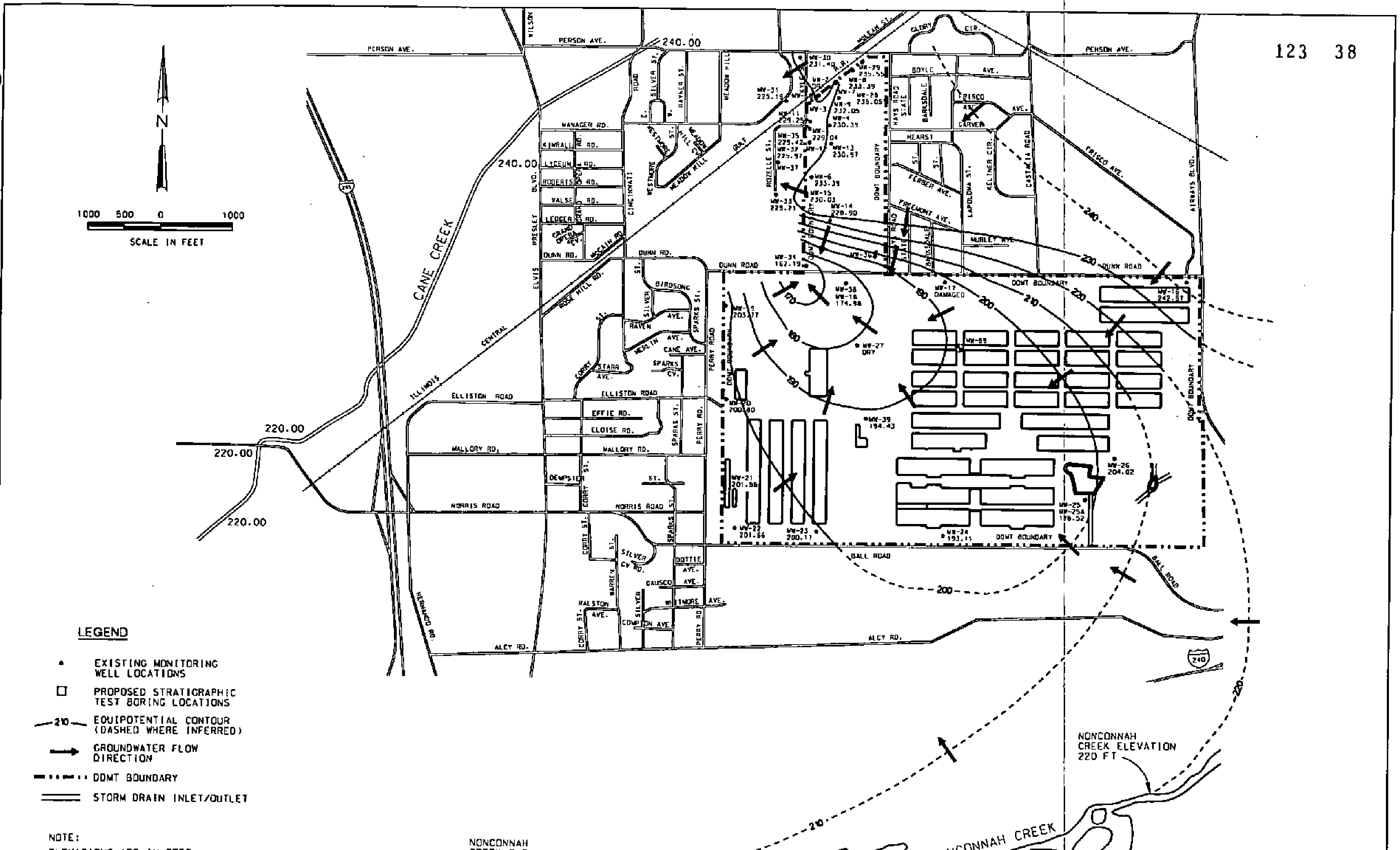

FIGURE 2-10
NOVEMBER, 1993 WATER TABLE SURFACE
MAP OF THE FLUVIAL AQUIFER

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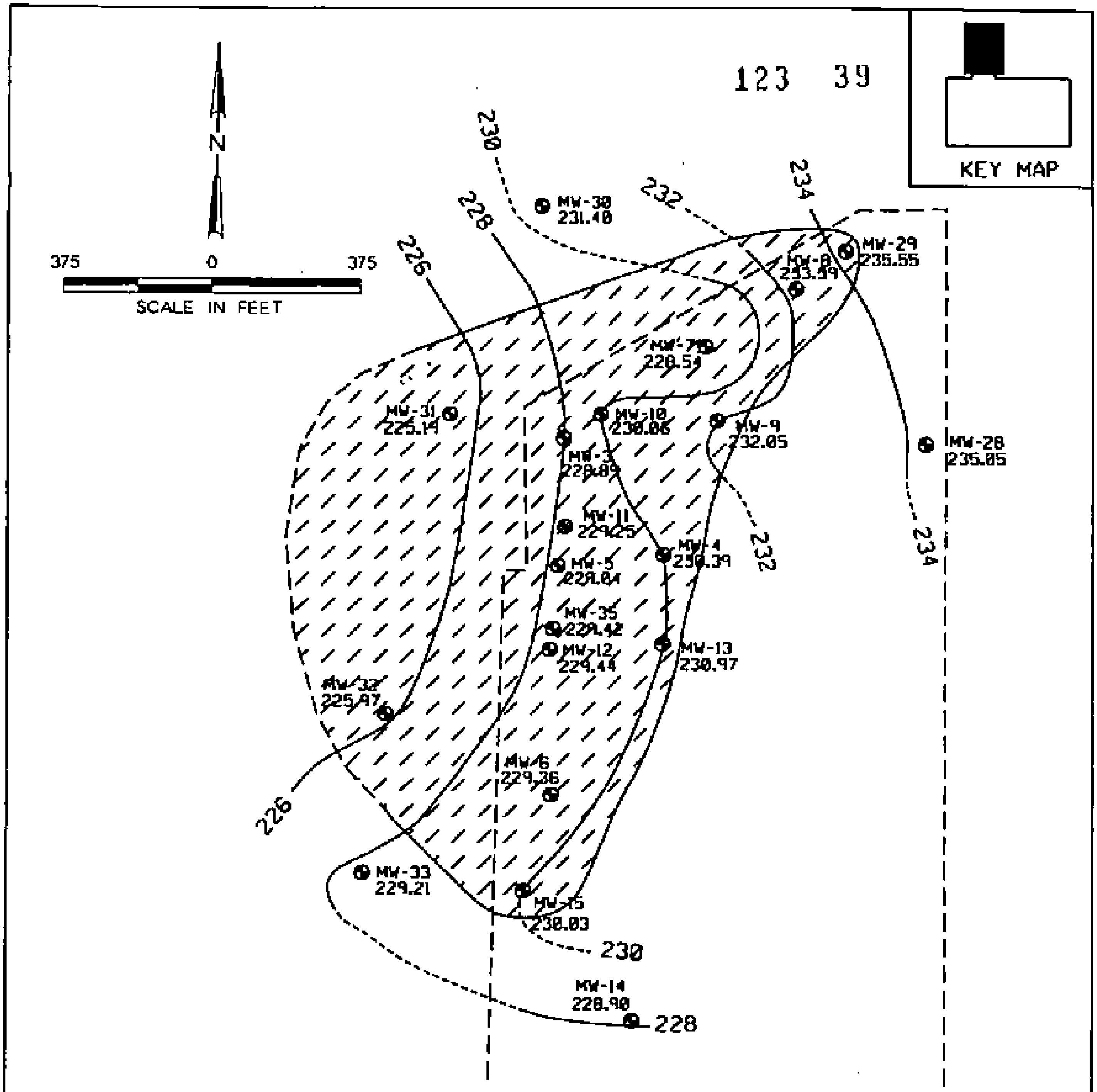

LEGEND

⊕ MONITORING WELL LOCATION

——— ISOPLETHS OF EQUAL ELEVATIONS

- - - - - INFERRED ELEVATIONS

CONTOUR INTERVAL = 2 FEET

•• SHADED AREA REPRESENTS CHLORINATED VOLATILE ORGANIC CONTAMINATION OF GROUND WATER; EXTENT OF CONTAMINATION IS UNKNOWN AND ALL BOUNDARIES OF THE PLUME HAVE BEEN INFERRED.

NOTE: THIS ILLUSTRATION REPRESENTS AN INTERPRETATION OF NATURAL CONDITIONS ON THE DATE OF MEASUREMENT.

FIGURE 2-11
WATER TABLE SURFACE OF FLUVIAL AQUIFER AT DUNN FIELD, NOVEMBER, 1993
Defense Depot Memphis, Tennessee

Source: ESE 1994

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The Memphis Sand Aquifer represents the region's most important source of water resources. The Memphis Sand Aquifer is reported to underlie the entire Memphis area. At DDMT, the top of the Memphis Sand is approximately 125 to 150 ft NGVD. The Memphis Sand Aquifer contains groundwater under artisan (confined) conditions. Locally, extensive pumping has lowered water levels considerably. The Memphis Sand Aquifer potentiometric level at MW-36 and MW-37 ranges seasonally from 143 to 146 ft NGVD. Flow in the unit is directed generally westward, toward the Allen Well Field, a major local pumping zone. The Memphis Sand Aquifer is reported to derive most of its recharge from areas where it crops out. The outcrop area forms a wide belt several miles east of Memphis and extends across much of west Tennessee.

The Fort Pillow Sand (or "1400-foot sand") underlies DDMT and the Memphis region at great depth, on the order of 1,400 ft bls. It is reported to average some 200 ft thick in the study area. The unit contains groundwater under artesian (confined) conditions. The Fort Pillow Sand Aquifer potentiometric level in the DDMT area was interpolated to be approximately 180 ft NGVD in the fall of 1985 (ref. 3).

Additional information on the hydrogeology of DDMT, including information on groundwater use and quality, can be found in Section 2.4.6.2 of the *Generic RI/FS WP* (ref. 1).

2.8 Land Use

2.8.1 Surrounding Area

DDMT is located in south-central Memphis in an area of widely varying uses. Most of the land surrounding DDMT is intensely developed. To the north of DDMT are the rail lines of the Frisco Railroad and Illinois Central Gulf Railroad. A number of large industrial and warehousing operations are located along the rail lines in this area. A triangular area immediately to the north of DDMT along Dunn Road also contains several industrial firms. Formerly a residential neighborhood, the area is characterized by small commercial and manufacturing uses with a few single-family residences remaining.

Airways Boulevard is the most heavily traveled thoroughfare in the vicinity and is developed with numerous small, commercial establishments. Businesses along Airways Boulevard are typical of highway commercial districts. Other commercial establishments are located to the north, south, and west of DDMT. Most are small groceries or convenience stores that serve their immediate neighborhoods.

DDMT is surrounded by residential development, including single- and multi-family residences. Numerous small church buildings and schools are scattered throughout the area. Figure 2-12 shows the most current land use information for the area surrounding DDMT. Further details on surrounding land use can be found in Section 2.4.7 of the *Generic RI/FS WP* (ref. 1).

2.8.2 Operable Unit 1

OU-1 is currently used as a storage site for U.S. government strategic stockpiles of bauxite and fluorspar. These are non-toxic mineral reserves. There is a small storage area for reels of electrical wires and miscellaneous metal parts to the east of these mineral storage areas. The areas that are not used for storage or as roadways (gravel) are covered with vegetation. There is evidence of the presence of typical urban wildlife such as squirrels, chipmunks, red foxes, opossums, quail, morning doves, and turtles. No threatened or endangered species are known to inhabit or use DDMT or the area within 1 mile of the facility (ref. 4).

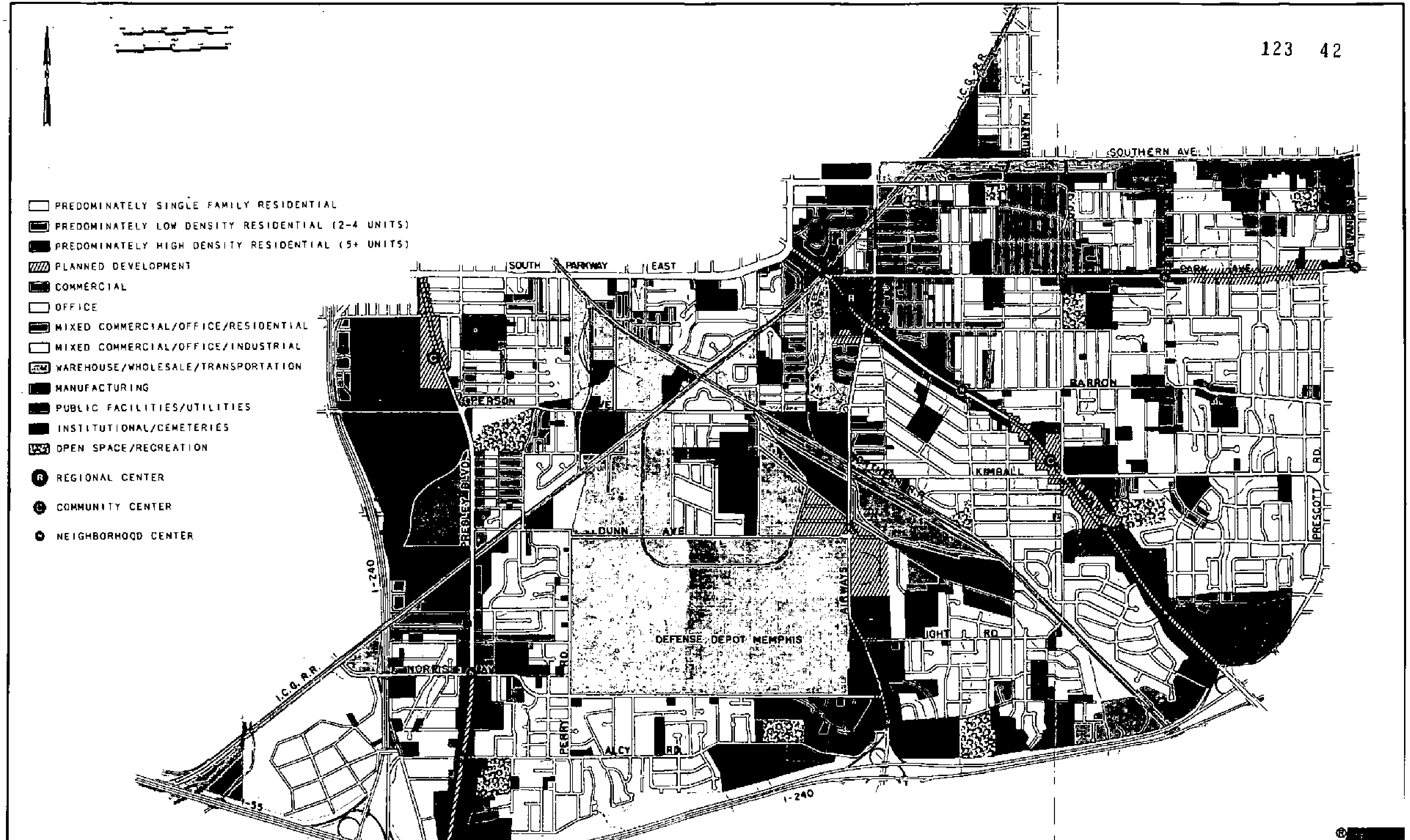
2.9 History and Existing Data

A discussion of the history of activities at the 7 RI sites in OU-1 and a summary of existing data is provided in Section 4 of this FSP. The information is presented on a site-specific basis. Data from previous investigations for OU-1 can be found in the tables located in Appendix B.

2.10 Operable Unit 1 Data Gaps

Using the existing data, knowledge of the site operations, and DDMT records, a review was conducted to assess where data was insufficient to achieve the objectives of the RI/FS process. The review process resulted in the identification of data gaps that need to be addressed during the RI/FS. The primary objectives for conducting field sampling at the OU-1 sites is to characterize potential releases from the site, to assess the nature and extent of soil and groundwater contamination, and to gather data to evaluate the feasibility of remedial actions. Table 2-1 provides a generalization of data needs, existing data, and future sampling requirements.

123 42



Source: Memphis and Shelby County Office of Planning and Development.
Map Prepared May, 1983.

FIGURE 2-12
LAND USE
Defense Depot Memphis, Tennessee

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Table 2-1 Generalized OU-1 Data Gaps Defense Depot Memphis, Tennessee		
Data Need/Use	**Existing Data**	**Future Data Collection**
Identify western extent of plume in Fluvial Aquifer	Offsite wells just west of OU-1 show contamination	Install/monitor additional MWs and groundwater recovery as part of GW IRA.
Identify risks associated with historical burial sites	Limited data to support site-specific recommendation.	Collect surface and subsurface soil samples. Install monitoring wells if site-specific data indicate site is a potential source of GW contamination

Monitoring wells will be installed offsite at the facility for several reasons, including the following:

1. To identify the nature and extent of the contaminant plume west of Dunn Field

2. To assist in developing a potentiometric surface map for the Fluvial Aquifer

Wells also will be installed north of the Dunn Field boundary and on the eastern boundary so that potential migration of contaminants from offsite can be evaluated. A more complete description of the facilitywide groundwater strategy is presented in Section 4.3 of the *OU-4 FSP* (ref. 17).

Subsequent sections of this FSP describe data needs, existing data, and future sampling requirements in detail for each site.

2.11 Summary of Available Information

Various other studies have been performed and documents compiled that provide relevant information to cleanup efforts at DDMT. These technical studies and work plans were performed or prepared in accordance with DLA environmental programs.

The *Generic RI/FS WP* (ref. 1) includes a facility description, background information, findings of previous studies, and potential ways contamination may have reached and affected people. Preliminary information regarding potential ARARs and preliminary cleanup goals is presented.

A *QAPP* and a *HASP* have been prepared. The *QAPP* (ref. 15) describes general sampling procedures and QA/QC procedures to be used so that the quality and the quantity of the information is adequate to evaluate the nature and extent of the contamination. The *HASP* (ref. 16) was prepared to provide procedures for the health and safety of facility personnel and the general public during the investigation at DDMT.

A geohydrologic study, performed by the U.S. Army Environmental Hygiene Agency (USAEHA), identified Dunn Field as having the potential for groundwater contamination (ref. 10). Groundwater samples were analyzed, using EPA Method 624, for volatile organic compounds (VOCs). The concentrations of all VOCs detected in these wells ranged from 3 micrograms per liter (μg/L) to 200 μg/L. Trichloroethene was detected in all five wells at levels ranging from 4 μg/L to 150 μg/L. Tetrachloroethene also was detected in all five wells; its level of concentration ranged from 3 μg/L to 81 μg/L.

Metals, pesticides/polychlorinated biphenyls (PCBs), and base/neutral acid extractable organics also were analyzed, but either were not detected or were detected at levels below the applicable maximum contaminant levels.

Law Environmental conducted an RI/FS that indicated contamination to the Fluvial Aquifer beneath Dunn Field. The RI/FS study focused on the installation, its activities, the environmental setting of the study area, the facility's environmental data collection, sample analyses, data evaluation, and a risk assessment (ref. 5).

Environmental Science & Engineering, Inc. (ESE), performed a groundwater monitoring study in 1993 to assess changes in groundwater quality since the completion of the RI/FS in 1990. The purpose was to evaluate contaminants in the groundwater and to evaluate the extent of migration of these contaminants on and around DDMT (ref. 2).

Engineering-Science, Inc. (ES), performed a pump test in September 1992 (ref. 18) to assess the shallow groundwater zone, to identify and evaluate pump-and-treat alternatives, and to identify technical performance specifications for an interim remedial measure. On the basis of the results of the pump test, ES drew the following conclusions:

- Calculated transmissivity values range from 1.197 feet squared per minute (ft^2/min) to 1.969 ft^2/min, with a mean of 1.385 ft^2/min.

- Calculated hydraulic conductivity values range from 6.0×10^{-2} ft/min to 9.8×10^{-2} ft/min, with a mean of 6.91×10^{-2} ft/min.

- Calculated specific yield values range from 0.018 to 0.25 with a mean of 0.19.

- The specific capacity of the pumping well is 5.84 gallons per minute per foot (gpm/ft); the efficiency is 83 percent.

- The Fluvial Aquifer is relatively isotropic in the vicinity of the pumping well.

- Values obtained from the pumping test compare well with hydraulic conductivities from silty to clean sands presented by Freeze and Cherry (1979) (ref. 21). Sieve analyses from samples collected in the saturated zone of the Fluvial Aquifer during the RI also indicate that the aquifer is composed of primarily silty and clean sands (Law, 1990).

- The pumping well that was installed for the test appears to be capable of sustaining a pumping rate of approximately 75 gpm, with a corresponding radius of influence of approximately 420 feet.

- The results of the chemical analysis indicate that pumping at 24.3 gpm for 42 hours did not lower concentrations of organic compounds in discharge water.

The radius of influence for the pumping well was evaluated for the test, and the evaluation was noted to have neglected the effect of the groundwater gradient. However, because the groundwater gradient is relatively steep, the capture zone(s), which combines the drawdown effects of groundwater withdrawals and natural groundwater flow gradient, should be evaluated.

The aquifer performance test appears to have been properly conducted and the data are therefore useable. The applicability of the data over a larger area depends on the homogeneity of the aquifer over the intended area of recovery/extent of the contamination. The extent of contamination has not been determined to date; therefore, the applicability of the actual recovery rate(s) of wells has not been evaluated.

An archive search regarding the possible use or disposal of chemical warfare agents (CWAs) on the site was conducted by the COE (ref. 19). The records obtained during this search indicate that only the Dunn Field area was used to destroy or bury conventional ordnance or CWAs. The first known destruction of CWAs was in 1946, with the neutralization/destruction of several German mustard bombs. The last known destruction was the burial of chemical agent identification sets (CAISs) in 1955 or 1956. Between 1946 and 1956, other chemicals associated with the Chemical Warfare Service were also buried. These included impregnite (a clothing treatment that prevents CWAs from affecting the skin), decontamination agent—non-corrosive (DANC), and RH-195. DANC is an organic N-chloroamide compound in solution with 1,1,2,2-Tetrachloroethane. RH-195 is the military designation for the compound 1,3-Dichloro-5,5-dimethyl-hydantoin, which is a white chlorinating powder. Contaminated or low-grade chloride of lime probably was buried in OU-1 as well. Conventional ordnance was destroyed in OU-1 after World War II (ref. 9). The sites investigated in this FSP are not believed to pertain to CWAs; however, a potential exists for encountering CWAs at Dunn Field during the RI field investigation.

The U.S. Army Corps of Engineers, Waterways Experiment Station (ref. 20) conducted a geophysical investigation at the western portion of Dunn Field to delineate the location of contamination of the Fluvial Aquifer. Magnetic and electromagnetic methods were used to survey six areas.

The surveys performed in the northwestern quadrant confirmed the location of approximately nine disposal sites. Six possible unknown disposal trenches and pits also were located.

One linear anomaly suggesting a possible disposal trench was identified in the southwestern quadrant of Dunn Field. Also, four anomalous areas indicate possible burial sites in the southwestern quadrant.

The results of the geophysical investigation will be used to map sites during the field investigations and to identify additional areas of concern.

TAB

Section 3 - Sampling Strategy for Operable Unit 1 Remedial Investigation

3.0 Sampling Strategy for Operable Unit 1 Remedial Investigation

This section describes the sampling strategy for OU-1 RI sites. The following information is provided:

- Structure of the investigation
- Data quality objectives (DQOs)
- Data comparisons
- Background data
- Preliminary ARARs and PRGs development
- Risk-based PRGs
- Statistical data comparison

3.1 Structure of Operable Unit 1 Investigation

This section is intended to give a detailed description of the overall strategy for the investigation of each site in OU-1. The approach presented is intended to support a decision to recommend one of the following options:

- Site upgrade (FS, Remedial Design [RD], and Remedial Actions [RA])
- Site downgrade (support NFA)
- Interim Remedial Actions (IRAs) or Early Removals

The structure of the investigation was designed using the observational approach. This work plan is intended to implement RI/FS activities on a cost- and time-effective basis. Field screening procedures and statistical evaluations will be used to facilitate decision making, as defined in Figure 3-1.

3.1.1 Scope

The scope of the field investigation for OU-1 includes soil (surface and subsurface) and groundwater (Fluvial Aquifer) sampling. Monitoring wells will only be installed at sites after an evaluation of results from soil sampling. Groundwater monitoring wells will only be installed if data are needed to assess site-specific remedial actions.

3.1.2 Approach

A phased approach is being used to implement the observational method for the investigation of the RI sites. The RI sites to be investigated as part of this work plan are located in the northwestern quadrant of Dunn Field. Numerous sites are in proximity (see Drawing 1) to the sites to be investigated. In particular, some sites have been identified for ER. Also, a contaminant plume identified in this area of OU-1 extends

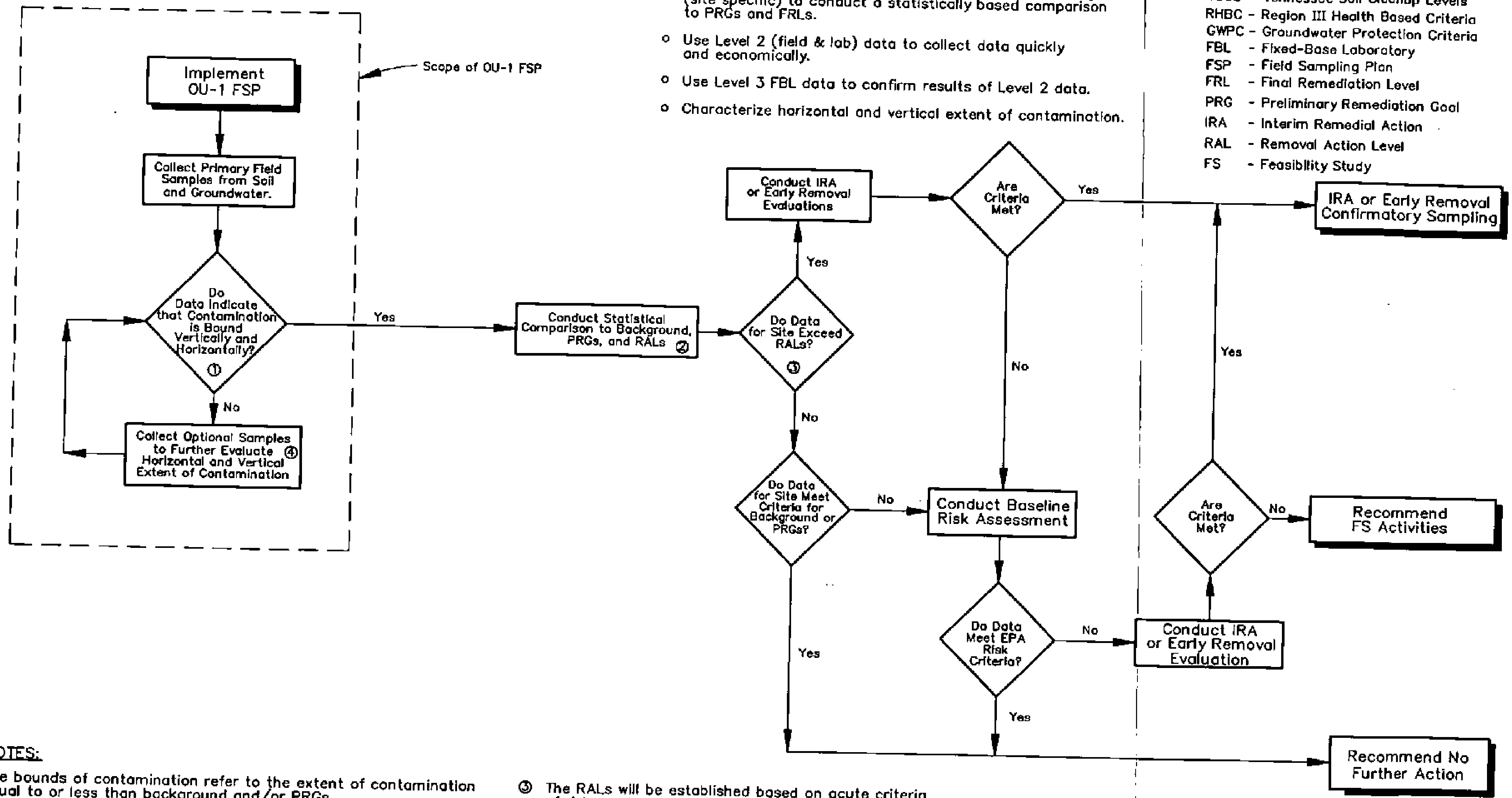
123 49

DQOs

- Collect the specified samples for each exposure pathway (site specific) to conduct a statistically based comparison to PRGs and FRLs.
- Use Level 2 (field & lab) data to collect data quickly and economically.
- Use Level 3 FBL data to confirm results of Level 2 data.
- Characterize horizontal and vertical extent of contamination.

Acronyms

- DQOs - Data Quality Objectives
- TSCL - Tennessee Soil Cleanup Levels
- RHBC - Region III Health Based Criteria
- GWPC - Groundwater Protection Criteria
- FBL - Fixed-Base Laboratory
- FSP - Field Sampling Plan
- FRL - Final Remediation Level
- PRG - Preliminary Remediation Goal
- IRA - Interim Remedial Action
- RAL - Removal Action Level
- FS - Feasibility Study



NOTES:

① The bounds of contamination refer to the extent of contamination equal to or less than background and/or PRGs.

② Background data set will be established by using criteria identified in the RI/FS WP. Comparison criteria are developed using TSCL, RHBC and GWPC, and other applicable regulatory criteria. These criteria are used as PRGs based on a conservative approach from the standpoint of risk (exposure and assessment criteria). Section 3 of this FSP discusses the comparison criteria. Statistical comparison will be limited by the amount of data collected during the field investigation.

③ The RALs will be established based on acute criteria of risks and economic factors.

④ Optional work will not be initiated without prior approval of CEHND. Optional samples will be collected only after a field charge request form is signed by CEHND.

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FIGURE 3-1
OU-1 LOGIC DIAGRAM
Defense Depot Memphis, Tennessee

CH2M HILL

westward off the facility property. This groundwater contamination is being addressed with an IRA (groundwater recovery system).

The focus of the approach to the RI site investigation is to evaluate potential ongoing sources of soil contamination, if present. Initial sampling depths are proposed based on initial characterization data needs. Additional samples will be collected to evaluate the nature and extent using the observational approach. Monitoring wells will be installed only when site-specific conditions warrant. Specific conditions may include (but are not limited to) any conditions that may affect the groundwater remedial action selection. The decision for monitoring wells will be made by DDMT, TDEC, and EPA.

The phases for the field activities include field screening (using Levels 1 and 2 data quality) and fixed-based laboratory (FBL) analyses (Levels 3 and 4 data). Four sites at DDMT have been identified for RI in OU-1 and are included in this work plan. Each site is evaluated to identify the quantity and quality of data needed to achieve the objectives of the RI activities. The site-specific sampling activities are included in Section 4 of this report. The proposed decision logic diagram is presented in Figure 3-1. Regulatory numerical criteria used for data evaluation are presented in Section 3.3.

3.1.3 Field Screening

Field screening will provide soil and groundwater data that can be used to effectively investigate the site. The Level 2 data will be coupled with Level 3 analyses. The Level 3 analyses will provide a qualitative evaluation of the Level 2 data, and can be used to the degree to which Level 2 data are comparable to Level 3 to show that Level 2 data can be used for risk assessment. The advantages of this type of assessment, as compared to using only Level 3, include quicker laboratory turnaround time for Level 2 results, ability to change based on site conditions, timely contaminant delineation, and reduced cost.

Section 3.2.2 of the *QAPP* (ref. 15) addresses QA/QC of the sample activities and will specifically describe the differences between Level 2 and Level 3 data. The primary differences that will be addressed include turnaround time, validation process, laboratory QC requirements, and cost. There are four quality levels, 1 through 4. Level 1 analyses may include field pH, photoionization detector (PID) (HNu), and field test kits for specified contaminants. Level 2 analyses include FBL methods for VOCs, semivolatile organic compounds (SVOCs), polynuclear aromatic hydrocarbons (PAHs), and priority pollutant metals (PPMs) on a 7- to 10-day turnaround basis. Level 3 analyses include FBL methods for VOCs, SVOCs, PAHs, and PPMs, with QA/QC analyses. Level 4 analyses will not be conducted at this time. The laboratory may produce Level 4 data package deliverables in the future.

3.1.4 Fixed-based Laboratory Procedures

Because of the wide variety of sites to be investigated, a complex array of analyses will be conducted for FBL analyses. On the basis of known contaminants at each site, existing data, and level of uncertainty, each field sample collected will be screened for one or more target compounds using Level 2 protocol. Approximately, but no less than, 10 percent of the field samples will be sent to an offsite laboratory for confirmational analyses. Approximately, but no less than, 10 percent of the Level 3 data will be submitted for target compound list/target analyte list (TCL/TAL) analyses, and at a minimum, one sample from each site will be analyzed for the TCL/TAL parameters. The list of analytical methods that will be used for offsite analysis is presented in Section 4 of the *QAPP* (ref. 15). The selection of the location of confirmatory samples (Level 3), based on the results of Levels 1 and 2 data, will be made by the field team leader (FTL) according to the criteria defined in Sections 3.2 and 3.3 of this document.

3.1.5 Remedial Actions

Sites may be upgraded to FS, RD, or RA, or an IRA may be conducted while the final remedy is being developed to expedite remediation; or, a removal action may be performed if appropriate. The RA evaluation will be conducted as a parallel effort to the field effort at DDMT.

3.1.6 Primary and Optional Activities

Primary field activities include field sampling for surface and subsurface soil and groundwater to estimate the horizontal and vertical extent of contamination. The analytical soil data, in comparison to PRGs, and the background data set will be used to evaluate the need for additional field sampling. The background data set collection is discussed in Section 5.3.2 the *Generic RI/FS WP* (ref. 1). Additional investigation may be necessary to support risk-based decisions, to develop information needed to select an appropriate RA, or to further characterize the extent of potential contamination. Optional field work could include additional surface or subsurface soil sampling, surface water and sediment sampling, well installation, and well sampling.

By using the field analytical data, DDMT can implement optional activities to achieve the objectives of the RI and DQOs. By using the optional activities in this manner, work can be conducted during a single field event to prevent remobilization. A field change request form will be instituted to document the description of optional activities, the reasons for implementing the change, and authorization to proceed with optional activities.

Facilitywide groundwater strategy is discussed in Section 4.3 of the *OU-4 FSP* (ref. 17). The strategy is presented in the *OU-4 FSP* to achieve a concise presentation of strategy and to prevent redundancy.

3.2 Data Quality Objectives

DQOs are qualitative and quantitative statements that specify the quality of the data required to support the decision-making process during the sampling activities. DQOs are developed based on the intended final use of the data. Specific objectives of the RI field sampling effort are divided into the following two parts: primary field work DQOs, to assess the magnitude of a contaminant release to surface and subsurface soils; and optional field work DQOs, to assess whether contaminant release has occurred to groundwater and to assist in data collection to support the decision-making process. The general DQOs guiding the field investigation process are the following:

- Collect soil samples (surface and subsurface) that are representative of actual site conditions.
- Provide reliable data results supported by QC measures implemented during sampling and analysis.
- Use Level 1 screening assays to aid in site sample selection activities.
- Use Level 2 FBL analytical methods to expedite the decision-making process and to collect data quickly and economically. Use analytical techniques for Level 2 data that provide quality data for use in the risk assessment.
- Conduct sufficient Level 3 FBL analyses to support confirmation of Levels 1 and 2 data and to support risk-based decisions for the NFA alternative.
- Compare the levels of contamination at sites to applicable regulatory levels and calculated risk-based levels, so that the appropriate recommendations can be developed.
- Provide laboratory support to produce Level 4 data to provide legally supportable documentation for decisions (if needed).

As a result of a phased field investigation process, specific DQOs for each phase are necessary. These phase-specific DQOs are presented in Table 3-1.

Table 3-1 Specific DQOs for OU-1 RI Sites Defense Depot Memphis, Tennessee	
Primary Field Work DQOs[1]	Optional Field Work DQOs[2]
Conduct proposed soil sampling at RI sites to evaluate the magnitude of a contaminant release as a result of historical site activities. Collect sufficient data (nine samples per exposure pathway) to support a statistical-based data comparison and to support a baseline risk assessment. Collect data to support the IRA evaluation.	Collect groundwater data upgradient and downgradient of the site to assess whether a release to groundwater as a result of site activity has occurred. Install additional soil borings to collect additional data, if necessary, to characterize the horizontal and vertical extent of contamination.

[1]DQOs that are achieved using the primary sampling activities presented in Section 4 of this FSP.
[2]DQOs applicable if a potential contaminant release to groundwater has been identified or if contaminants in soil media are not evaluated during the primary field activities.

3.3 Data Comparisons

Surface soil, subsurface soil, and groundwater data will be collected during the primary field work investigation at OU-1. The data will be collected at locations identified in Section 4 of this report. Locations have been selected where current data show that the highest probability of contamination exists. Once the RI field investigation is underway, data will be collected through the use of the Level 2 data quality, thus expediting the turnaround time (7 to 10 days). Four data comparisons will be conducted during the RI activities as part of the ongoing investigation, as follows:

- Individual data points for Level 2 data will be compared to the PRGs (see Sections 3.5 and 3.6) for organic constituents. Contaminants that exceed the PRGs are considered to be representative of contamination for a site. For inorganic constituents, Level 2 data will be compared to the background data for each data point first, then to PRGs. (Background data are discussed in Section 3.4 of this document.) Therefore, when attempting to estimate the horizontal and vertical extent of contamination, additional soil borings may be necessary when organic constituents exceed PRGs or when inorganic constituents exceed background and PRGs.

- Level 2 data will be compared to Level 3 data (23-day turnaround time) to assess the data usability. This comparison will be conducted after the Level 3 data have been analyzed by the laboratory and validated. Section 3.2.2.2 of the *QAPP* (ref. 15) discusses the approach to assessing Level 2 data quality usability. The goal is to collect Level 2 data of sufficient quality to be used for statistics and for baseline risk assessment (BRA).

- Level 2 data will be compared to removal action levels (RALs) for each data point. The RALs are discussed in Section 3.5.

- The final data comparison will be conducted after the field investigation is complete. This data comparison will use a statistical approach to compare the data for a site to PRGs and RALs. This approach is presented in Section 3.6.

3.4 Background Data

Background data for groundwater, surface water, soil (surface and subsurface), and sediment will be collected during the screening and RI field work activities. The approach to collecting this data is presented in Section 5.3.2 of the *Generic RI/FS WP* (ref. 1). The background data set will be used to establish individual background data numerical criteria for each constituent of concern. The method for establishing this background data numerical criteria is presented in Section 5.3.2 of the *Generic RI/FS WP* (ref. 1). Individual parameters for each biased sampling location will be compared to the background data set to evaluate whether a contaminant release has occurred. If the data do not exceed the background data, the site will be recommended for NFA. Only the parameters that exceed background data will be considered for further investigation using the optional field activities (additional borings, wells, and ERs).

3.5 Preliminary Identification of Applicable or Relevant and Appropriate Requirements and Preliminary Remediation Goals

3.5.1 Introduction

The purpose of this section is to summarize information used in the scoping phase of DDMT projects on issues relating to compliance with ARARs, including identification of PRGs. This information guides the development of appropriate sampling and analysis plans and ER actions, or facilitates the development of a range of appropriate remedial alternatives and can focus selection on the most effective remedy. Terms used in this section are defined in Table 3-2.

The procedures for identification and evaluation of ARARs and PRGs are presented in several important sources, particularly the following:

- The NCP, specifically 55 FR 8741-8766 for a description of ARARs, and 8712-8715 for using ARARs as PRGs; also 53 FR 51394

- CERCLA Compliance Manuals (EPA 1988 and 1989)

Table 3-2
ARARs and PRGs Definitions
Defense Depot Memphis, Tennessee

Term	Definition
Applicable or Relevant and Appropriate Requirements (ARARs)	"Applicable" requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal, state, or local law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. "Relevant and appropriate" requirements are those cleanup standards which, while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. ARARs can be action-specific, location-specific, or chemical-specific.
Final Remediation Levels (FRLs)	Chemical-specific cleanup levels are documented in the Record of Decision (ROD). They may differ from preliminary remediation goals (PRGs) because of modifications resulting from consideration of various uncertainties, technical and exposure factors, as well as all nine selection-of-remedy criteria outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).
Preliminary Remediation Goals (PRGs)	Initial cleanup goals that (1) are protective of human health and the environment, and (2) comply with ARARs. They are developed early in the process based on readily available information and are modified to reflect results of the baseline risk assessment. They also are used during analysis of remedial alternatives in the remedial investigation/feasibility study (RI/FS).
Risk-based PRGs	Concentration levels set at scoping for individual chemicals that correspond to a specific cancer risk level of 10^{-6} or a Hazard Quotient/Hazard Index (HQ/HI) of 1. They are generally selected when ARARs are not available.
Screening Risk-based PRGs	Conservative risk-based estimates and guidance concentrations to be used for site and pathway screening. Lower values than typically estimated after a baseline risk assessment are presented—values correspond to an HQ/HI of 0.1.
Remedial Goal Options (RGOs)	Remedial goal options are typically developed during the baseline risk assessment to present risk managers with a range of possible target FRLs.
Removal Action Levels (RALs)	Concentrations that trigger consideration of removal actions based on the potential for acute or long-term chronic effects.

- *Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual.* Part B, Development of Risk-Based Preliminary Remediation Goals. EPA, 1991 (RAGS Part B)

Three types of federal and state ARARs have been identified as described below:

- **Chemical-specific**—Health or risk management-based numbers or methodologies that result in the establishment of numerical values for a given media that would meet the NCP "threshold criteria" of overall protection of human health and the environment and compliance with ARARs. The development and presentation of these "threshold criteria" are a major focus during this initial phase because of their role in the development of the specific sampling plans and their use in initial data interpretation.

- **Location-specific**—Restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because they are in special locations (such as wetlands).

- **Action-specific**—Usually technology or activity-based requirements or limitations on actions taken with respect to hazardous waste.

The detailed ARAR and PRG information provided in Section 3.5 of the *Generic RI/FS WP* (ref. 1) presents initial guidelines. This information does not establish that cleanup to meet these goals is warranted. As more information is obtained about all OUs and as remedial alternatives are considered, federal and state requirements will be narrowed to those that are potential ARARs for each alternative.

3.5.2 Chemical-specific Threshold Concentrations

Threshold criteria were developed for each media of potential concern, specifically groundwater, surface water, soil, and sediment. These include ARAR-based PRGs, guidance values that are "to be considered," and screening risk-based PRGs.

The screening PRGs represent the most conservative approach to the interpretation of the site data. These data are intended for use in screening sites to evaluate the appropriate disposition of the site.

The screening PRGs were developed from information provided in Risk Assessment Guidance for Superfund (RAGS) Part B and guidance from EPA Region IV.

Region III publishes screening PRGs, and the table is updated semiannually. Region III PRGs were used for guidance in developing the PRGs. However, the screening values for DDMT are more conservative than the Region III values. The following factors were considered and led to the development of these conservative screening PRGs for DDMT:

- Presence of multiple contaminants
- Pathways not considered in the published values (soil-to-groundwater pathways)
- Potential ecological effects
- Appropriate land-use assumptions

Remedial goal options (RGOs), consistent with EPA Region IV guidance, will be developed during the RI process and will provide a more realistic basis for the development of final remediation levels (FRLs). Also, a more detailed discussion of media-specific PRGs and the PRG values are presented in Section 3.6 of the *Generic RI/FS WP* (ref. 1).

3.5.3 Action-specific ARARs

Action-specific ARARs usually are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site. Remedial alternatives that involve, for example, closure or discharge of dredged or fill material may be subject to ARARs under RCRA and the Clean Water Act, respectively. A detailed media-specific explanation of action-specific ARARs is presented in Section 3.5.3 of the *Generic RI/FS WP* (ref. 1).

3.5.4 Location-specific ARARs

Location-specific ARARs generally are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in special locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Discussions with TDEC, Division of Solid Waste Management, have indicated that the state is not aware of any natural resources for which it acts as a trustee that are potentially threatened or damaged as a result of past or current waste disposal practices conducted at DDMT. Furthermore, a search for possible location-specific ARARs was conducted during the RI (ref. 5), and no federal, state, or local natural resources were found to be near the site. Before the completion of the final RI/FS report(s), a CERCLA 104B.2 Notification Form will be submitted to the Department of Interior (DOI) by DDMT to evaluate whether the DOI is a trustee of any natural resources that may be threatened by a release of hazardous substances from the site.

3.6 Risk-based Preliminary Remediation Goals

The PRGs developed for use in DDMT work plans are designed to be protective using conservative assumptions. In this way, they may be used for screening sites where a focused investigation is conducted to select locations that represent "worst-case conditions," and decision makers can be confident that chemicals reported below these concentrations would result in acceptable risks at the site after a BRA. For risk-based PRGs, the following general assumptions are used:

- Residential land use
- Target risk level (TRL) of 10^{-6}; Target hazard index (THI) of 0.1

The current land use is industrial, and many areas of the facility are located where worker exposures would be relatively infrequent. Risk estimates based on the TRL of 10^{-6} or THI of 0.1 would be protective if several chemicals were present below the specified concentrations. However, under conditions where 10 or more chemicals were reported, additional review would be required. More detailed information regarding PRG development and calculation can be found in Section 3.6 of the *Generic RI/FS WP* (ref. 1).

3.7 Statistical Data Comparison

If a biased sample (assumed to represent potential "hot spot" or high concentration locations) shows concentrations exceeding the conservative screening PRGs (but below the RALs), it is possible that the average concentration over the designated exposure area would not represent a potential for adverse effects. Statistical sampling and comparison of estimates of the average concentration would meet the requirements to demonstrate acceptable risk-based levels.

The exposure concentrations used in risk assessments reflect the arithmetic average of the concentration that would be contacted over the exposure period. Although this concentration may not reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate of the concentration likely to be contacted over time, because it is not reasonable to assume long-term contact with the maximum concentration. Providing that no "hot spots" (areas of high concentration relative to other areas of the site or elevated above a RAL) are identified, risk estimates are based on the average concentration (RAGS, EPA, 1989). However, because of the uncertainty associated with any estimate of soil concentration, the 95 percent upper confidence limit (UCL95) of the arithmetic average is used for this estimate. The PRGs are based on the average exposure below the estimated concentration, and therefore, these would also be compared with a statistical estimate of the average.

This method is also documented in EPA guidance for statistical comparisons. For example, methods for testing whether soil chemical concentrations at a site are statistically below a cleanup standard or ARAR are presented in *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media* (ref. 14). Several approaches are identified, including comparison of the estimate of the mean (UCL95) with the target concentrations.

3.7.1 Statistical-based Samples

Samples of surface and subsurface soil for each site will be collected. The collection of nine samples is recommended based on the minimal number of samples that can be used to estimate the UCL95. This number provides information regarding the chemical distribution and sufficient data to prevent default to the maximum concentration based on a limited data set.

The objective of the sampling program is to allow a set of samples collected from a site to be generalized to the entire site; that is, to be used as a data set. This form of systematic (probablistic) sampling is proposed to optimize the program objectives to assist in reaching conclusions regarding a site as efficiently as possible, while maintaining a degree of confidence that the site has been effectively sampled.

TAB

Section 4 - Sampling Plan

4.0 Sampling Plan

Section 4 describes the activities that will be conducted during the field investigation at DDMT. This section discusses activities that will support the investigative strategy described in Section 3.0 of this report. For each site, the following information is provided:

- Site description
- Site history
- Existing sampling data
- Potential contaminants of concern (PCOCs)
- Data gaps and site-specific DQOs
- Soil sampling and analysis
- Groundwater sampling and analysis

Tables 4-1 and 4-2 (located at the end of this section) show the number of proposed soil and groundwater samples for each site. Additionally, these tables show the parameters and data quality for each proposed sample.

4.1 Site 6—Eye Ointment Burial Site

On November 2, 1955, approximately 40,000 units of eye ointment of an unknown size were disposed of at this site. Site 6 is approximately 85 ft south of the north fence and 100 ft northeast of the Methyl Bromide Burial Site (Drawing 1).

4.1.1 Site History

Although the name of the ointment was not recorded, it should be taken into consideration that the ointment was a medication prescribed for the eye, which is one of the most delicate organs of the human body, and is not known to be hazardous or toxic in nature. The ointment was likely an antibacterial agent combined in a petroleum base. Aerial photographs taken during 1965 show ground disturbances where the disposal records indicate that the burial of the eye ointment occurred. Also, chemical warfare agents have been buried in Sites 1 and 9, in reasonable proximity to the site.

4.1.2 Existing Sampling Data

No sampling data appear to exist for this site. On the basis of the data provided for this site and the known potential for contamination at the facility, the PCOCs are VOCs, SVOCs, metals, and PAHs. Thiodyglycol is also a PCOC because it is a mustard breakdown product and because of the reasonable proximity of chemical warfare sites.

4.1.3 Data Gaps and Site-specific DQOs

The following summary chart identifies the major data gaps and DQOs for Site 6.

Site 6—Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
No data to assess whether a release has occurred to the surface or subsurface soils	Collect surface and subsurface soil samples to assess the presence of a contaminant release. Use Level 2 data to expedite the field investigation process. Use Level 3 data to confirm Level 2 data. Collect a minimum of 1 TCL/TAL sample at a field-selected location.

4.1.4 Soil Sampling and Analysis

The sampling rationale at this site is based on a biased approach to meet the DQOs. . The objective of the surface and subsurface soil samples (shown in Figure 4-1) is to confirm the presence of a contaminant release.

One soil boring will be installed in the center of the site to evaluate whether a subsurface release has occurred. Samples will be collected at depths of zero to 12 inches, 5 ft, 10 ft, and 20 ft. Three additional surface soil samples (for a total of 4) will be taken to evaluate whether a release has occurred. The following presents a summary of the quality and quantity of the proposed surface and subsurface soil sample analyses for the site:

- Seven samples will be analyzed for VOCs, SVOCs, and metals, using Level 2 data quality.
- One sample will be analyzed for VOCs, SVOCs, and metals, using Level 3 data quality to confirm Level 2 data quality.
- One sample will be analyzed for TCL/TAL (location will be based on field monitoring equipment results). This sample also will be analyzed for thiodyglycol to confirm or deny the presence of chemical warfare breakdown products at this site.

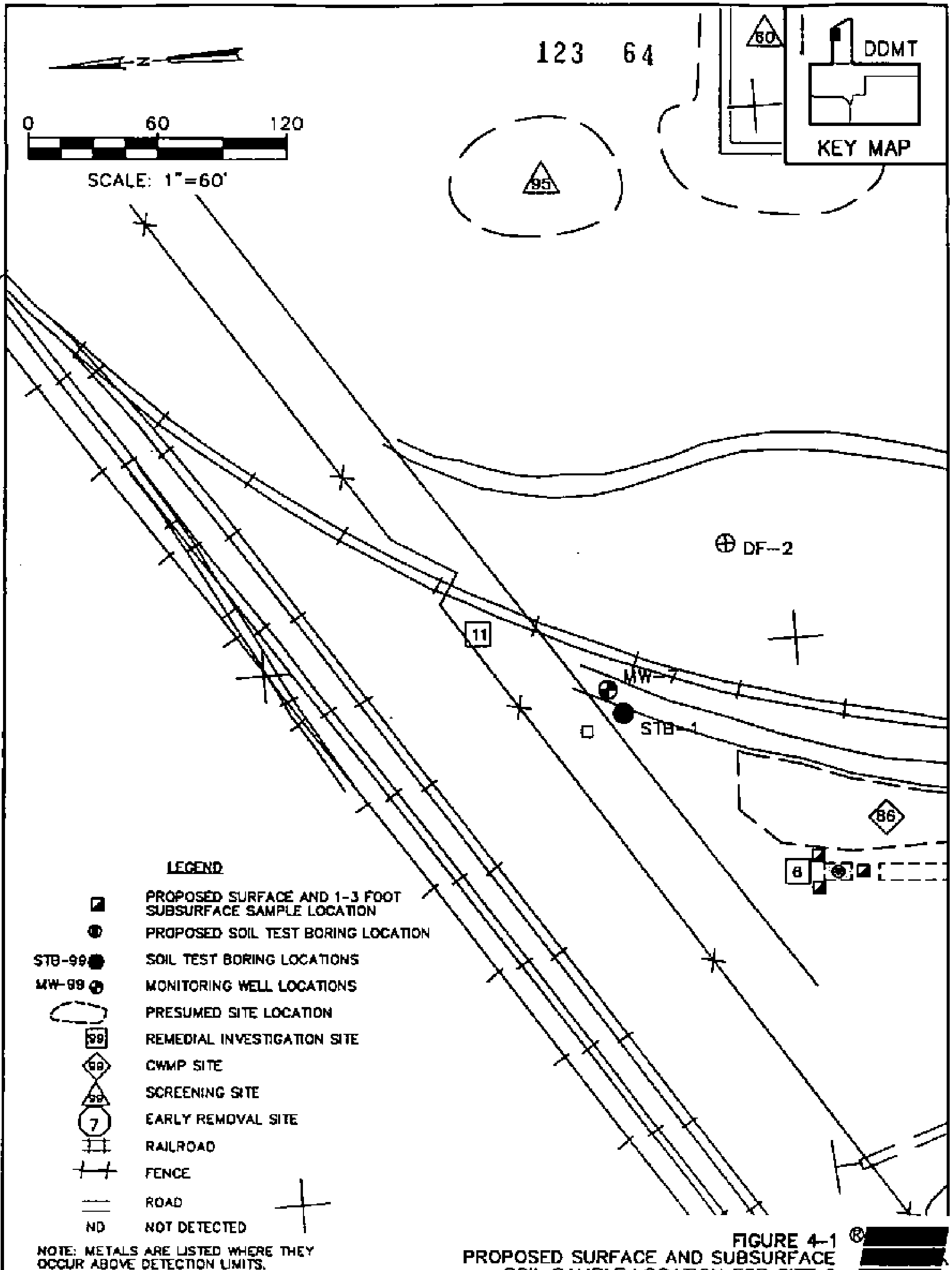


FIGURE 4-1
PROPOSED SURFACE AND SUBSURFACE
SOIL SAMPLE LOCATION FOR SITE 6
Defense Depot Memphis, Tennessee

CH2M HILL

4.2 Site 10—Solid Waste Burial Site

Site 10 is located in Dunn Field approximately 30 ft south of the north fence and 35 ft east of the west fence (Drawing 1). This site was discovered during the installation of MW-10. Charred metal, cans, broken glass, and ashes were encountered at a depth of 3.5 ft. MW-2 and STB-6 did not reveal the presence of any buried debris during their installation (ref. 5).

4.2.1 Site History

It is uncertain whether disposal at Site 10 was a one-time event or if the site was used continually. Unlike other burial sites recorded by DDMT, there is no documented use of this site. The installation records do not indicate this burial activity. Aerial photographs taken during 1958 reveal a possible trench around the area of the proposed site location. The boundary of the site presented in Figures 4-2 and 4-3 is estimated using the historical aerial photography. The 1960 photo obtained indicates that the site was backfilled.

4.2.2 Existing Sampling Data

Monitoring wells MW-2, MW-3, and MW-10 and soil boring STB-6 are located within the proposed site location (Figure 4-2). MW-2 is screened at a depth of 29 ft and is believed to be in a perched aquifer. The data from MW-2 are useful in evaluating whether leaching is occurring from this or other sites. Previous sampling activities (refs. 2 and 5) indicated the presence VOCs and metals in MW-10 and MW-3, although only metals were detected in MW-2. STB-6 was sampled at depths of 71.5, 76.0, 86.0, and 181.0 ft. The presence of VOCs and metals was detected at all sample depths. However, mud rotary procedures were used, and it is possible that contaminants were carried to these depths through this procedure. Appendix B contains the sampling data.

4.2.3 Potential Contaminants of Concern

Previous groundwater and soil samples taken at the site indicate contaminant levels exceeding PRGs of VOCs and metals. Therefore, the PCOCs for this site are VOCs and metals.

4.2.4 Data Gaps and Site-Specific DQOs

The following summary chart identifies the major data gaps and DQOs for Site 10.

Site 10 – Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
No data to assess what was buried at the site No data to identify the source of potential contamination No data to assess horizontal or vertical extent of soil contamination	Collect surface and subsurface soil samples to assess source of contamination. Use Level 2 data to expedite the field investigation process. Use Level 3 data to confirm Level 2 data.
No data to indicate whether contaminants are a result of disposal at Site 10 or other sites (surface/subsurface samples – upgradient well)	Collect a minimum of 1 TCL/TAL sample at a field-selected location.

4.2.5 Soil Sampling and Analysis

The sampling rationale at this site is based on both systematic and biased sample locations to meet the DQOs.

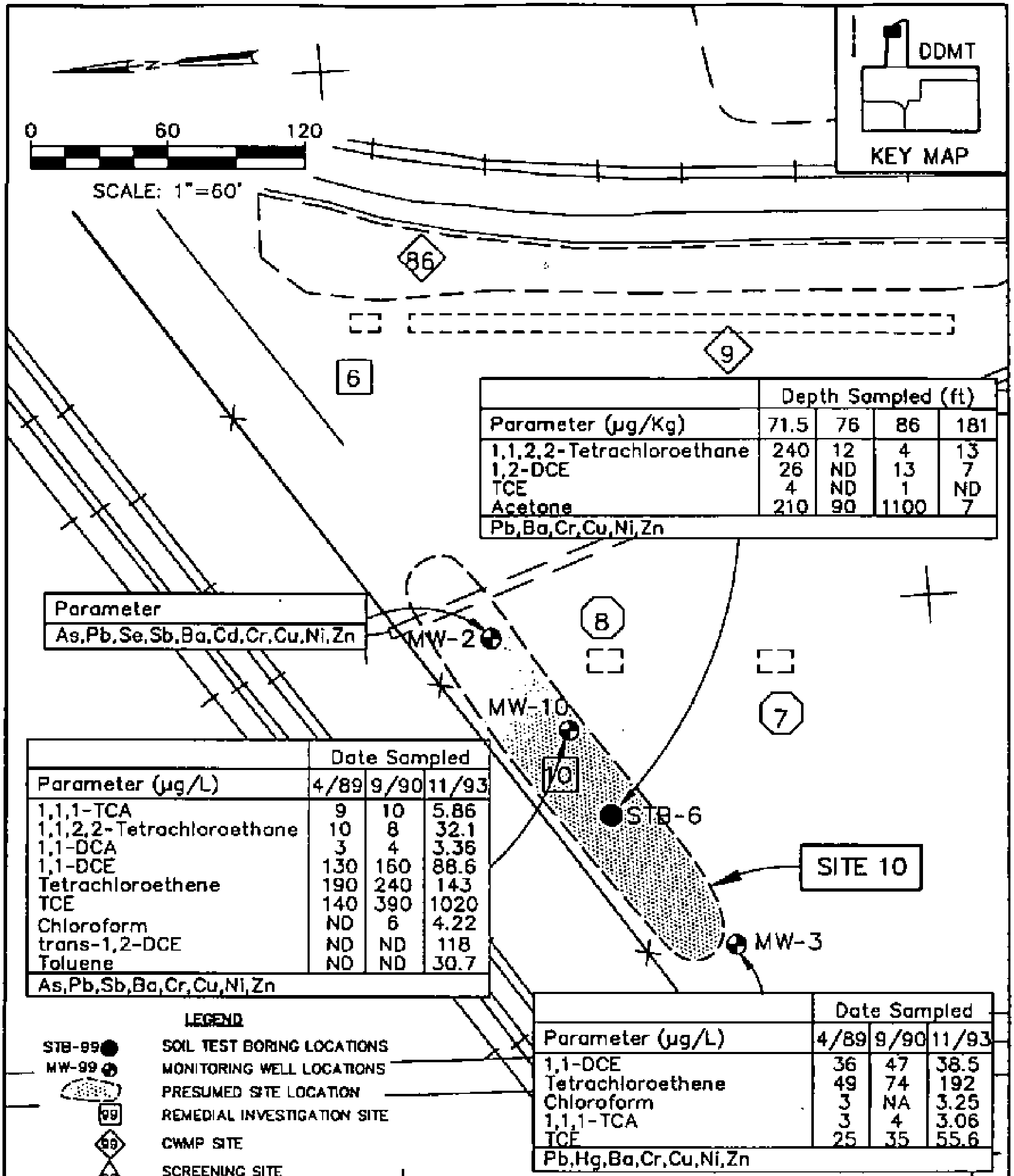
The objective of surface and subsurface soil analyses is to evaluate the origin and the vertical extent of contaminants at the site and to develop enough data to conduct a statistical comparison (see Section 3.5). Four soil borings will be installed at the site (Figure 4-3). Two of the borings will be on the perimeter of the proposed site location, and the remaining two borings will be installed within the boundary of the proposed site location. Samples will be collected at depths of zero to 12 inches, 5 ft, 10 ft, and 20 ft, and at 20-foot intervals to the top of the water table to assess the extent of contamination. Five surface soil samples will be taken at the site (Figure 4-3) to assess the presence and extent of surface soil contamination. The following list shows the quantity and quality of the proposed surface and subsurface soil sample analyses for the site based on the assumption that the water table is approximately 80 ft bgs:

- Thirty-three samples will be analyzed for VOCs and metals using Level 2 data quality.
- Four samples will be analyzed for VOCs and metals using Level 3 data quality to confirm Level 2 data quality.
- One sample will be analyzed for TCL/TAL (based on field observations of monitoring equipment).

One sample will be collected from one of the borings (at the 10-foot depth) at Site 10 for geotechnical analyses. The purpose of the analyses is to obtain initial geotechnical and fate and transport data on subsurface soils for OU-1. The sample for analyses will be field selected by the hydrogeologist. The sample will be analyzed for grain size, Atterberg limits, and moisture content in accordance with Section 5.4.2.5 of the *QAPP* (ref. 15). Additional analyses to support fate and transport assessment include pH (SW-846 Method 9045), alkalinity (EPA 310.1M), cation exchange capacity (SW-846 Method 9080), and total organic carbon (EPA Method 415.1M).

4.2.6 Groundwater Sampling and Analysis

The facilitywide groundwater strategy is presented in Section 4.3 of the *OU-4 FSP*. Samples will be collected from wells MW-2, MW-3, and MW-10 adjacent to Site 10 for VOCs and metals, as explained in more detail in Section 4.3 of *OU-4 FSP*. Refer to the *OU-4 FSP* for additional details.



	Depth Sampled (ft)			
Parameter (µg/Kg)	71.5	76	86	181
1,1,2,2-Tetrachloroethane	240	12	4	13
1,2-DCE	26	ND	13	7
TCE	4	ND	1	ND
Acetone	210	90	1100	7
Pb,Ba,Cr,Cu,Ni,Zn				

Parameter
As,Pb,Se,Sb,Ba,Cd,Cr,Cu,Ni,Zn

	Date Sampled		
Parameter (µg/L)	4/89	9/90	11/93
1,1,1-TCA	9	10	5.86
1,1,2,2-Tetrachloroethane	10	8	32.1
1,1-DCA	3	4	3.36
1,1-DCE	130	160	88.6
Tetrachloroethene	190	240	143
TCE	140	390	1020
Chloroform	ND	6	4.22
trans-1,2-DCE	ND	ND	118
Toluene	ND	ND	30.7
As,Pb,Sb,Ba,Cr,Cu,Ni,Zn			

	Date Sampled		
Parameter (µg/L)	4/89	9/90	11/93
1,1-DCE	36	47	38.5
Tetrachloroethene	49	74	192
Chloroform	3	NA	3.25
1,1,1-TCA	3	4	3.06
TCE	25	35	55.6
Pb,Hg,Ba,Cr,Cu,Ni,Zn			

LEGEND

- STB-99 SOIL TEST BORING LOCATIONS
- MW-99 MONITORING WELL LOCATIONS
- PRESUMED SITE LOCATION
- 99 REMEDIAL INVESTIGATION SITE
- 99 CWMP SITE
- 99 SCREENING SITE
- 7 EARLY REMOVAL SITE
- RAILROAD
- FENCE
- ROAD
- ND NOT DETECTED

NOTE: METALS ARE LISTED WHERE THEY OCCUR ABOVE DETECTION LIMITS.

FIGURE 4-2
EXISTING SOIL TEST BORING AND DATA FOR SITE 10
Defense Depot Memphis, Tennessee

CH2MHILL

MU1-0002.DWG 12-Oct-1995

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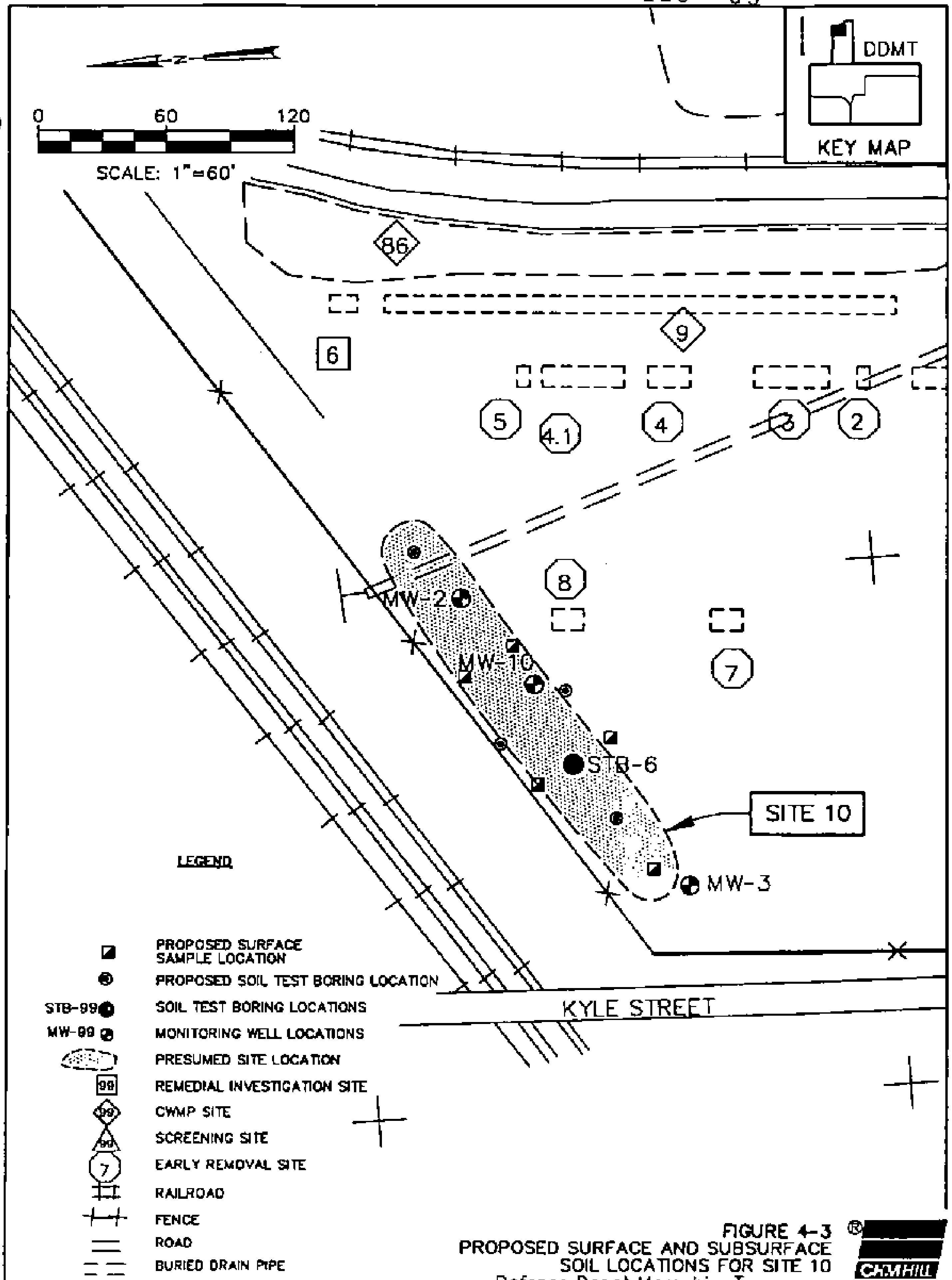


FIGURE 4-3
PROPOSED SURFACE AND SUBSURFACE SOIL LOCATIONS FOR SITE 10
Defense Depot Memphis, Tennessee

MU1-0005.DWG 12-Oct-1995

4.3 Site 14—Municipal Waste Burial Site

Site 14 is located approximately 75 ft from the western boundary and is adjacent to MW-12 and MW-35 (Drawing 1).

4.3.1 Site History

The date of burial at this site is unknown. However, an aerial photograph taken during September 1965 reveals a road leading to the proposed site location. This site was used for municipal solid waste burial.

4.3.2 Existing Sampling Data

MW-12 and MW-35 are at Site 14. Previous results of groundwater analysis from MW-12 and MW-35 (refs. 2 and 5) indicate the presence of VOCs, SVOCs, and metals (Figure 4-4). No surface or subsurface sampling data exist for this site. Appendix B contains the sampling data for MW-12 and MW-35.

4.3.3 Potential Contaminants of Concern

Previous groundwater samples taken at the site indicate contaminant levels exceeding PRGs of VOCs, SVOCs, and metals. Therefore, the PCOCs for this site are VOCs, SVOCs, and metals.

4.3.4 Data Gaps and Site-specific DQOs

The following summary chart identifies the major data gaps and DQOs for Site 14.

Site 14—Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
No data to assess if surface or subsurface soil contamination is present	Collect surface and subsurface soil samples to assess source of contamination.
No data to assess horizontal or vertical extent of soil contamination if it exists	Use Level 2 data to expedite the field investigation process.
No data to indicate whether contaminants are a result of disposal at Site 14 or other sites (surface/subsurface samples—upgradient well)	Use Level 3 data to confirm Level 2 data. Collect a minimum of 1 TCL/TAL sample at a field-selected location.

4.3.5 Soil Sampling and Analysis

The sampling rationale at this site is based on both systematic and biased sample locations to meet the DQOs.

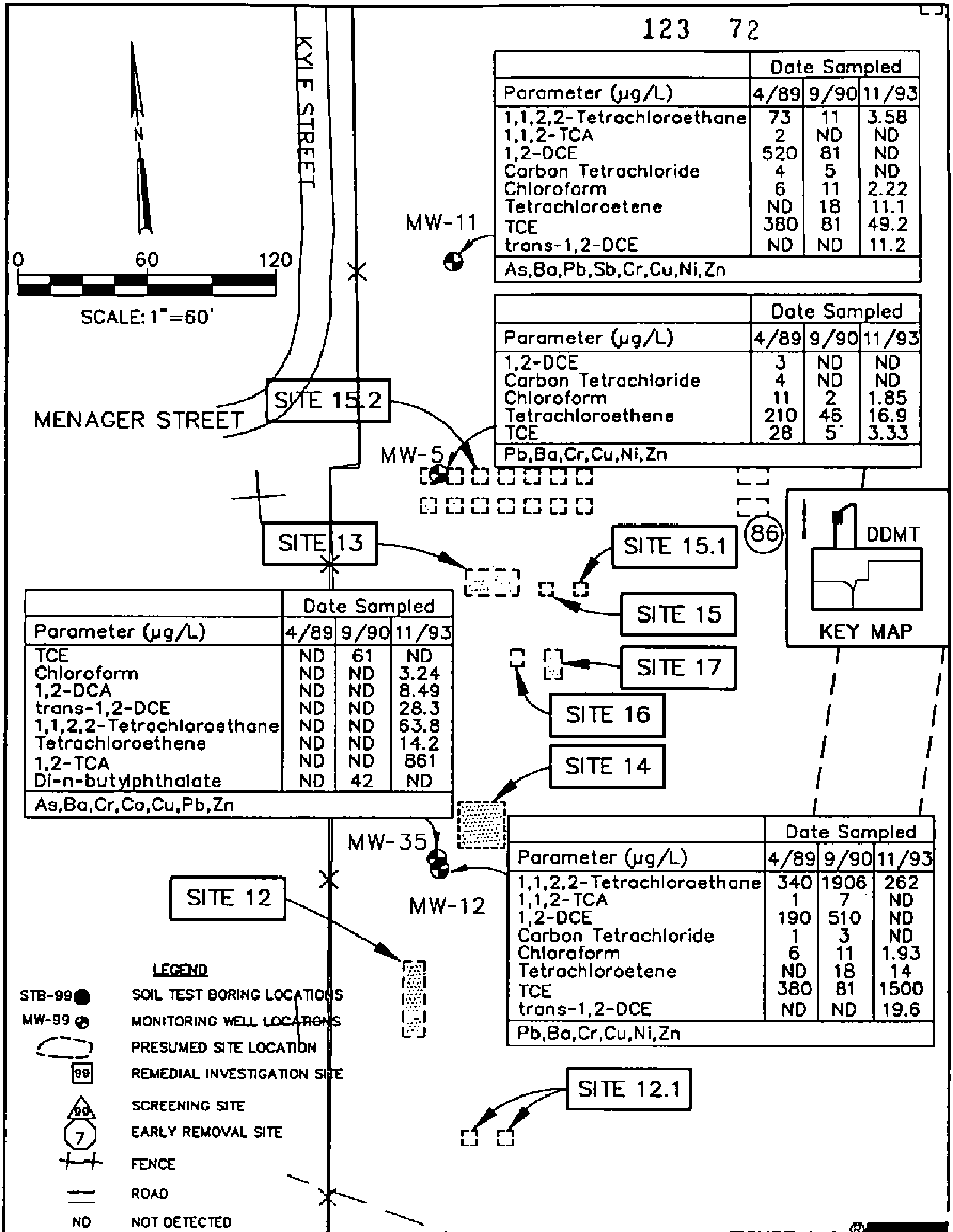
The objective of surface and subsurface soil analyses is to evaluate whether soil contamination exists and to evaluate the vertical extent of possible existing contaminants at the site (see Section 3.7). One soil boring will be installed at the proposed site location (Figure 4-5). Samples will be collected at depths of zero to 12 inches, 5 ft, 10 ft, and 20 ft. The 20-foot depth was selected because existing data indicate that a release has occurred. Three surface soil samples will be taken at the site (Figure 4-5) to assess the presence and extent of surface soil contamination. The following list shows the quantity and quality of the proposed surface and subsurface soil sample analyses for the site:

- Seven samples will be analyzed for VOCs, SVOCs, and metals using Level 2 data quality.
- One sample will be analyzed for TCL/TAL (based on the results of field monitoring equipment).

4.3.6 Groundwater Sampling and Analysis

Groundwater samples will be collected from existing monitoring wells at the site (MW-35 and MW-12) as part of the facilitywide groundwater approach. This approach is presented in Section 4.3 of the *OU-4 FSP*.

123 72



MW-11

	Date Sampled		
Parameter (μg/L)	4/89	9/90	11/93
1,1,2,2-Tetrachloroethane	73	11	3.58
1,1,2-TCA	2	ND	ND
1,2-DCE	520	81	ND
Carbon Tetrachloride	4	5	ND
Chloroform	6	11	2.22
Tetrachloroetene	ND	18	11.1
TCE	380	81	49.2
trans-1,2-DCE	ND	ND	11.2
As,Ba,Pb,Sb,Cr,Cu,Ni,Zn			

MW-5

	Date Sampled		
Parameter (μg/L)	4/89	9/90	11/93
1,2-DCE	3	ND	ND
Carbon Tetrachloride	4	ND	ND
Chloroform	11	2	1.85
Tetrachloroethene	210	45	16.9
TCE	28	5	3.33
Pb,Ba,Cr,Cu,Ni,Zn			

MW-35

	Date Sampled		
Parameter (μg/L)	4/89	9/90	11/93
TCE	ND	61	ND
Chloroform	ND	ND	3.24
1,2-DCA	ND	ND	8.49
trans-1,2-DCE	ND	ND	28.3
1,1,2,2-Tetrachloroethane	ND	ND	63.8
Tetrachloroethene	ND	ND	14.2
1,2-TCA	ND	ND	861
Di-n-butylphthalate	ND	42	ND
As,Ba,Cr,Co,Cu,Pb,Zn			

MW-12

	Date Sampled		
Parameter (μg/L)	4/89	9/90	11/93
1,1,2,2-Tetrachloroethane	340	1906	262
1,1,2-TCA	1	7	ND
1,2-DCE	190	510	ND
Carbon Tetrachloride	1	3	ND
Chloroform	6	11	1.93
Tetrachloroetene	ND	18	14
TCE	380	81	1500
trans-1,2-DCE	ND	ND	19.6
Pb,Ba,Cr,Cu,Ni,Zn			

FIGURE 4-4
EXISTING SOIL TEST BORING AND MONITORING WELL DATA FOR SITES 14 AND 15
Defense Depot Memphis, Tennessee

CH2M HILL

MU1-0003.DWG 12-Oct-1995

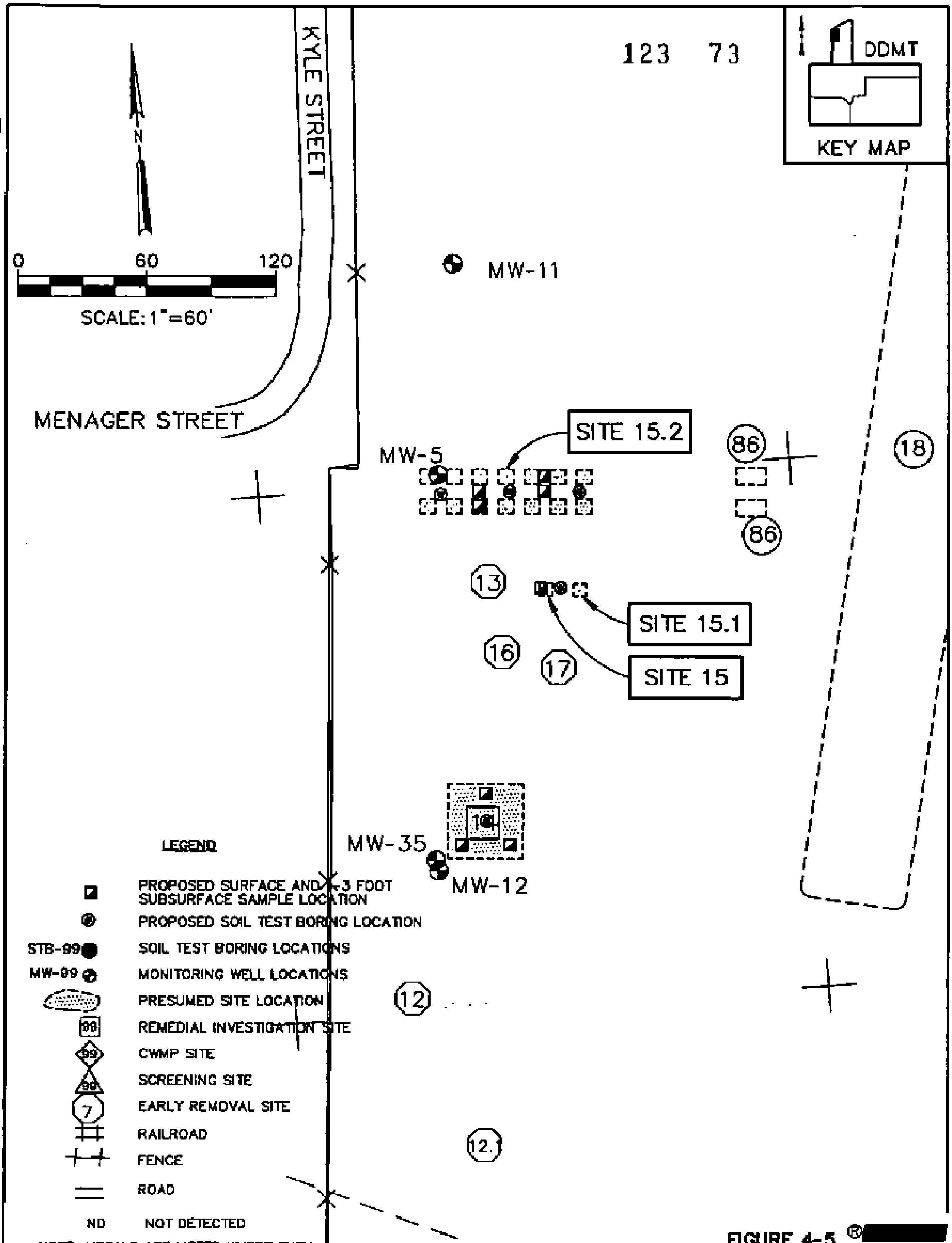


FIGURE 4-5
PROPOSED SURFACE AND SUBSURFACE SOIL LOCATIONS FOR SITES 14 AND 15
Defense Depot Memphis, Tennessee

MU1-0006.DWG 13-Oct-1995

4.4 Site 15—Sodium Burial Sites

Site 15 (which includes sites 15, 15.1, and 15.2) is located approximately 90 ft from the western boundary and 450 ft from the northern boundary (Drawing 1). The site consists of two rows of seven pits (Site 15), and two other 6-foot by 6-foot sites (Sites 15.1 and 15.2). An aerial photograph taken during 1971 reveals no ground disturbances at the proposed site location.

4.4.1 Site History

DDMT disposal records indicate that one pallet of sodium was buried in 1968 (Site 15), along with the burial of one pallet of sodium phosphate in 1968 (Site 15.1), and the burial of an unknown quantity of sodium (suspected salt), sodium phosphate, undefined acid, chlorinated lime, and medical supplies in 1970 (Site 15.2). The *RFA Report* (ref. 12) suggests that the VOCs and metal contamination in MW-5 and MW-11 are attributable to this site. However, records indicate burial of sodium salts and do not indicate that VOC-containing materials were buried.

4.4.2 Existing Sampling Data

MW-5 is located at the site and MW-11 is located approximately 90 ft north of the site. Prior sampling data (refs. 2 and 5) indicate the presence of VOCs and metals in both wells (Figure 4-4). No surface or subsurface soil sample data exist for this site. Appendix B contains the sample data for MW-5 and MW-11.

4.4.3 Potential Contaminants of Concern

Previous groundwater samples taken near the site indicate contaminant levels exceeding PRGs of VOCs and metals. Also, medical supplies have historically been disposed at the site. Therefore, the PCOCs for this site are VOCs, SVOCs, sodium, iodide, metals, and pH.

4.4.4 Data Gaps and Site-Specific DQOs

The following summary chart identifies the major data gaps and DQOs for Site 15.

Site 15 – Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
No data to assess if surface or subsurface soil contamination is present	Collect surface and subsurface soil samples to assess source of contamination.
No data to assess horizontal or vertical extent of soil contamination if it exists	Use Level 2 data to expedite the field investigation process.
No data to indicate whether contaminants are a result of disposal at Site 15 or other sites (surface/subsurface samples – upgradient well)	Use Level 3 data to confirm Level 2 data. Collect a minimum of 1 TCL/TAL sample at a field-selected location.

4.4.5 Soil Sampling and Analysis

The sampling rationale at this site is based on a systematic approach of sample locations to meet the DQOs.

The objective of surface and subsurface soil analyses is to evaluate whether soil contamination exists, to evaluate the vertical extent of possibly existing contaminants at the site, and to develop enough data to conduct a statistical comparison (see Section 3.7). Four soil borings will be installed around the site (Figure 4-5). Samples will be collected at depths of zero to 12 inches, 5 ft, 10 ft, and 20 ft. The 20-foot depth was selected to assess whether a release to subsurface soils beneath the burial has occurred. Additionally, five surface soil samples will be taken at the site (Figure 4-5) to assess the presence and extent of surface soil contamination. The following list shows the quantity and quality of the proposed surface and subsurface soil sample analyses for the site:

- Twenty-one samples will be analyzed for VOCs, sodium, SVOCs, iodide, pH, and metals using Level 2 data quality.

- Two samples will be analyzed for VOCs, sodium, SVOCs, iodide, pH, and metals using Level 3 data quality to confirm Level 2 data quality.

- One sample will be analyzed for TCL/TAL (based on the results of the field monitoring equipment).

4.4.6 Groundwater Sampling and Analysis

Groundwater samples will be collected from existing monitoring wells at the site (MW-5 and MW-11) as part of the facilitywide groundwater strategy. The groundwater strategy is presented in Section 4.3 of the *OU-4 FSP*.

Table 4-1
Proposed Number of Analyses for Level 2 Data Quality
Defense Depot Memphis, Tennessee

Site	Level 2 Analytical Soil Samples					pH
	VOCs	SVOCs	Metals PPM (1)	Na (2)	Iodide	
6	7	7	7	-	-	-
10	33	-	33	-	-	-
14	7	7	7	-	-	-
15	21	21	21	21	21	21
TOTAL	68	35	68	21	21	21

- Not Analyzed
(1) PPM - Priority Pollutant Metals
(Ag, As, Be, Cd, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn)
(2) Na - Sodium
Note: See Section 3.2.2 of *QAPP* for analytical methods to be used for each parameter.

Table 4-2
Proposed Number of Analyses for Level 3 Data Quality
Defense Depot Memphis, Tennessee

Site	Level 3 Soils								Level 3 Water					
	VOCs	SVOCs	Metals PPM[1]	Na[2]	Iodide	pH	Thio-dyglycol	TCL/ TAL	VOCs	SVOCs	Metals (total) PPM[1]	Metals (dissolved) PPM[1]	Na[2]	TCL/ TAL
6	1	1	1	-	-	-	1	1	-	-	-	-	-	-
10	4	-	4	-	-	-	-	1	3	-	3	3	-	1
14	-	-	-	-	-	-	-	1	2	2	2	2	-	1
15	2	2	2	2	2	2	-	1	2	2	2	2	2	1
TOTAL	7	3	7	2	2	2	1	4	7	4	7	7	2	3

- Not Analyzed
[1]PPM - Priority Pollutant Metals (Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn)
[2]Na - Sodium
Note: See Section 3.2.2 of *QAPP* for analytical methods to be used for each parameter.

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TAB

Section 5 - Preliminary Data Needs for Remedial Alternatives

5.0 Preliminary Data Needs for Remedial Alternatives

After the RI field work has been completed, the data can be assessed to evaluate the appropriate future disposition of a site (NFA, FS, or IRA). Sites that require an FS to meet the objectives of the program will require additional data collection. The additional collection may be used to support the alternatives evaluation, to refine select alternatives, or to collect data to support remedial design activities.

5.1 Initial Alternatives

A cursory review of the RI sites at OU-1 has been conducted to develop a list of initial preliminary alternatives. These initial alternatives have been identified from existing data, the PCOCs, and knowledge about treatment technologies available. The initial alternatives do not represent a complete, detailed evaluation of alternatives or represent the final remedy. They do represent an initial attempt at identifying alternatives that are likely to be on the final list of developed alternatives for evaluating a site for remedial activities. The alternatives listed are presented for soil media only. Groundwater at OU-1 is currently being addressed through an IRA because of the known contamination in the groundwater at Dunn Field. The list of initial alternatives for soil media at each site is presented in Table 5-1.

5.2 Data Collection

For each alternative listed in Table 5-1, a select group of parameters has been identified. These parameters must be considered when evaluating the identified alternative. The parameters for each identified alternative are presented in Table 5-1. A field decision for each site will be made to assess whether the identified data needs will be met during the RI field investigation. Factors affecting the decision to collect data include the following:

- Presence of contamination
- Spatial magnitude of contamination
- Concentrations of contaminants
- Character of contaminants (VOCs, SVOCs, metals, and so forth)

Future data collection should be identified using data collected in the RI field investigation and by completing a detailed identification of remedial alternatives for each site.

Data collected for groundwater are presented in the *OU-4 FSP* (ref. 17). The facilitywide groundwater approach is presented in Section 4.3 of the *OU-4 FSP* to achieve a concise presentation of strategy.

Table 5-1
Preliminary Screening of Remedial Alternatives for RI Sites—OU-1
Defense Depot Memphis, Tennessee

Site Numbers and Descriptions[a]	Media	Analytical Data Available	Possible Parameters to be Remediated[b]	Remedial Options That May Be Evaluated[c]	Data Need for Initial Evaluation of Alternatives
Site 6—40,037 units Ointment (eye) Burial Site	Soil/Waste	No Site-Specific	pH, specific conductance	Landfill	TCLP[d], hazardous waste characteristics
				Cover	Adequate blow count information on boring logs (to 15 ft or so)
Site 10—Solid Waste Burial Site	Soil/Waste	Yes; VOC plumes	VOCs (based on contaminant plumes)	Landfill	TCLP, hazardous waste characteristics
				Cover	Adequate blow count information on boring logs (to 15 ft or so)
				Incineration	Metals (TCLP and total), chlorine, BTU as higher heating value and ash content (can probably use reference values)
				SVE	Grain size (if clay, do Atterburg), moisture content, soil boring profiles to water table, pump test (slug test if pump test not possible)
Site 11—Trichloroacetic Acid Burial Site	Soil	No Site-Specific	pH, metals may be mobilized	Neutralization	pH, alkalinity, moisture content
Site 15—Sodium Burial Sites	Soil	No Site-Specific	pH, sodium, phosphates, metals may be mobilized	Neutralization	pH, alkalinity, moisture content

Note: [a]Screening sites and NFA sites are not included in this table. Status of sites was based on the December 9, 1995, listing for the Site Management Plan.

[b]Listed are general categories of potential categories of contaminants. The list is not all inclusive nor a limitation on the analytical data to be collected, because current analytical data are not available for many sites and the listed COCs are based on reported activities. The "contaminants of concern" are for potential collection of data to support an alternatives evaluation.

[c]This table is a general list of potential data needs for the RI to aid in the scoping of field activities. It is not intended for use as the preliminary remedial alternatives screening for the FS, nor is it intended to collect data for all potential remedial alternatives to be evaluated. Alternatives that will not require data collection during the RI field activities are not included. Similar technologies would be grouped under a specific name; for example, incineration would generally also represent thermal desorption, cement kilns, incinerators, pyrolysis, or wet air oxidation as similar technologies.

[d]TCLP = Toxicity characteristic leachate procedure.

TAB

Section 6 - Quality Assurance for Field Sampling

6.0 Quality Assurance for Field Sampling

The goal of QA in the field is to provide data of known quality to the project team to support the project decision-making process. The implementation of QA goals is the responsibility of the FTL. The FTL reports to the project manager (PM) and is responsible for the coordination of field efforts, provides for the availability and maintenance of sampling equipment and materials, and provides shipping and packing materials. The FTL supervises the completion of all chain-of-custody records, supervises the proper handling and shipping of samples, and is responsible for accurate completion of the field notebook. As the lead field representative, the FTL is responsible for consistently implementing program QA/QC measures at the site and for performing field activities in accordance with approved work plans, policies, and field procedures. The *QAPP* (ref. 15) provides details on meeting the goal of QA during the field investigation. This section summarizes some of the critical field QA procedures, as well as the QA/QC samples to be collected during the field investigation.

6.1 Field Documentation Summary

All field notes will be recorded in indelible ink on standard forms in bound notebooks. Section 4.3 of the *QAPP* (ref. 15) contains all information that will be recorded in the field book. A daily field log will be completed by the FTL. This log will be signed and dated daily. Significant events occurring during the day will be recorded and reported to the PM. Daily communication is essential to evaluate whether timely corrective measures are necessary. The field notebooks must provide a place for the field team members to sign and date the entries. The FTL or designated representative will conduct weekly informal audits for completeness. The following items must be entered:

- Sample labels
- Chain-of-custody records
- Field notebooks
- Sampling operations
- Document control

6.2 Field Monitoring Summary

All field monitoring equipment will be calibrated according to the procedures outlined in Section 6 of the *QAPP* (ref. 15); all field procedures concerning groundwater, soil, sediment, and surface water sampling are described in Section 5. Additionally, Section 5 contains soil boring and monitoring well drilling procedures, geophysical survey and logging procedures, and all equipment decontamination procedures.

6.3 QA/QC Sampling Summary

Different types of QA/QC samples will be collected and analyzed during the RI/FS at DDMT. These samples include the following:

- Trip blanks
- Equipment blanks
- Field blanks
- Field duplicates
- Matrix spike/matrix spike duplicate (MS/MSD) samples
- Split Samples

6.3.1 Trip Blanks

Trip blanks are to be analyzed for VOCs only. Three 40-milliliter (mL) VOC vials will accompany each ice chest that contains samples collected for VOC analyses. The trip blanks will be shipped to the site from the laboratory filled with American Society for Testing and Materials (ASTM) Type II water, along with sampling kits. One of the trip blanks will accompany split VOC samples to the COE QA laboratory.

6.3.2 Equipment Blanks

Equipment blanks are processed by rinsing decontaminated sampling equipment with ASTM Type II water obtained from the laboratory. The rinse water is collected in sample bottles, preserved, and handled in the same manner as the samples. Equipment blanks will be collected once a day for the equipment used during sampling procedures. Split equipment blank samples of the rinsate will be sent to the COE QA laboratory.

6.3.3 Field Blanks

Field blanks are samples of source water used for decontamination and are used to monitor the potential for contamination from the source water. One field blank will be collected from each source once a week.

6.3.4 Field Duplicates

The FTL will choose at least 10 percent of the Level 3 samples and 5 percent of the Level 2 samples from sample locations previously known to be contaminated, and will collect duplicate samples from those locations. The source information will be recorded in the field notes, but not on the chain-of-custody. The identity of the duplicates will not be given to the analyst. The source of information will be forwarded to the QA reviewer to aid in the review and validation of the data. The source of the field duplicate will be clearly identified in the chain-of-custody form sent to the QA laboratory.

6.3.5 Matrix Spike/Matrix Spike Duplicate

MS/MSD samples will be collected and shipped to the laboratory for spike sample analyses. Five percent of the samples collected at OU-1 will be accompanied by spike samples. However, if an MS/MSD sample has not been collected in a 14-day time period, a spike sample will be collected and sent for sample analyses.

6.3.6 Split Samples

Split samples will be collected for 1 percent of the samples at OU-1. Split samples will be handled as identified in Section 4.2.5 of the *QAPP* (ref. 15).

TAB

Appendix A - References

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TAB

Appendix B - Existing Sampling Data

Appendix B – Table of Contents
Summary of Previous Investigations
Defense Depot Memphis, Tennessee

Remedial Investigation/Feasibility Study
Law Environmental
August 1990

TABLE B-1 [illegible title text]

SAMPLE ID'S PARAMETERS	UNITS	STORET METHOD	MW3 CDDMTW 3	MW4 CDDMTW 4	MW5 CDDMTW 5	MW6 CDDMTW 6	MW7 CDDMTW 7	MW8 CDDMTW 8	MW9 CDDMTW 9	MW10SP CDDMTW 10	MW11 CDDMTW 11	MW12SP CDDMTW 12	MW13 CDDMTW 13	MW14 CDDMTW 14	MW15 CDDMTW 15	State and Federal MCLs: Tennessee MCL	Federal MCL
DATE TIME			11/12/93 15:00	11/15/93 15:00	11/16/93 12:00	11/18/93 09:00	11/15/93 18:50	11/17/93 11:20	11/15/93 17:11	11/11/93 18:00	11/13/93 09:30	11/11/93 15:10	11/15/93 15:30	11/17/93 15:45	11/18/93 12:00		
CARBON TETRACHLORIDE	UG/L	32102 8010-G	--	--	--	83.7	--	--	3.07	1.32	--	--	--	--	33.8	5	5
CHLOROFORM	UG/L	32106 8010-G	3.35	--	1.15	14.1	17.8	--	1.78	4.22	2.22	1.93	--	--	59.2	--	100
1,1-DICHLOROETHANE	UG/L	34496 8010-G	1.06	--	--	--	1.49	1.87	--	3.36	--	--	--	--	--	--	--
1,2-DICHLOROETHANE	UG/L	34531 8010-G	--	--	--	--	--	--	--	1.56	--	--	--	--	--	5	5
1,1-DICHLOROETHYLENE	UG/L	34501 8010-G	38.5	--	--	--	36.5	34.4	7.50	18.4	--	--	--	--	--	7	7
TRANS-1,2-DICHLORO ETHENE	UG/L	34546 8010-G	--	--	--	20.8	--	--	--	118	11.7	19.6	--	--	2.09	100	100
METHYLENE CHLORIDE	UG/L	34423 8010-G	--	--	--	--	--	--	--	134	--	--	--	--	--	--	5
1,1,2,2-TETRACHLORO ETHANE	UG/L	34516 8010-G	--	--	--	319	--	--	--	33.1	3.58	761	--	--	2.71	--	--
TETRACHLOROETHENE	UG/L	34475 8010-G	197	33.6	16.9	3.06	35.0	35.2	22.1	141	11.1	54.0	2.01	--	4.39	5	5
1,1,1-TRICHL'ETHANE	UG/L	34506 8010-G	1.96	--	--	--	1.61	1.96	--	5.86	--	--	--	--	--	200	200
1,1,2-TRICHL'ETHANE	UG/L	34511 8010-G	--	--	--	9.10	--	--	--	4.34	--	--	--	--	--	--	5
TRICHLOROETHENE	UG/L	39180 8010-G	55.8	--	1.33	338	1177	16.3	9.70	1020	4932	1500	--	--	46.4	5	5
TOLUENE	UG/L	34010 8020-G	--	--	--	--	--	--	1.89	10.7	--	--	--	--	--	1000	1000
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	39100 8270/3520-G	1.4	--	--	--	--	6.0	3.6	5.3	2.8	--	--	6.9	--	--	6
DI-N-BUTYLPHTHALATE	UG/L	39110 8270/3520-G	--	--	--	--	--	1.7	--	--	--	--	--	--	--		--
FLUORANTHENE	UG/L	34376 8270/3520-G	--	--	--	3.5	--	--	--	--	--	--	--	--	--	--	--
PHENOL	UG/L	34694 8270/3520-G	--	--	--	--	--	--	--	4.3	--	--	--	--	--	--	--
ACENAPHTHENE	UG/L	34205 8310/3520-G	--	--	--	10.1	--	--	--	--	--	--	19.0	--	--	--	--
ANTHRACENE	UG/L	34220 8310/3520-G	--	1.59	1.27	6.04	4.84	1.65	--	--	--	--	38.5	5.77	--	--	--
BENZO(A)ANTHRACENE	UG/L	34526 8310/3520-G	0.027	0.052	0.014	0.786	0.136	0.041	0.004	0.015	0.010	--	1.01	0.121	0.004	--	0.1
BENZO(A)PYRENE	UG/L	34247 8310/3520-G	0.025	0.048	0.037	0.836	0.165	0.052	0.008	0.021	0.037	--	1.37	0.116	0.003	--	0.2
BENZO(B)FLUORANTHENE	UG/L	34230 8310/3520-G	0.024	0.057	0.041	0.915	0.144	0.055	0.010	0.021	--	--	1.47	0.139	0.002	--	0.2
BENZO(GHI)PERYLENE	UG/L	34521 8310/3520-G	0.021	0.098	0.068	1.61	0.275	0.089	--	0.026	0.010	--	2.20	0.225	--	--	--
BENZO(K)FLUORANTHENE	UG/L	34242 8310/3520-G	0.012	0.035	0.019	0.421	0.066	0.027	0.005	0.011	0.006	--	0.697	0.068	0.002	--	0.2
CHRYSENE	UG/L	34320 8310/3520-G	--	--	--	2.14	0.129	1.58	--	--	--	--	1.43	2.82	--	--	0.2
DIBENZ(A,H)ANTHRACENE	UG/L	34556 8310/3520-G	--	0.008	0.004	0.932	0.017	0.008	--	--	0.034	--	0.150	0.006	--	--	0.3
FLUORANTHENE	UG/L	34376 8310/3520-G	0.057	0.105	0.089	3.31	0.334	0.113	0.015	0.050	--	--	2.70	0.321	0.018	--	--
INDENO(1,2,3 CD) PYRENE	UG/L	34403 8310/3520-G	0.016	0.015	0.005	1.37	0.060	0.014	--	0.030	0.027	0.005	0.360	0.061	0.010	--	0.4
NAPHTHALENE	UG/L	34696 8310/3520-G	--	--	--	1.88	--	--	--	--	--	--	3.90	--	--	--	--
PHENANTHRENE	UG/L	34461 8310/3520-G	--	0.150	0.144	3.02	0.939	0.165	--	--	--	--	4.59	0.784	--	--	--
PYRENE	UG/L	34469 8310/3520-G	0.130	0.287	0.208	6.91	3.54	0.275	--	--	1.15	--	11.7	3.35	--	--	--
ALDRIN	UG/L	39330 8080/3520-G	--	--	--	--	--	--	--	--	--	--	0.077	--	--	--	--
DDD, PP'	UG/L	39310 8080/3520-G	--	--	--	--	--	--	--	0.091	--	--	--	--	--	--	--
DDE, PP'	UG/L	39320 8080/3520-G	--	--	--	--	--	--	--	0.023	--	--	--	--	--	--	--
DDT, PP'	UG/L	39300 8080/3520-G	--	--	--	--	--	--	--	0.041	0.015	--	--	--	--	--	--
DIELDRIN	UG/L	39380 8080/3520-G	--	0.007	--	--	--	0.057	0.044	0.011	--	--	--	--	--	--	--

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TABLE B-1

SAMPLE ID'S PARAMETERS UNITS	STORET METHOD	MW3 CDDMTW 3	MW4 CDDMTW 4	MW5 CDDMTW 5	MW6 CDDMTW 6	MW7 CDDMTW 7	MW8 CDDMTW 8	MW9 CDDMTW 9	MW10SP CDDMTW 10	MW11 CDDMTW 11	MW12SP CDDMTW 12	MW13 CDDMTW 13	MW14 CDDMTW 14	MW15 CDDMTW 15	State and Federal MCLs*: Tennessee MCL	Federal MCL
DATE TIME		11/12/93 15:00	11/15/93 15:00	11/16/93 12:00	11/10/93 09:00	11/15/93 18:50	11/17/93 12:20	11/15/93 17:31	11/11/93 18:00	11/13/93 09:30	11/11/93 15:30	11/15/93 15:30	11/17/93 15:45	11/18/93 17:00		
ALUMINUM, TOTAL UG/L	1105 6010-G	16200	33600	59400	47900	26900	167000	61300	119000	137000	51200	34300	103000	124000	--	--
ARSENIC, TOTAL UG/L	1002 7060-G	--	6.5	11.5	1.0	2.6	--	4.2	13.4	4.6	7.1	--	136	19.4	50	50
BARIUM, TOTAL UG/L	1007 6010-G	155	110	218	610	147	571	360	1020	1330	354	180	1570	508	2000	2000
CHROMIUM, TOTAL UG/L	1034 6010-G	59.3	112	131	11.9	76.7	364	304	365	301	88.9	66.1	708	100	100	100
COBALT, TOTAL UG/L	1037 6010-G	30.4	98.6	53.1	104	94.3	132	63.9	90.7	344	233	42.1	129	180	--	--
COPPER, TOTAL UG/L	1047 6010-G	33.3	87.1	63.0	18.5	47.8	216	138	391	312	81.4	115	109	182	--	1300
LEAD, TOTAL UG/L	1051 7421-G	18.3	137	30.3	44.1	18.7	89.0	13.3	477	183	33.4	37.5	109	55.3	5	15
MERCURY, TOTAL UG/L	71900 7470-G	--	0.87	0.43	0.69	--	0.73	--	0.77	0.74	0.23	0.31	1.53	1.00	2	2
ZINC, TOTAL UG/L	1092 6010-G	122	195	232	138	131	417	165	739	475	191	168	452	454	--	--
RESIDUE, DISS (TDS) MG/L	70300 160.1-G	270	169	177	760	268	405	222	302	280	202	186	350	223	--	--
ALUMINUM, DISS UG/L	1106 6010-G	--	--	--	--	--	--	--	43.3	--	--	--	292	--	--	--
BARIUM, DISS UG/L	1005 6010-G	97.0	49.4	18.0	377	63.2	58.1	54.9	76.9	62.6	47.4	36.0	85.2	39.4	--	--
LEAD, DISS UG/L	1049 7421-G	--	--	--	--	--	--	--	--	--	--	--	--	10.3	--	--
ZINC, DISS UG/L	1090 6010-G	--	--	--	24.7	--	--	--	--	--	--	--	--	--	--	--

*All units in micrograms per liter (ug/L).
•Proposed value.

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TABLE B-1

SAMPLE ID'S / PARAMETERS / UNITS	STORET METHOD	MW16 COUNTY 16	MW19 COUNTY 19	MW20 COUNTY 20	MW21 COUNTY 21	MW22SP COUNTY 22	MW23 COUNTY 23	MW24 COUNTY 24	MW25 COUNTY 25	MW26 COUNTY 26	MW28 COUNTY 28	MW29 COUNTY 29	MW30 COUNTY 30	MW31 COUNTY 31	State and Federal MCLs*: Tennessee MCL	Federal MCL
DATE / TIME		11/09/93 14:05	11/19/93 18:00	11/19/93 14:30	11/18/93 17:00	11/17/93 15:00	11/15/93 09:30	11/14/93 17:00	11/13/93 08:20	11/09/93 19:30	11/19/93 18:30	11/17/93 09:45	11/19/93 15:45	11/19/93 12:30		
CARBON TETRACHLORIDE UG/L	32102 8010-G	--	--	--	--	--	--	--	--	3.16	--	--	--	4.81	5	5
CHLOROFORM UG/L	32106 8010-G	--	--	--	--	--	--	--	--	--	--	4.26	--	21.1	--	100
1,1-DICHLOROETHANE UG/L	34496 8010-G	--	--	--	--	--	--	--	--	--	--	2.69	--	1.66	--	--
1,2-DICHLOROETHANE UG/L	34531 8010-G	--	--	--	--	--	--	--	--	--	--	--	--	1.50	5	5
1,1-DICHLOROETHYLENE UG/L	34501 8010-G	--	--	--	--	--	--	--	--	--	--	32.3	--	52.4	7	7
TRANS-1,2-DICHLORO ETHENE UG/L	34546 8010-G	--	--	--	--	--	--	--	--	--	--	--	--	144	100	100
1,1,2,2-TETRACHLORO ETHANE UG/L	34516 8010-G	--	--	--	--	--	--	--	--	--	--	--	--	56.0	--	--
TETRACHLOROETHENE UG/L	34475 8010-G	--	--	--	45.1	--	--	--	33.2	6.58	--	43.3	--	55.4	5	5
1,1,1-TRICHLOROETHANE UG/L	34506 8010-G	--	--	--	--	--	--	--	--	--	--	--	--	2.77	200	200
1,1,2-TRICHLOROETHANE UG/L	34511 8010-G	--	--	--	--	--	--	--	--	--	--	--	--	6.41	--	5
TRICHLOROETHENE UG/L	39180 8010-G	1.10	--	--	4.42	1.24	--	--	--	1.29	--	14.9	--	1130	5	5
BIS(2-ETHYLHEXYL) PHTHALATE UG/L	39100 8270/3520-G	1.9	--	5.6	2.4	--	--	9.6	4.0	5.0	--	3.4	11	2.1	--	6
PHENOL UG/L	34694 8270/3520-G	2.8	--	1.5	--	--	--	--	--	--	--	--	--	--	--	--
ANTHRACENE UG/L	34220 8310/3520-G	--	--	--	--	--	--	--	--	--	--	0.263	--	--	--	--
BENZO(A)ANTHRACENE UG/L	34526 8310/3520-G	--	--	--	--	0.008	0.003	0.009	--	--	0.015	0.013	--	--	--	0.1*
BENZO(A)PYRENE UG/L	34247 8310/3520-G	--	--	0.005	0.002	0.010	0.005	0.004	--	--	0.006	0.008	0.007	0.001	--	0.2
BENZO(B)FLUORANTHENE UG/L	34230 8310/3520-G	--	0.002	0.006	0.003	0.015	0.008	0.005	--	0.002	0.008	0.008	0.009	0.005	--	0.2*
BENZO(K)FLUORANTHENE UG/L	34242 8310/3520-G	--	--	0.003	0.003	0.005	0.003	0.002	--	--	0.004	0.004	0.004	0.003	--	0.2*
CHRYSENE UG/L	34320 8310/3520-G	--	--	--	--	--	--	--	--	--	--	1.68	0.183	--	--	0.3*
DIBENZ(A,H)ANTHRACENE UG/L	34556 8310/3520-G	--	--	--	--	0.005	--	--	--	--	0.006	--	--	--	--	0.3*
FLUORANTHENE UG/L	34376 8310/3520-G	0.007	0.005	0.012	0.009	0.022	0.033	0.009	--	0.007	0.017	0.019	0.018	0.019	--	--
INDENO(1,2,3-CD) PYRENE UG/L	34403 8310/3520-G	0.007	--	--	--	0.020	--	--	--	--	--	--	--	--	--	0.4*
NAPHTHALENE UG/L	34696 8310/3520-G	--	1.30	1.13	--	--	--	--	--	--	1.20	--	--	--	--	--
ALUMINUM, TOTAL UG/L	1105 6010-G	37800	31100	120000	105000	198000	196000	85900	33400	23400	141000	129000	75500	78900	--	--
ARSENIC, TOTAL UG/L	1002 7060-G	6.2	--	3.0	4.9	6.0	67.5	--	--	--	98.3	44.5	8.4	12.0	50	50
BARIUM, TOTAL UG/L	1007 6010-G	167	567	433	399	462	566	358	599	360	1350	119	316	381	2000	2000
CADMIUM, TOTAL UG/L	1027 6010-G	--	--	--	--	--	13.8	--	--	--	--	--	--	--	10	5
CHROMIUM, TOTAL UG/L	1034 6010-G	27.4	89.8	131	773	834	428	111	109	45.3	370	209	119	143	100	100
COBALT, TOTAL UG/L	1037 6010-G	--	37.5	63.2	42.7	79.8	66.7	156	103	33.1	971	16.5	--	62.1	--	--
COPPER, TOTAL UG/L	1042 6010-G	84.8	122	314	142	179	230	71.6	50.3	97.3	196	99.6	49.7	76.6	--	1300
LEAD, TOTAL UG/L	1051 7421-G	20.9	88.9	85.3	75.2	91.3	444	34.4	21.8	17.5	119	34.5	20.2	81.1	5	15
MERCURY, TOTAL UG/L	71900 7470-G	--	0.38	0.66	0.47	1.86	1.65	0.31	0.36	0.38	1.13	0.33	--	0.61	2	2
ZINC, TOTAL UG/L	1092 6010-G	71.6	136	331	389	846	1530	268	148	107	657	281	126	264	--	--
RESIDUE, DISS (TDS) MG/L	70300 160.1-G	406	207	335	366	288	398	182	373	260	332	478	325	245	--	--
ALUMINUM, DISS UG/L	1106 6010-G	--	--	--	--	--	--	--	--	494	--	--	--	--	--	--
BARIUM, DISS UG/L	1005 6010-G	53.3	133	61.0	29.8	91.6	27.3	38.8	44.9	171	29.0	82.8	--	84.8	--	--
COPPER, DISS UG/L	1040 6010-G	--	--	--	--	--	--	--	--	--	--	11.4	--	--	--	--

*All units in micrograms per liter (ug/L).
*Proposed value.

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TABLE B-1

SAMPLE ID'S / PARAMETERS / UNITS	STORET METHOD	MW32 CDDMTW 32	MW33 CDDMTW 33	MW34 CDDMTW 34	MW35 CDDMTW 35	MW36 CDDMTW 36	MW37BP CDDMTW 37	MW38 CDDMTW 38	MW39 CDDMTW 39	MW40DUP CDDMTW 40	MW41DUP CDDMTW 41	MW42DUP CDDMTW 42	MW43DUP CDDMTW 43	MW44EBLY CDDMTW 44	State and Federal MCLs: Tennessee MCL	Federal MCL
DATE / TIME		11/18/93 17:00	11/19/93 09:20	11/19/93 10:30	11/14/93 17:30	11/12/93 17:35	11/18/93 11:10	11/15/93 10:15	11/15/93 13:40	11/18/93	11/11/93	11/11/93	11/17/93	11/16/93 16:30		
CARBON TETRACHLORIDE UG/L	32102 8010-G	33.0	--	--	--	--	--	--	--	--	1.12	--	--	--	5	5
CHLOROBENZENE UG/L	34301 8010-G	--	--	--	1.18	--	--	--	--	--	--	--	--	--	--	100
CHLOROFORM UG/L	32106 8010-G	11.3	--	2.37	1.24	--	--	--	--	--	4.18	2.97	--	1.06	--	--
1,1-DICHLOROETHANE UG/L	34496 8010-G	--	--	--	--	--	--	--	--	--	3.38	--	--	--	--	--
1,2-DICHLOROETHANE UG/L	34531 8010-G	--	--	--	0.49	--	--	--	--	--	1.73	1.12	--	-	5	5
1,1-DICHLOROETHYLENE UG/L	34501 8010-G	--	--	--	--	--	--	--	--	--	18.1	--	--	-	7	7
TRANS-1,2-DICHLORO ETHENE UG/L	34546 8010-G	10.4	--	--	28.3	--	--	--	--	--	129	11.2	--	--	100	100
METHYLENE CHLORIDE UG/L	34423 8010-G	--	--	--	--	--	--	--	--	--	226	--	--	2.47	--	5
1,1,2,2-TETRACHLORO ETHANE UG/L	34516 8010-G	162	2.38	--	63.8	--	--	--	--	--	41.6	233	--	--	--	--
TETRACHLOROETHENE UG/L	34475 8010-G	2.00	--	--	1432	--	--	--	2.39	--	161	19.8	--	--	5	5
1,1,1-TRICHLOROETHANE UG/L	34506 8010-G	--	--	--	--	--	--	--	--	--	6.03	--	--	--	200	200
1,1,2-TRICHLOROETHANE UG/L	34511 8010-G	7.69	--	--	--	--	--	--	--	--	4.46	1.64	--	--	--	5
TRICHLOROETHENE UG/L	39180 8010-G	137	--	--	861	--	--	1.55	3.53	--	3310	3130	--	--	5	5
TOLUENE UG/L	34010 8020-G	--	--	--	--	--	--	--	--	--	33.3	-	--	--	1000	1000
BIS(2-ETHYLHEXYL) PHTHALATE UG/L	39100 8270/3520-G	46	4.2	2.5	--	5.2	13	7.8	1.9	12	2.4	3.9	2.5	--	--	6
PHENOL UG/L	34694 8270/3520-G	2.3	3.4	--	--	--	2.2	5.9	2.2	2.4	5.5	--	2.4	-	--	--
ANTHRACENE UG/L	34220 8310/3520-G	--	--	--	0.462	--	--	--	1.84	--	0.805	--	0.291	--	--	--
BENZO(A)ANTHRACENE UG/L	34526 8310/3520-G	--	--	--	0.015	0.008	--	0.003	0.035	--	0.114	--	0.031	--	--	0.1
BENZO(A)PYRENE UG/L	34247 8310/3520-G	--	0.006	0.008	0.013	0.033	--	0.003	0.046	--	0.140	--	0.010	--	--	0.2
BENZO(B)FLUORANTHENE UG/L	34230 8310/3520-G	--	0.006	0.006	0.013	0.034	--	0.002	0.063	--	0.167	--	0.012	--	--	0.2
BENZO(GHI)PERYLENE UG/L	34521 8310/3520-G	--	--	--	0.018	--	--	--	0.093	--	0.114	--	0.023	--	--	--
BENZO(K)FLUORANTHENE UG/L	34242 8310/3520-G	--	0.003	0.005	0.007	0.012	--	0.001	0.029	--	0.063	--	0.006	--	--	0.2
CHRYSENE UG/L	34320 8310/3520-G	--	--	--	--	0.120	0.109	--	0.127	0.213	0.219	--	--	--	--	0.2
DIBENZ(A,H)ANTHRACENE UG/L	34556 8310/3520-G	--	--	--	--	--	--	--	0.005	--	0.014	-	--	--	--	0.1
FLUORANTHENE UG/L	34376 8310/3520-G	0.004	0.020	0.025	0.027	0.035	--	0.001	0.075	0.004	0.248	--	0.026	--	-	--
INDENO(1,2,3-CD) PYRENE UG/L	34403 8310/3520-G	--	--	--	--	0.013	0.003	--	0.020	--	0.114	0.004	--	--	--	0.4
PHENANTHRENE UG/L	34461 8310/3520-G	--	--	--	--	--	--	--	0.150	--	0.098	--	--	--	--	--
PYRENE UG/L	34469 8310/3520-G	--	--	--	0.065	--	--	--	0.166	--	1.02	--	-	1.58	--	--
DDD, PP' UG/L	39310 8080/3520-G	--	--	--	--	--	--	--	--	--	0.015	--	--	--	--	-
DDT, PP' UG/L	39300 8080/3520-G	--	--	--	--	--	--	--	--	--	0.013	--	--	--	--	-
DIELDRIN UG/L	39380 8080/3520-G	--	--	--	0.008	--	--	0.067	--	--	--	0.005	--	--	-	--
HEPTACHLOR EPOXIDE UG/L	39420 8080/3520-G	--	--	--	--	--	--	--	--	--	--	0.005	--	--	0.2	0.2

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TABLE B-1

SAMPLE ID'S PARAMETERS UNITS	STORET METHOD	MW32 COUNTW 32	MW33 COUNTW 33	MW34 COUNTW 34	MW35 COUNTW 35	MW36 COUNTW 36	MW37SP COUNTW 37	MW38 COUNTW 38	MW39 COUNTW 39	MW40DUP COUNTW 40	MW41DUP COUNTW 41	MW42DUP COUNTW 42	MW43DUP COUNTW 43	MW44 COUNTW 44	State and Federal MCLs*: Tennessee MCL	Federal MCL
DATE TIME		11/18/93 17:00	11/19/93 09:20	11/19/93 10:10	11/14/93 17:30	11/12/93 17:15	11/18/93 11:30	11/15/93 18:35	11/15/93 13:40	11/18/93	11/11/93	11/11/93	11/17/93	11/16/93 16 10		
ALUMINUM, TOTAL UG/L	1105 6010-G	137000	61200	3710	17800	765	3210	4990	3550	3480	174000	52100	179000	--	--	--
ARSENIC, TOTAL UG/L	1002 7060-G	30.6	39.4	--	4.6	--	--	--	4.7	--	4.6	--	22.5	--	50	50
BARIUM, TOTAL UG/L	1007 6010-G	3450	435	142	387	316	588	93.7	122	574	1030	326	450	--	2000	2000
CHROMIUM, TOTAL UG/L	1034 6010-G	331	116	13.9	81.4	10.2	--	20.4	21.7	--	342	83.3	895	--	100	100
COBALT, TOTAL UG/L	1037 6010-G	117	32.5	--	72.7	--	--	--	--	--	80.1	188	57.4	--	--	--
COPPER, TOTAL UG/L	1042 6010-G	303	64.9	7.6	63.7	6.4	6.5	16.5	25.2	5.4	172	59.4	180	--	--	1300
LEAD, TOTAL UG/L	1051 7421-G	96.1	46.1	4.7	36.0	6.3	7.5	4.7	37.5	--	131	28.1	54.0	--	5	15
MERCURY, TOTAL UG/L	71900 7470-G	1.96	0.26	--	--	--	--	--	--	--	0.74	0.26	1.96	-	2	2
ZINC, TOTAL UG/L	1092 6010-G	307	226	21.1	161	36.8	--	40.0	37.1	--	373	176	845	--	--	--
RESIDUE, DISS (TDS) MG/L	70300 160.1-G	633	202	127	196	196	216	166	198	214	179	193	279	0.0	--	--
ALUMINUM, DISS UG/L	1106 6010-G	--	--	--	225	--	--	--	--	--	44.0	--	--		--	--
BARIUM, DISS UG/L	1005 6010-G	263	58.7	47.8	37.6	344	464	--	40.5	456	33.1	41.8	90.2		--	--
LEAD, DISS UG/L	1049 7421-G	--	--	--	--	--	--	--	2.3	--	--	--	3.0		--	--
ZINC, DISS UG/L	1090 6010-G	--	--	66.5	--	20.5	--	--	--	--	33.3	--	--		--	--

*All units in micrograms per liter (ug/L).
[a]Proposed value.

123 95

TABLE B-1

SAMPLE ID'S PARAMETERS UNITS	STORET METHOD	MW45EBLK COOMTW 45	MW46EBLK COOMTW 46	MW47EBLK COOMTW 47	MW48TS COOMTW 48	MW49TS COOMTW 49	MW50TS COOMTW 50	MW51TS COOMTW 51	MW52TBLK COOMTW 52	MW53TBLK COOMTW 53	MW55TBLK COOMTW 55	MW56TBLK COOMTW 56	MW57TBLK COOMTW 57	MW58THLK COOMTW 58	State and Federal MCLs* Tennessee MCL	Federal MCL
DATE TIME		11/18/93 15:00	11/18/93 16:10	11/18/93 18:10	11/19/93 17:15	11/18/93 15:15	11/18/93 17:45	11/18/93 18:10	11/15/93 21:30	11/11/93 21:00	11/14/93 17:50	11/13/93 13:10	11/09/93 16:00	11/10/93 22:00		
CHLOROFORM UG/L	32106 8010-G	1.63	--	1.35	--	--	--	--	--	--	--	--	--	--	--	--
METHYLENE CHLORIDE UG/L	34423 8010-G	--	--	--	--	--	--	--	--	--	--	--	1.32	--	--	5
1,1,2,2-TETRACHLORO ETHANE UG/L	34516 8010-G	--	--	--	--	--	--	--	--	1.09	--	--	--	--	--	--
TRICHLOROETHENE UG/L	39180 8010-G	--	--	--	--	--	--	--	--	1.27	--	--	--	--	5	5
BARIUM, TOTAL UG/L	1007 6010-G	--	--	--	38.4	31.6	35.4	36.5							2000	2000
LEAD, TOTAL UG/L	1051 7421-G	--	--	--	2.9	5.7	2.4	2.4							5	15
ZINC, TOTAL UG/L	1092 6010-G	--	--	--	705	2310	549	428							--	--
RESIDUE, DISS (TDS) MG/L	70300 160.1-G	--	--	--	250	272	257	240							--	--
BARIUM, DISS UG/L	1005 6010-G				36.5	30.7	37.8	33.6							--	--
LEAD, DISS UG/L	1049 7421-G				2.3	5.9	2.5	2.8							--	--
ZINC, DISS UG/L	1090 6010-G				702	2390	546	431							--	--

*All units in micrograms per liter (ug/L).
•Proposed value

123 96

TABLE B-1

SAMPLE ID'S / PARAMETERS / UNITS	STORET / METHOD	MW60TBLK CDOMTW 60	MW61TBLK CDOMTW 61	MW62TBLK CDOMTW 62	MW64TBLK CDOMTW 64	MW76 CDOMTWD 1	MW77 CDOMTWD 2	MW78 CDOMTWD 1	State and Federal MCLs*: Tennessee MCL	Federal MCL
DATE / TIME		11/12/93 15:00	11/17/93 19:00	11/19/93 22:00	11/18/93 20:00	11/10/93 11:35	11/10/93 13:30	11/10/93 15:35		
BROMODICHLOROMETHANE UG/L	32101 8010-G	--	--	--	--	--	18.6		--	100
DIBROMOCHLOROMETHANE UG/L	32105 8010-G	--	--	--	--	--	15.5		--	100
1,2-DICHLOROETHANE UG/L	34531 8010-G	--	--	--	--	--	17.8		--	--
TRANS-1,2-DICHLORO ETHENE UG/L	34546 8010-G	--	--	--	--	--	17.8		100	100
CIS-1,3-DICHLORO PROPENE UG/L	34704 8010-G	--	--	--	--	--	15.8		--	--
TRANS-1,3-DICHLORO PROPENE UG/L	34699 8010-G	--	--	--	--	--	14.6		--	5
METHYLENE CHLORIDE UG/L	34423 8010-G	--	15.4	--	--	--	16.9		--	--
1,1,2,2-TETRACHLORO ETHANE UG/L	34516 8010-G	1.72	--	--	--	--	--		5	5
TETRACHLOROETHENE UG/L	34475 8010-G	--	--	--	--	--	15.3		200	200
1,1,1-TRICHL'ETHANE UG/L	34506 8010-G	--	--	--	--	--	33.3		5	5
TRICHLOROETHENE UG/L	39180 8010-G	0.25	--	--	--	--	--		2	2
VINYL CHLORIDE UG/L	39175 8010-G	--	--	--	--	--	20.0		--	--
ACENAPHTHENE UG/L	34205 8270/3520-G					--	39		--	0.2+
BENZO(B)FLUORANTHENE UG/L	34230 8270/3520-G					--	8.6		--	0.2+
BENZO(K)FLUORANTHENE UG/L	34242 8270/3520-G					--	8.3		--	--
DI-N-BUTYLPHTHALATE UG/L	39110 8270/3520-G					--	33		--	--
2,4-DIMETHYLPHENOL UG/L	34606 8270/3520-G					--	87		--	--
2,6-DINITROTOLUENE UG/L	34626 8270/3520-G					--	33		--	--
FLUORENE UG/L	34381 8270/3520-G					--	38		--	--
ISOPHORONE UG/L	34408 8270/3520-G					--	34		--	--1
PENTACHLOROPHENOL UG/L	39032 8270/3520-G					--	77		--	1
PHENANTHRENE UG/L	34461 8270/3520-G					--	37		--	--
PHENOL UG/L	34694 8270/3520-G					--	72		--	--
PYRENE UG/L	34469 8270/3520-G					--	38		--	--
2,4,6-TRICHL'PHENOL UG/L	34621 8270/3520-G					--	73		--	--
2,4,5-TRICHL'PHENOL UG/L	77687 8270/3520-G					--	64		--	--
ALUMINUM, TOTAL UG/L	1105 6010-G					--	1930	94200	--	
ARSENIC, TOTAL UG/L	1002 7060-G					--	19.8	--	50	50
BARIUM, TOTAL UG/L	1007 6010-G					--	458	--	2000	2000
CADMIUM, TOTAL UG/L	1027 6010-G					--	40.4	--	10	5
CHROMIUM, TOTAL UG/L	1034 6010-G					--	48.3	--	100	100
COBALT, TOTAL UG/L	1037 6010-G					--	101	--	--	--
COPPER, TOTAL UG/L	1042 6010-G					--	45.3	--	--	1100
LEAD, TOTAL UG/L	1051 7421-G					--	20.7	--	5	15
MERCURY, TOTAL UG/L	71900 7470-G					--	0.28	--	2	2
SELENIUM, TOTAL UG/L	1147 7740-G					--	17.3	--	--	--
ZINC, TOTAL UG/L	1092 6010-G					--	28.0	--	--	--

*All units in micrograms per liter (ug/L)
+Proposed value.

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Groundwater Monitoring Results for DDMT
Environmental Science and Engineering, Inc.
September 1993

TABLE B-2
POSITIVE RESULTS IN GROUND WATER
DUNN FIELD AREA
DEFENSE DEPOT MEMPHIS TENNESSEE

PARAMETER		Background Well MW16	MCL	MW3	MW4	MW5	MW6	MW7	MW8	MW9	MW10	MW11	MW12	MW13	MW14	MW15	MW28	MW29	MW34	MW35	MW30	MW31	MW32	MW33
HALOGENATED VOLATILES (ug/l)																								
1,1,1-Trichloroethane	PHASE I	--	200	3J	--	--	--	5J	5	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		4J	--	--	--	4J	5	--	10	--	--	--	--	--	--	9	--	--	--	8	--	--
1,1,2,2-Tetrachloroethane	PHASE I	--	--	--	--	--	150	--	--	--	10	73	340D	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	86	--	--	--	8	11	1900D	2J	--	--	--	--	--	--	--	260D	110	--
1,1,2-Trichloroethane	PHASE I	--	--	--	--	--	7	--	--	--	--	2J	1J	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	4J	--	--	--	--	--	7	--	--	--	--	--	--	--	--	12	5	--
1,1-Dichloroethane	PHASE I	--	--	--	--	--	--	3J	3J	--	3J	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	2J	4J	--	4J	--	--	--	--	--	--	5	--	--	--	--	--	--
1,1-Dichloroethylene	PHASE I	--	7	36	--	--	--	81	66	3J	130	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		47	--	--	--	58	66	2J	160	--	--	--	--	--	--	58	--	--	--	61	--	--
1,2-Dichloroethane	PHASE I	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	3J	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethylene	PHASE I	--	100/70(c)	--	--	3J	270D	--	--	--	6J	620D	190D	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	160	--	--	--	160	61	510D	--	--	2J	--	--	--	1J	--	1100D	110	--
Carbon Tetrachloride	PHASE I	--	5	--	5J	4J	77	--	--	7	--	4J	1J	--	1J	10J	--	--	--	--	--	--	--	--
	PHASE II	--		--	10	--	40	--	--	6	3J	8	3J	--	--	17	--	--	--	--	--	11	52	--
Chloroform	PHASE I	--	100(c)	3J	2J	11	15	6	--	3J	--	6	3J	--	--	4J	--	--	--	--	--	--	--	--
	PHASE II	--		--	7	2J	10	6	--	--	6	11	10	--	--	18	--	--	--	--	--	33	12	--
Methylene chloride	PHASE I	--	5	--	--	--	--	4BJ	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		2J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	PHASE I	--	5	49	100	210	3	59	58	6	190	--	--	3J	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		74	200D	48	2J	47	54	5	240D	18	33	9	--	--	--	67	--	--	--	86	2J	--
Trichloroethene	PHASE I	--	5	25	4J	28	190D	19	21	7	140	380D	1700D	--	--	2J	--	--	--	--	--	--	--	--
	PHASE II	--		35	9	5	120	16	21	4J	390D	81	5100D	--	--	6	--	24	--	61	--	1500D	110	--
NONHALOGENATED VOLATILES (ug/l)																								
Acetone	PHASE I	3J	--	--	--	--	34B	3J	--	--	--	1JB	1JB	1JB	2JB	--	--	--	--	--	--	--	--	--
	PHASE II	--		6J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NONHALOGENATED SEMIVOLATILES (ug/l)																								
Benzoic acid	PHASE I	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		3J	3J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	PHASE I	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	42	--	--	--	--
N-Nitrosodiphenylamine	PHASE I	2J	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		4BJ	19B	8BJ	5BJ	3BJ	4BJ	3BJ	8BJ	4BJ	7BJ	6BJ	--	5BJ	3BJ	6BJ	--	3BJ	--	--	--	--
bis(2-Ethylhexyl) phthalate	PHASE I	5J	--	6J	7J	6J	5J	5J	5J	6J	13	--	5J	3J	6J	8J	--	--	--	--	--	--	--	--
	PHASE II	3J		7BJ	--	--	--	--	--	--	--	3BJ	--	--	--	--	--	--	--	11J	--	--	--	--

TABLE B-2
POSITIVE RESULTS IN GROUND WATER
DUNN FIELD AREA
DEFENSE DEPOT MEMPHIS TENNESSEE

PARAMETER		Background Well MW16	MCL	MW3	MW4	MW5	MW6	MW7	MW8	MW9	MW10	MW11	MW12	MW13	MW14	MW15	MW28	MW29	MW34	MW35	MW30	MW31	MW32	MW33
VOLATILE METALS (ug/l)																								
Arsenic	PHASE I	55	50	--	--	--	--	--	--	62	85	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	40		--	--	--	--	--	--	--	180	--	--	--	210	--	--	50	--	--	50	180	--	80
Lead	PHASE I	79	50/15(f)	238N	257N	84N	395N	300N	165N	171N	653N	353N	417N	150N	507N	255N	--	--	--	--	--	--	--	--
	PHASE II	60		90	130	40	70	260	70	--	1000	140	70	40	200	120	80	90	--	--	50	290	120	100
Mercury	PHASE I	--	2	1.5	1.1	.6	3.6	1.4	1.7	.8	.7	1.4	.5	1.4	1.9	3.1	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	1	--	1	--	1	--	--	--	2	1	--	--	--	--	--	1	1	--
NONVOLATILE METALS (ug/l)																								
Antimony	PHASE I	--	6	45BN	50BN	--	142N	170N	113N	81N	81N	54BN	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Barium	PHASE I	218	2000	659N	695N	224N	117N	1030N	994N	418N	1310N	3390N	2010N	415N	3740N	899N	--	--	--	--	--	--	--	--
	PHASE II	410		310	260	200	630	540	350	130	1900	1200	580	220	1500	550	960	410	120	120	600	880	1000	460
Cadmium	PHASE I	--	5	--	--	--	8N	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--	--	--	9	9	--	--	--	--	--	--
Chromium (d)	PHASE I	55	100	643N	823N	170N	386N	1240N	471N	182N	286N	530N	517N	184N	800N	393N	--	--	--	--	--	--	--	--
	PHASE II	50		60	120	50	40	340	100	10	310	120	40	20	190	110	130	170	--	--	50	260	140	100
Copper	PHASE I	188	1300(g)	345N	438N	78N	213N	856N	304N	138N	813N	643N	454N	190N	592N	400N	--	--	--	--	--	--	--	--
	PHASE II	180		50	80	40	40	210	180	20	910	520	80	50	180	110	80	80	--	--	50	100	50	70
Nickel	PHASE I	29	100	324N	301N	57N	145N	602N	170N	67N	142N	226N	350N	79N	421N	170N	--	--	--	--	--	--	--	--
	PHASE II	40		40	50	20	30	170	50	--	170	50	40	20	100	60	70	80	--	--	30	130	80	50
Silver	PHASE I	--	100(h)	--	--	--	20	--	--	--	--	--	42	11	13	68	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	PHASE I	116	5000(h)	114N	115N	311N	517N	1910N	745N	304N	1120N	872N	1300N	407N	1840N	662N	--	--	--	--	--	--	--	--
	PHASE II	160		160	170	91	63	450	160	14	1300	230	110	79	430	140	250	210	24	36	160	490	220	230

(c) Trans isomer/Cis isomer
(d) No distinction between Chromium (III) and Chromium (VI)
(e) Total trihalomethanes
(f) MCL/ Action Level
(g) MCLG. Primary MCL is a Treatment Technique
(h) Secondary MCL

B (Inorganic) = Value less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).
B (Organic) = Found in method blank.
D = Identified in an analysis at a secondary dilution factor.
J = Estimated value less than the sample quantitation limit but greater than zero.
N = Spiked sample recovery not within control limits.
-- = Not detected.
NA = Not Available.

123 100

TABLE B-3
POSITIVE RESULTS IN SUBSURFACE SOILS
DEFENSE DEPOT MEMPHIS TENNESSEE

	PHASE I														
PARAMETER	STB-1-1	STB-1-2	STB-1-3	STB-2-1	STB-2-2	STB-2-3	STB-3-1	STB-3-2	STB-3-3	STB-4-1	STB-4-2	STB-4-3	STB-5-1	STB-5-2	STB-5-3
Depth of Sample:	26.5'	52.5'	73.5'	10.0'	17.5'	67.5'	21.0'	20.0'	23.5'	19.0'	28.0'	102.0'	10.0'	78.0'	83.0'
HALOGENATED VOLATILES ug/kg															
Chloroform	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	16B	19B	10B	7B	6B	12B	3J	3J	3J	2J	18B	19B	13B	21B	12B
NONHALOGENATED VOLATILES ug/kg															
2-Butanone	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--
Acetone	57	43	20	24B	12B	10B	--	--	30	31	8J	17	18	14B	14
Toluene	--	--	--	--	--	--	--	--	--	1J	--	--	--	--	--
NONHALOGENATED SEMIVOLATILES ug/kg															
Benzoic acid	--	--	--	--	--	58J	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl) phthalate	1200	1200	760J	1100	1900	1600	2000B	6700	910B	610B	1500B	560BJ	450B	440B	320BJ
Di-n-butyl phthalate	--	--	--	--	210BJ	100BJ	140BJ	170BJ	120BJ	--	--	--	--	--	--
N-Nitrosodiphenylamine	--	--	--	43JB	--	--	--	--	--	--	44J	--	--	--	--
Polynuclear Aromatic Hydrocarbons (PAHs)															
Fluoranthene	--	--	--	--	51J	47J	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	40J	40J	--	--	--	--	--	--	--	--	--
TOTAL PAHs	--	--	--	--	91	87	--	--	--	--	--	--	--	--	--
NONVOLATILE METALS															
Barium (EPTOX in ug/l)	15	25	58	--	--	--	10	18	49	--	--	25	--	10	--
Cadmium (EPTOX in ug/l)	--	12	5	20	6	--	7	--	--	--	--	--	--	--	--

B (Organic) = Found in method blank.
J = Estimated value less than the sample quantitation limit, but greater than zero.
-- = Not detected

TABLE B-3
POSITIVE RESULTS IN SUBSURFACE SOILS
DEFENSE DEPOT MEMPHIS TENNESSEE

PARAMETER	Phase II											
	STB-6-1	STB-6-2	STB-6-3	STB-6-4	STB-7-1	STB-7-2	STB-7-3	STB-7-4	STB-8-1	STB-8-2	STB-8-3	STB-8-4
Depth of Sample:	71.5'	78.0'	88.0'	181.0'	71.0'	76.0'	91.0'	170.0'	92.0'	97.0'	127.0'	217.0'
HALOGENATED VOLATILES ug/kg												
1,1,2,2-Tetrachloroethane	240E	12	4J	13	--	--	--	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	11
1,2-Dichloroethylene	26	--	13	7	--	--	--	--	--	--	--	--
Methylene chloride	21B	16B	6BJ	5JB	5BJ	11B	6B	6	10B	7B	5BJ	5BJ
Trichloroethane	4J	--	1J	--	--	--	--	--	--	--	--	--
NONHALOGENATED VOLATILES ug/kg												
2-Butanone	--	--	15	--	--	--	--	--	3BJ	2BJ	2J	--
Acetone	210	90	1100D	74	250	96	31	9J	60B	40B	45	26
Toluene	1J	1J	5J	--	--	5J	--	--	--	3J	--	2J
NONHALOGENATED SEMIVOLATILES ug/kg												
bis(2-Ethylhexyl) phthalate	580B	280BJ	6400B	500B	1600B	160BJ	1000B	230BJ	520B	250BJ	350BJ	270BJ
Di-n-butyl phthalate	--	--	--	--	--	--	78J	--	--	--	--	--
N-Nitrosodiphenylamine	--	--	--	--	--	--	--	--	85BJ	53BJ	30J	96BJ
PESTICIDES ug/kg												
beta-BHC	--	--	14Z	--	--	--	--	--	--	--	--	10Z
VOLATILE METALS mg/kg												
Lead	8	7	5	9	11	9	7	--	--	8	--	7
NONVOLATILE METALS mg/kg												
Barium	20.7	39.1	42.5	72.7	39.1	51.6	68.6	10.6	3.6	26.1	2.9	14.2
Cadmium	--	--	--	--	--	--	--	0.8	--	--	--	--
Chromium **	9	11	4	5	12	11	6	4	1	5	2	5
Copper	3	3	4	5	2	6	6	2	3	5	3	5
Nickel	2	--	5	3	3	3	7	3	--	6	--	4
Zinc	15.7	11.4	31.2	47.2	12.1	41.3	31	11.9	14	29.5	3.6	11.6

B (Organic) = Found in method blank.
D = Identified in an analysis at a secondary dilution factor.
J = Estimated value less than the sample quantitation limit, but greater than zero.
E = Concentration exceeds the calibration range of the GC/MS Instrument for this specific analysis.
Z = Matrix interference; compound not positively identifiable
** = No distinction between Chromium (III) and Chromium (VI)
-- = Not detected.

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