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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 122

Operable Unit 2
Field Sampling Plan
Draft Final

for

Defense Distribution Depot Memphis

September 1995

Prepared for

U.S. Army Corps of Engineers
Huntsville Division

Prepared by

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Executive Summary

Introduction

In October 1992, the Defense Depot Memphis, Tennessee (DDMT), was placed on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA). Therefore, DDMT must fulfill requirements under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and National Oil and Hazardous Substances Pollution Contingency Plan (NCP). A remedial investigation/feasibility study (RI/FS) will be conducted to accomplish the following:

- Assess the nature and extent of contamination
- Evaluate the risk to human health and the environment
- Screen potential cleanup actions

The *Generic Remedial Investigation/Feasibility Study Work Plan* (*Generic RI/FS WP*) was prepared to show how the investigation and study will be accomplished. This field sampling plan (FSP) was prepared for Operable Unit 2 (OU-2) as a supplement to the *Generic RI/FS WP*. The objective of the OU-2 FSP 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-2 at DDMT.

The ultimate goal of the RI/FS is to select cost-effective cleanup actions that protect 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 investigated, and proposed cleanup actions must be evaluated. By implementing the field investigation strategies described in the FSPs, the quantity and quality of data collected will aid in achieving the goal of the RI/FS at DDMT.

Site Background and Location

DDMT 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

DDMT is divided into four operable units (OUs) for evaluation purposes. OU-1, north of the Main Installation, is called Dunn Field. The Main Installation is divided into three areas: the southwestern quadrant (OU-2), the southeastern quadrant including Lake Danielson and the golf course area (OU-3), and the north-central area (OU-4). Sites identified in OU-1 for investigation resulted from use of the area for landfill operations, mineral stockpiles, pistol range use, and materials storage. Potential contamination of OU-2 may have resulted from spills or releases from the hazardous material storage and recouping area, sandblasting and painting activities, or both. In the recouping area, hazardous and nonhazardous materials from damaged and leaking containers were repacked. The potential sources of contamination in OU-3 are storage of polychlorinated biphenyls (PCBs) and the use of pesticides and herbicides. Principal contamination in OU-4 probably resulted from a wood treatment operation and hazardous material storage.

Soil samples taken in OU-2 around the recouping area indicated metal and pesticide contamination. Concentrations above detection limits (33 parts per billion) of toluene also were detected. In the northeastern portion of OU-2, an underground tank was used to store waste oil and has since been removed. Soil samples taken in the area have detected elevated levels of tetrachloroethene, polynuclear aromatic hydrocarbons (PAHs), and a few metals. Soil samples have also previously been collected in OU-2 around the area where sandblasting and painting activities occurred. In this area, the categories of contaminants that were detected included PAHs, pesticides, and metals.

Summary of FSP

This FSP describes the DDMT facility, history of OU-2, data gaps, and data needed for OU-2. General information is also provided on OU-2 location, geography and topography, meteorology, surface water hydrology, geology, hydrogeology, and land use. Additionally, this FSP describes the sampling strategy and sampling plan for the RI sites in OU-2. The final section of the plan describes the data needs required to propose remedial alternatives for OU-2. The purpose of the activities proposed in this FSP are as follows:

- To characterize potential releases from the site
- To assess the nature and extent of soil and groundwater contamination attributable to past operations
- To support a baseline risk assessment (BRA)
- To gather data to evaluate the feasibility of remedial actions for this site

Sampling Strategy

A cost-effective, sampling strategy has been developed to perform an RI/FS at DDMT. This FSP uses an observational approach to collecting field data 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 RI site:

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

To support the development of recommendations in a timely manner, soil and water samples will be collected at OU-2 and analyzed using quick-turnaround methods from a fixed-base laboratory (FBL). A minimum of 10 percent of the quick-turnaround samples (Level 2) will be sent to the laboratory for Level 3 confirmational analysis. The Level 2 and Level 3 data will be used for comparison to regulatory levels and calculated risk levels of contamination to aid in supporting the appropriate recommendation for action at a given site.

Proposed Sampling

The OU-2 FSP describes RI 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. Surface soil samples will provide information to assess the horizontal extent of contamination and will provide data to evaluate risk associated with the surface soil exposure pathway. Soil borings will also be installed at the proposed site locations. Surface and subsurface soil samples will be collected at regular intervals from the borings to assess the vertical extent of contamination.

Groundwater sampling will be conducted at each RI site in OU-2. At two of the three sites, a well is located on the upgradient side of the site. At the third site, an existing well is located downgradient of the site. These wells will be sampled during the field activities. Monitoring wells will be installed along the property boundary of DDMT upgradient of a number of the RI sites, as described in the *OU-4 FSP*, to evaluate whether offsite sources are contributing to contamination found at DDMT. Installing additional downgradient monitoring wells will be an optional activity that depends upon the results of the soil sampling and the results from the existing wells and the wells planned for monitoring of offsite sources. This groundwater evaluation strategy will aid in describing the source of contamination, whether it is an offsite source or an onsite source.

By implementing the OU-2 FSP, the RI/FS can be conducted in a cost-effective, timely manner. Additionally, data will be obtained to support an evaluation of remedial alternatives for cleanup of OU-2 at DDMT.

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Acronyms

ARARs	Applicable or relevant and appropriate requirements
bls	Below land surface
BRA	Baseline risk assessment
CEHND	U.S. Army Corps of Engineers, Huntsville Division
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
CSL	Close support laboratory
DDE	Dichlorodiphenyldichloroethylene
DDMT	Defense Distribution Depot Memphis, Tennessee
DDT	Dichlorodiphenyltrichloroethane
DLA	Defense Logistics Agency
DOI	Department of Interior
DQO	Data quality objective
DRMO	Defense Reutilization Marketing Office
EPA	United States Environmental Protection Agency
FBL	Fixed-base laboratory
FFA	Federal Facilities Agreement
FR	Federal Register
FRL	Final remediation level
FS	Feasibility study
FSP	Field sampling plan
HASP	Health and Safety Plan
HRS	Hazardous Ranking System
IRA	Interim remedial action
MCL	Maximum contaminant level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No further action
NGVD	National geodetic vertical datum
NPL	National Priorities List
OU	Operable unit
OVA	Organic vapor analyzer
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRG	Preliminary remediation goal
QA/QC	Quality assurance/quality control
QAPP	Quality assurance project plan
QC	Quality control
RA	Remedial action
RAL	Removal action level
RCRA	Resource Conservation and Recovery Act

Acronyms (cont'd.)

RFA	RCRA Facility Assessment
RGO	Remedial goal option
RI	Remedial investigation
RI/FS	Remedial investigation/feasibility study
RI/FS WP	*Generic RI/FS Work Plan*
ROD	Record of Decision
SMP	Site Management Plan
TAL	Target analytes list
TCL	Target compound list
TDEC	Tennessee Department of Environment and Conservation
THI	Target hazard index
TRL	Target risk level
VOC	Volatile organic compound

TAB

Section 7 Introduction

1.0 Introduction

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1.1 Objective

The objective of this field sampling plan (FSP) for Operable Unit 2 (OU-2) 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-2 at the Defense Depot Memphis, Tennessee (DDMT).

The purpose of this effort is as follows:

- To characterize potential releases from the sites
- To assess the nature and extent of soil and groundwater contamination attributable to past operations
- To support a baseline risk assessment (BRA)
- To gather data to evaluate the feasibility of remedial actions for the sites

Once the site has been characterized, the data collected will be evaluated and used to make decisions concerning OU-2. Possible decisions include downgrading the site to a no further action (NFA) site, recommending the site for early removal, or selecting a remedial alternative to address contamination at the site. The southwest section of the Main Installation has been designated by the U.S. Environmental Protection Agency (EPA) and DDMT as OU-2.

1.2 Regulatory Requirements

DDMT was issued a Resource Conservation and Recovery Act (RCRA) Part B permit (No. TN4 210 020 570) by EPA's Region IV and the Tennessee Department of Environment and Conservation (TDEC) on September 28, 1990. Subsequently, 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 Hazardous 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.

DDMT has entered into a Federal Facility 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 (RI, feasibility study [FS], proposed plan, Record of Decision [ROD], remedial design, remedial action, or NFA).

1.3 Facility and Site Status

As a result of the NPL status, the required site-specific investigations, and the FFA, the facility has been geographically delineated into four operable units (OUs). OU-specific FSPs are being prepared for OUs 1, 2, 3, and 4. These OU-specific FSPs will provide guidelines for conducting the remedial investigation/feasibility studies (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-2 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-2 that have been previously identified as requiring a remedial investigation (i.e., Sites 27, 32, 34, 89). The remainder of the identified sites within OU-2 are proposed for one of four other status categories: screening site, no further action site, feasibility study site, or early removal site (Table 1-1). Activities related to these sites will be addressed in the *Screening Sites FSP*, *NFA Report*, *Early Removal 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 all the sites at OU-2 and cites the specific document that will address future work planned for each site.

1.4 Elements of the Field Sampling Plan

This FSP is written as a supplement to the generic (facilitywide) work plans for DDMT. Details 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 (Generic RI/FS WP)*
- *Generic Quality Assurance Project Plan (QAPP)*
- *Generic Health and Safety Plan (HASP)*

The FSP defines the sampling and data-gathering that will be conducted. The structure of the FSP includes all known site conditions and history; proposed site-specific sampling, analysis, intended data use, and data quality level; and a discussion of required field actions that are not site-specific. Sample designation, sample equipment and procedures, and sample handling and analysis are addressed in the *QAPP* (ref. 1).

Table 1-1
OU-2 (Southwest Area of Main Installation)
Site Status
Defense Depot Memphis, Tennessee

RI/FS Site Number	Description	RFA Number	RI Report Number	RFA Status	Current Status	Document Addressing Future Work
30	Paint Spray Booths (2 of 3 total; Bldgs. 770 and 1086)	30	-	NFA	NFA	*NFA Report*
40	Safety Kleen Units—5 of 9 total (all located in Bldg. 770)	40	-	NFA	NFA	*NFA Report*
41	Satellite Drum Accumulation Areas—2 of 4 total (vicinity of Bldg. 770)	41	-	NFA	NFA	*NFA Report*
47	Former Cont. Soil Drum Storage Area (300 ft west of Bldg. 689, removed 1988)	47	-	NFA	NFA	*NFA Report*
29	Former Underground Waste Oil Storage Tank	29	66	PRFI	ER	*Early Removal Memo*
87	DDT, banned pesticides (Bldg. 1084)	-	64	-	ER	*Early Removal Memo*
88	POL (Bldg. 1085)	-	65	-	ER	*Early Removal Memo*
27	Former Recoup Area	27	60	RFI	RI	*OU-2 FSP*
32	Sandblasting Waste Accumulation Area	32	67	RFI	RI	*OU-2 FSP*
34	Bldg. 770 Underground Oil Storage Tanks	34	58	PRFI	RI	*OU-2 FSP*
31	Former Paint Spray Booth (Bldg. 1087)	31	-	PRFI	Screening	*Screening Site FSP*
33	Sandblasting Waste Drum Storage Area (metal shed south of Bldg. 1088)	33	-	NFA	Screening	*Screening Site FSP*
71	Herbicide—All Railroad Tracks	-	71	-	Screening	*Feasibility Study WP*
73	2,4-Dichlorophenoxyacetic Acid (all grassed areas)	-	73	-	Screening	*Screening Site FSP*
82	Flammables (Bldg. 783)	-	59	-	Screening	*Screening Site FSP*
84	Flammables, solvents, waste oil, etc. (Bldg. 972)	-	63	-	Screening	*Screening Site FSP*
89	Acids (Bldg. 1089)	-	68	-	RI	*Screening Site FSP*

DDT - Dichlorodiphenyltrichloroethane.
FSP - Field sampling plan.
NFA - No further action.
OU-2 - Operable Unit 2.
POL - Petroleum, oil, and lubricants.
PRFI - Preliminary RCRA facility investigation.
RFA - RCRA Facility Assessment.
RFI - RCRA facility investigation.
RI - Remedial investigation.
RI/FS - Remedial investigation/feasibility study.
SWMU - Solid waste management unit.
WP - Work plan.
\- - Site number or site status not identified in the RFA report or RI report, as appropriate.

TAB

Section 2 - Facility and Operable Unit Description

2.0 Facility and Operable Unit Description

2.1 Location

DDMT covers 642 acres of land in Shelby County, Memphis, 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 Road, Ball Road, and Perry Road serve as the northern, southern, and western boundaries, respectively, of the Main Installation. Dunn Field extends north to Person Avenue. Figure 2-1 shows the installation's location within the Memphis area.

OU-2 is located in the southwest quadrant of the Main Installation at DDMT and consists of about 108 acres. It is bounded by G Street on the north, 6th Street on the east, Ball Road on the south (installation boundary), and Perry Road on the west (installation boundary). The location of OU-2 is shown in relation to the entire DDMT facility and other proposed OUs in Figure 2-2.

2.2 Operable Unit Description

OU-2 is located in the southwest quadrant of the Main Installation of DDMT and is further characterized as an industrial area where maintenance and repair activities have taken place. The boundaries of OU-2 were defined primarily because of the geographic proximity of the sites and the similar nature of activities that occurred on these sites. OU-2 has a total of 17 identified sites: 4 NFA sites, 3 early removal sites, 3 RI sites, 6 screening sites, and 1 feasibility study site (Table 1-1). OU-2 includes the following four key areas:

- The former hazardous materials recoupment area (Building S-873), designated as Site 27, which is addressed in this FSP.

- The painting area and sandblasting waste accumulation area (Buildings 1087 and 1088), designated as Sites 31, 32, and 33, and the adjacent Buildings 1084, 1085, and 1089 (Sites 87, 88, and 89, respectively). Sites 87 and 88 are designated as early removal sites, Sites 31 and 33 are screening sites, and Sites 32 and 89 are addressed in this FSP.

- The underground oil storage tanks at Building 770, designated as Site 34, which is addressed in this FSP.

- The former underground waste oil storage tank, designated as Site 29, which is designated as an early removal site.

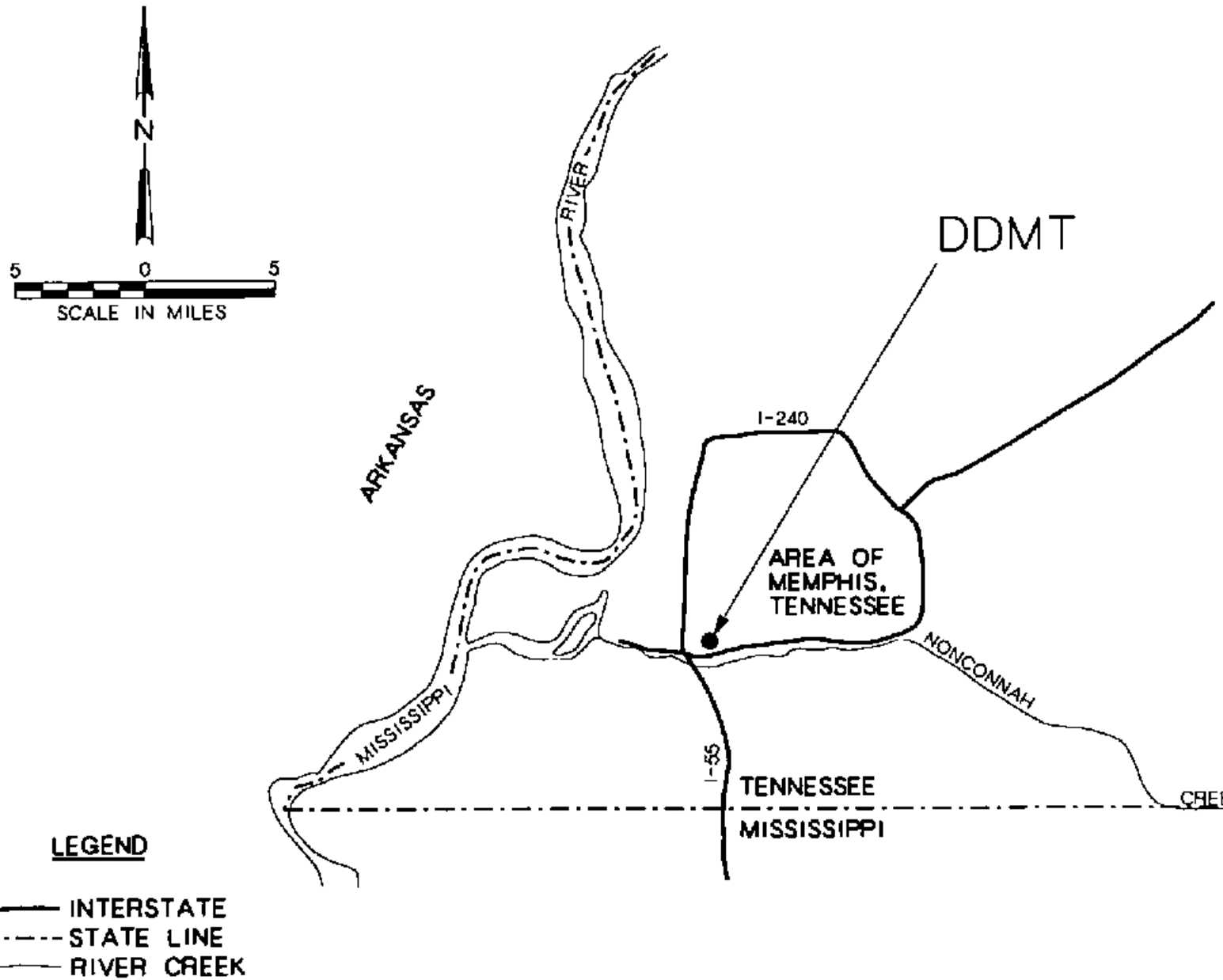
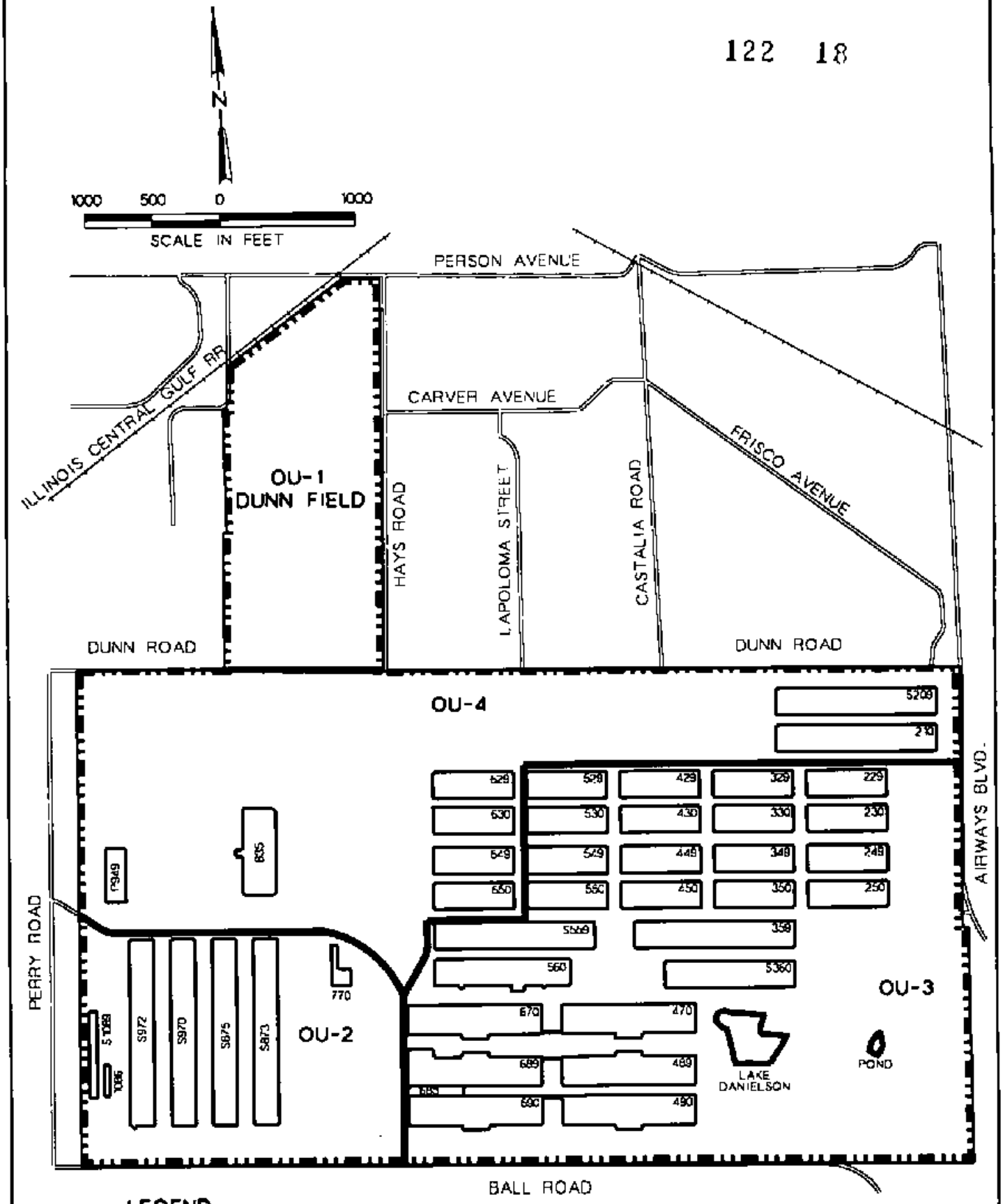


FIGURE 2-1
DDMT LOCATION IN MEMPHIS METROPOLITAN AREA
Defense Depot Memphis, Tennessee

Source: Engineering-Science, 1993



Source: Engineering-Science, 1993

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

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Figure 2-3 shows the location and status of each of the identified sites in OU-2. A brief description of each site along with its status is also provided in Table 1-1.

2.3 Geography and Topography

DDMT is divided into two areas, the Main Installation and Dunn Field, each with its own distinct land surface and use-related features. Figure 2-4 shows the topographic features of DDMT and surrounding areas.

About 57 percent of the Main Installation is 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 national geodetic vertical datum (NGVD) in the Defense Reutilization and Marketing Office (DRMO) storage yard next to Dunn Avenue to 267 ft NGVD in the low area below Lake Danielson's earthen dam. The topography across OU-2 is essentially level, with a geographic high in the southwest corner. Figure 2-5 shows the topography of OU-2.

Dunn Field lies just north of the Main Installation and Dunn Avenue and consists of approximately 64 acres of undeveloped land. About one-half the area is grassed; the remaining area contains crushed rock and paved surfaces. 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 NGVD at the north outfall/installation boundary fenceline to 315 ft NGVD in the field's approximate center.

2.4 Meteorology

This area of Tennessee experiences a continental 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; ref. 2). 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. 2).

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 2-6 illustrates the surface drainage features, installation drainage areas, and local streams associated with the DDMT facility. Figure 2-5 shows the locations of the storm water and sanitary sewers within OU-2.

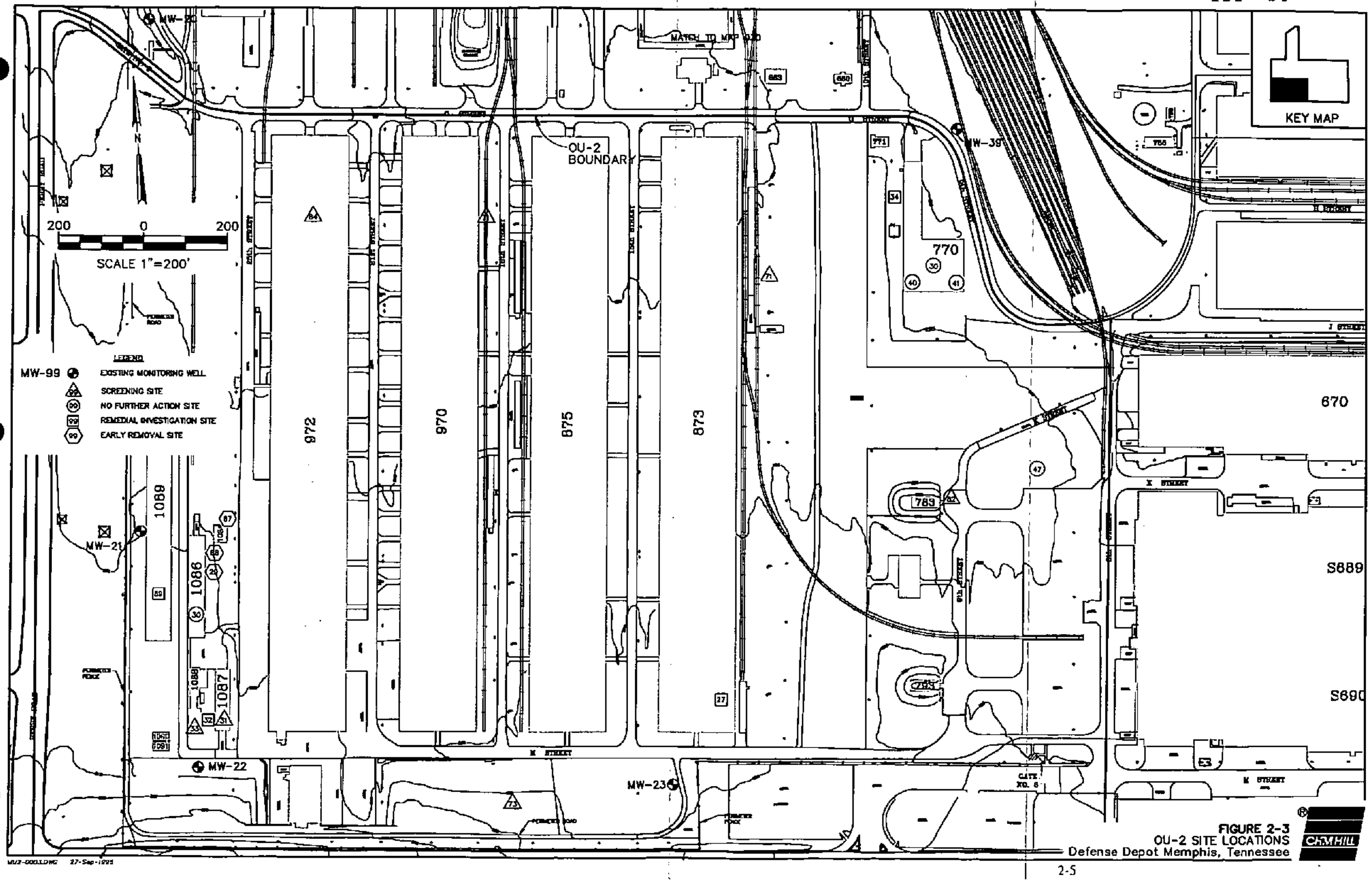

FIGURE 2-3
OU-2 SITE LOCATIONS
Defense Depot Memphis, Tennessee

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

FIGURE 2-4
SURFACE TOPOGRAPHY OF DDMT AND SURROUNDING AREA OF MEMPHIS, TENNESSEE
Defense Depot Memphis, Tennessee

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OU-2 BOUNDARY

KEY MAP

N

200 0 200

SCALE 1"=200'

LEGEND

- MW-99 EXISTING MONITORING WELL
- SBT-99 SOIL BORING LOCATION S689
- SS-99 SURFACE SAMPLE LOCATION
- SW-99 SURFACE WATER SAMPLE LOCATION
- SCREENING SITE
- NO FURTHER ACTION SITE
- REMEDIAL INVESTIGATION SITE
- CHEMICAL WARFARE MANAGEMENT PLAN SITE
- EARLY REMOVAL SITE
- 200 TOPOGRAPHIC CONTOURS S690
- STORM DRAINAGE LINES (ARROWS INDICATE FLOW DIRECTION)
- SANITARY SEWER LINES (ARROWS INDICATE FLOW DIRECTION)

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FIGURE 2-5
OU-2 TOPOGRAPHIC CONTOURS, STORM DRAINAGE, AND SANITARY SEWER LAYOUT
Defense Depot Memphis, Tennessee

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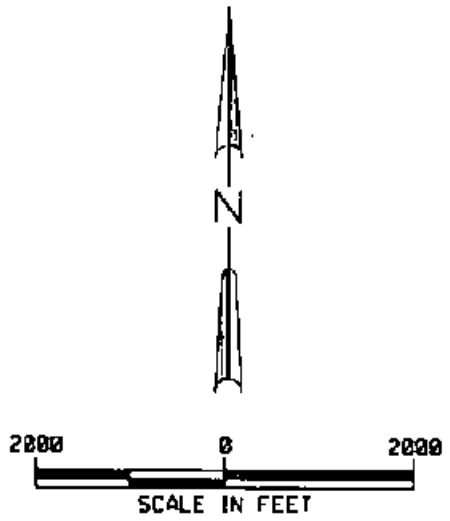
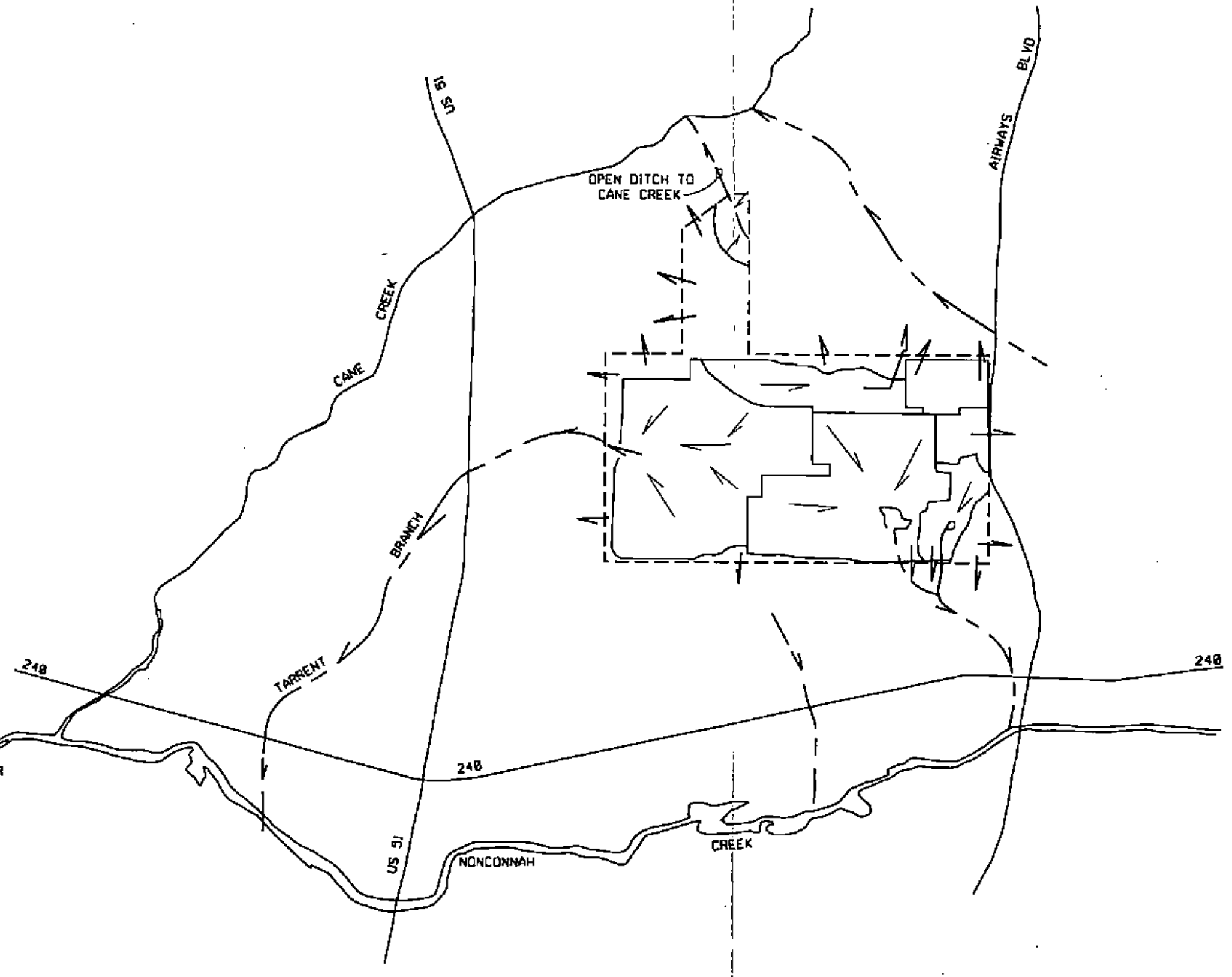




LEGEND

- INTERMITTENT STREAM
- BASIN BOUNDARIES
- DRAINAGE DIRECTION, LOCAL STROM DRAINS
- DRAINAGE DIRECTION, OVERLAND FLOW
- DEFENSE DEPOT BOUNDARY

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 2-6
STUDY AREA SURFACE DRAINAGE
Defense Depot Memphis, Tennessee

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 would capture the majority of runoff.

Most Dunn Field drainage is achieved by overland flow to the adjacent properties to the north and west. 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; ref. 3) are well above the average Mississippi River alluvial valley flood levels (185 to 230 ft NGVD). Furthermore, the surface elevations at DDMT 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.

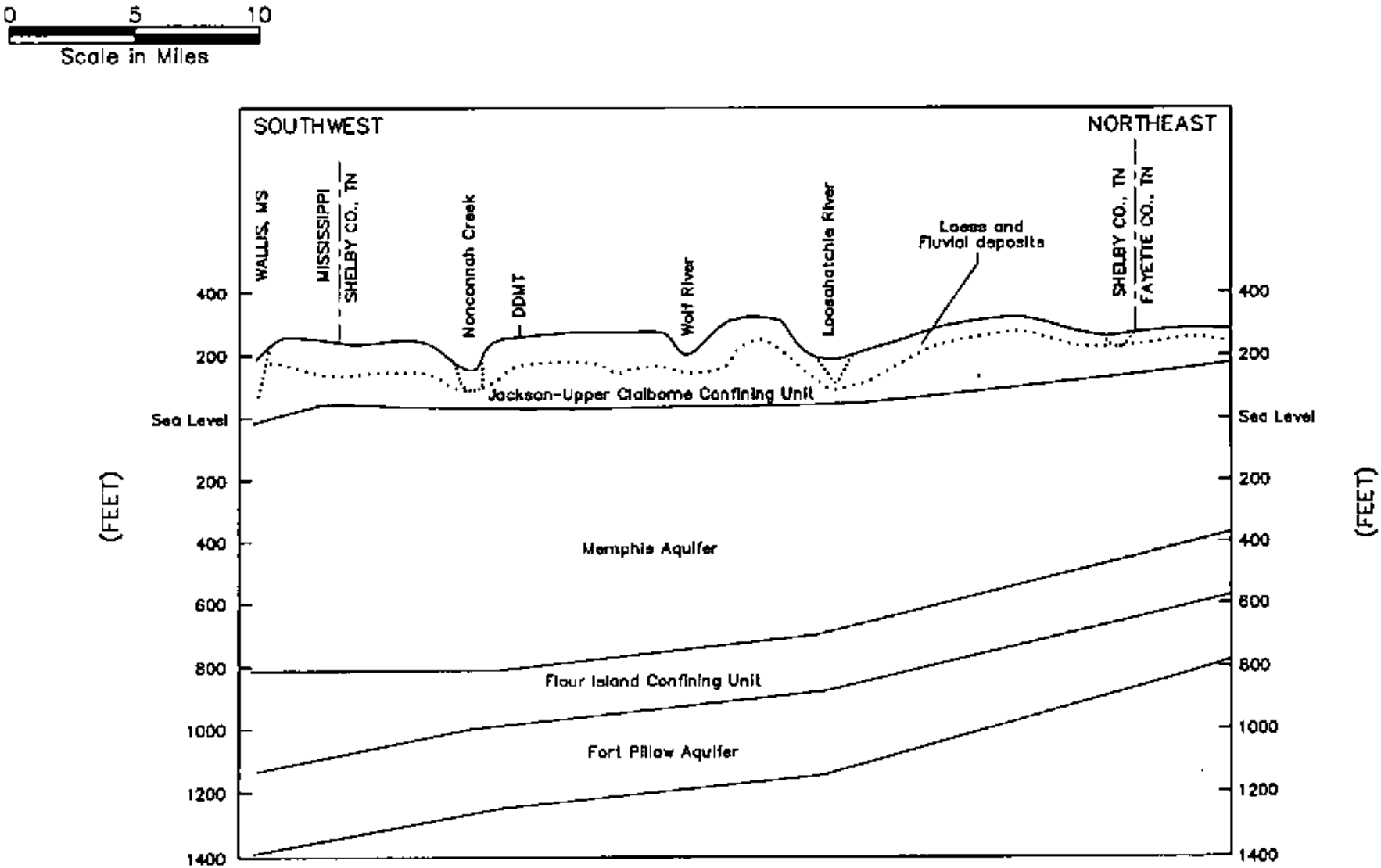
OU-2 has no perennial surface water bodies. More detail on the surface water hydrology at DDMT can be found in Section 2.4.3 of the *Generic RI/FS WP* (ref. 3).

2.6 Geology

2.6.1 Regional Geology

The area of Memphis, Tennessee, straddles two major subdivisions of the Atlantic Coastal Plain Physiographic Province. Figure 2-7 shows a general geologic cross section of the Memphis area. DDMT is situated within a major structural feature termed the Mississippi Embayment. This area is described as a youthful to mature, belted coastal plain (ref. 4).

Information describing major regional geologic units has been obtained from Wells (ref. 5), Moore (ref. 6), Nyman (ref. 7), and Graham and Parks (ref. 4). 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 Section 2.4.5.1 of the *Generic RI/FS WP* (ref. 3).



Source: Parks, 1990

FIGURE 2-7
GENERAL GEOLOGIC CROSS SECTION OF THE MEMPHIS AREA
Defense Depot Memphis, Tennessee

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2.6.2 Geology of Defense Depot Memphis, Tennessee

The geology of DDMT was investigated by reviewing the existing published geologic information and work performed during 1990 RI activities (ref. 8). On the basis of the soil borings and monitoring wells installed during the RI activities, 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 RI activities (ref. 8) included loess, fluvial deposits, Jackson Formation/Upper Claiborne Group clays (based on interpretation), and what has been interpreted to be the Memphis Sand Formation. Figures 2-8 and 2-9 illustrate two of the geologic cross sections of DDMT.

The uppermost geologic unit at or near ground surface at DDMT is loess (eolian deposits consisting of brown silty clay, clayey silt, and fine sandy clayey silt). 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).

Fluvial deposits underlie the loess and were encountered at all drilling locations during the 1990 RI activities (ref. 8). The unit is composed of three generalized members:

- 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.

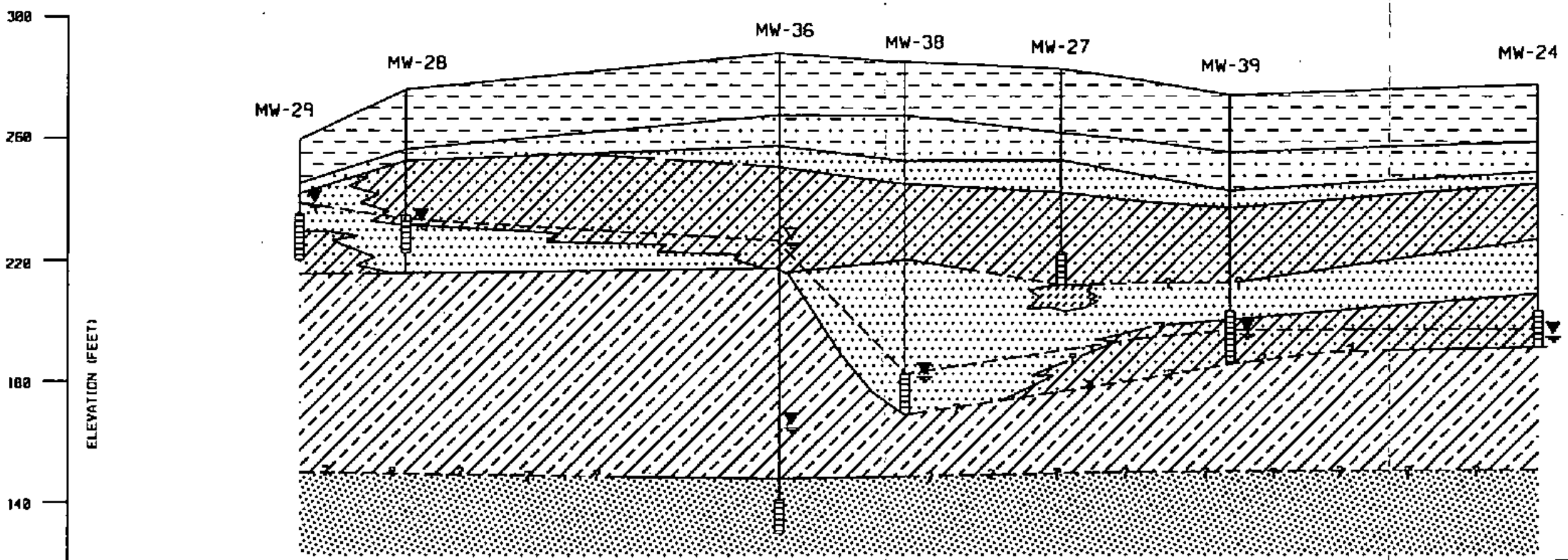
Clayey soils that have been interpreted as the Jackson Formation/Upper Claiborne Group were penetrated in three soil borings and two monitoring wells. This unit is represented at DDMT by a distinctive stiff gray or orange, low to high plasticity lignitic clay. This member underlies the fluvial deposits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

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 by a gray, very fine-grained, silty sand.

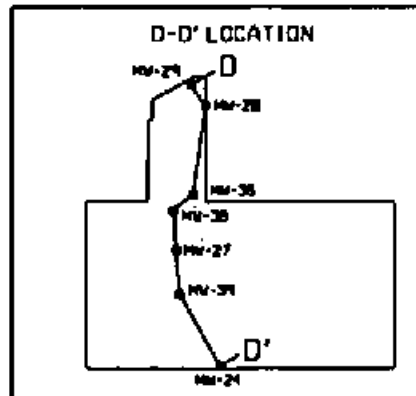
More detailed information on DDMT geology is available in Section 2.4.5.2 of the *Generic RI/FS WP* (ref. 3).

D
NORTH

D'
SOUTH

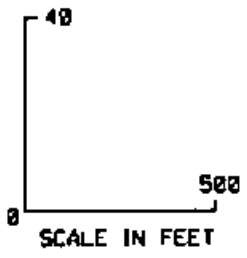


D-D' LOCATION



LEGEND

- SILTY CLAY, CL; SILTY SAND CLAY
- CLAYEY SAND, SC
- CLEAN, FINE TO MEDIUM GRAINED SAND, SP-SM-SW
- GRAVELLY SAND, SP-GP
- VERY STIFF, LEAN TO SLIGHTLY SILTY CLAY; POSSIBLY THE UPPER CLAIBORNE UNIT, SC
- GRAY FINE TO MEDIUM GRAINED SAND; POSSIBLY THE MEMPHIS SAND, SM
- SILTY AND FINE SANDY CLAY
- MW-37 MONITORING WELL DESIGNATION
- SCREEN INTERVAL
- BT DEPTH OF BORING TERMINATED
- WATER TABLE



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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122 28

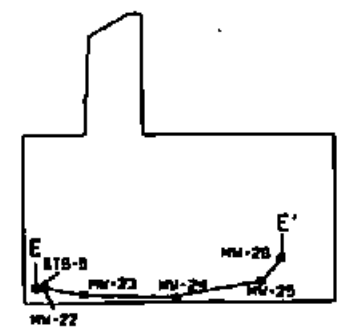
E
WEST

E'
WEST

STB-5
MW-22
MW-23
MW-24
MW-25
MW-26

300
260
220
180
ELEVATION (FEET)

E-E' LOCATION



LEGEND

- SILTY CLAY, CL; SILTY SAND CLAY
- CLAYEY SAND, SC
- CLEAN, FINE TO MEDIUM GRAINED SAND, SP-SM-SW
- GRAVELLY SAND, SP-GP
- VERY STIFF, LEAN TO SLIGHTLY SILTY CLAY; POSSIBLY THE UPPER CLAIBORNE UNIT, SC
- GRAY FINE TO MEDIUM GRAINED SAND; POSSIBLY THE MEMPHIS SAND, SM
- MW-37 — MONITORING WELL DESIGNATION
- SCREEN INTERVAL
- BT — DEPTH OF BORING TERMINATED
- WATER TABLE

40
0
500
SCALE IN FEET

NOTE: THIS ILLUSTRATION REPRESENTS AN INTERPRETATION OF NATURAL

FIGURE 2-9
CROSS SECTION E-E', WEST TO EAST

CH2MHILL

2.7 Hydrogeology

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

- Alluvial Aquifer
- Fluvial (Terrace) Aquifer
- Memphis ("500-ft") Sand Aquifer
- Fort Pillow ("1400-ft") Sand Aquifer

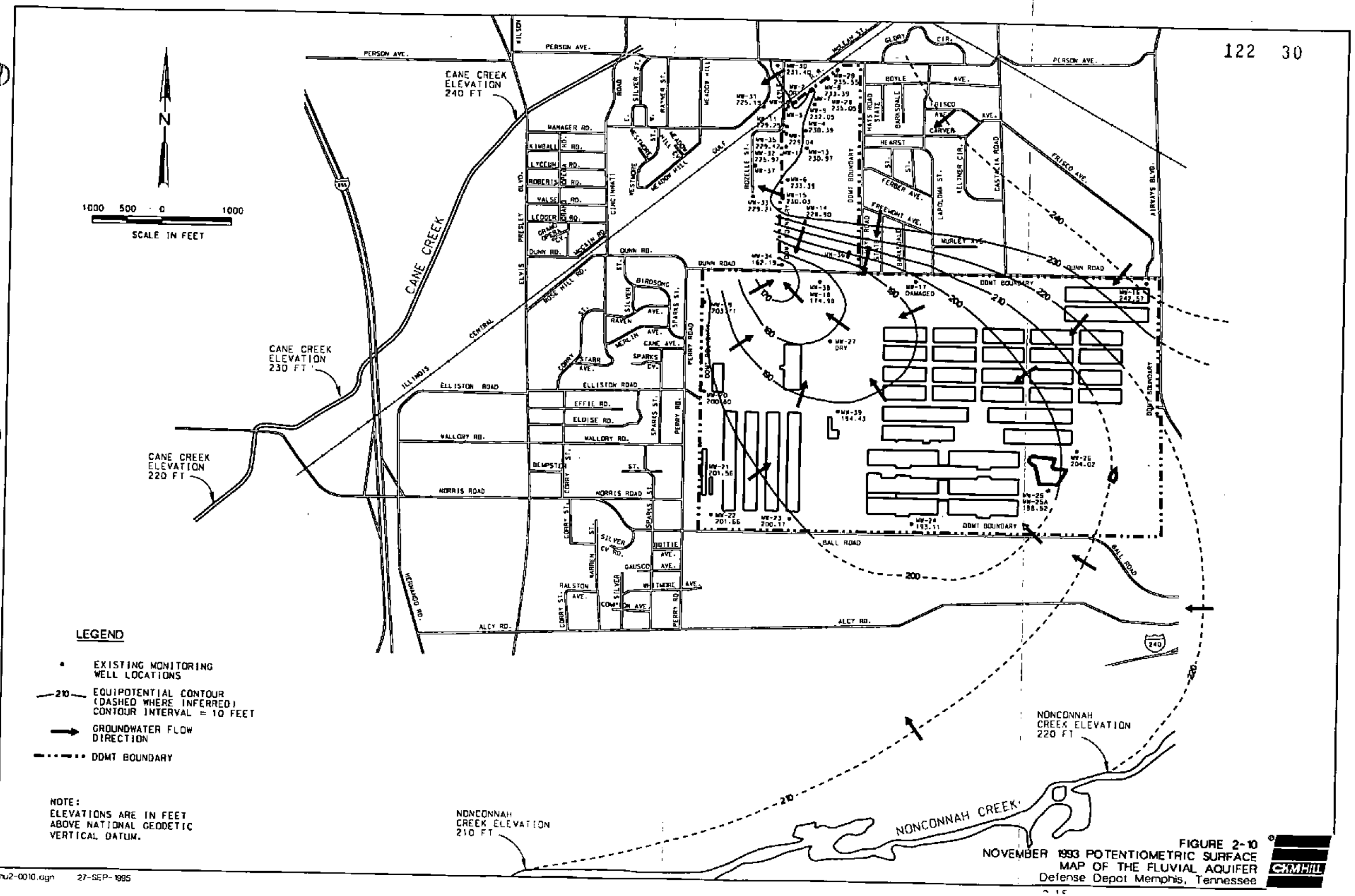
The Alluvial Aquifer's distribution is limited to the channels of primary streams; therefore, it does not occur at DDMT. The Fluvial, Memphis Sand, and Fort Pillow Sand aquifers underlie the installation.

Site-specific hydrogeologic conditions were investigated by physical inspection, test borings, monitoring well installation, groundwater quality monitoring, and direct measurement of in situ hydraulic properties during RI activities (ref. 8).

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 hydrogeology at DDMT. The fluvial deposits form the site's shallow (water table) aquifer, which ranges in thickness from 40 to 131 ft at DDMT. Recharge to this unit is primarily from the infiltration of rainfall (ref. 4). According to the water levels measured in the monitoring wells during RI activities (ref. 8), only the base of the unit is saturated. Published seasonal water levels indicate that the groundwater levels fluctuate several feet. Water level data from DDMT wells were used to prepare a water table surface map (ref. 8) 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 Fluvial Aquifer water table surface within OU-2.

The Jackson Formation/Upper Claiborne Group was encountered at more than half the monitoring well and soil boring installation locations. The unit is significant because it is a regionally important confining bed separating shallow water-bearing zones from



LEGEND

- • EXISTING MONITORING WELL LOCATIONS
- —210— EQUIPOTENTIAL CONTOUR (DASHED WHERE INFERRED) CONTOUR INTERVAL = 10 FEET
- → GROUNDWATER FLOW DIRECTION
- ---••--- DDMT BOUNDARY

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

FIGURE 2-10
NOVEMBER 1993 POTENTIOMETRIC SURFACE MAP OF THE FLUVIAL AQUIFER
Defense Depot Memphis, Tennessee

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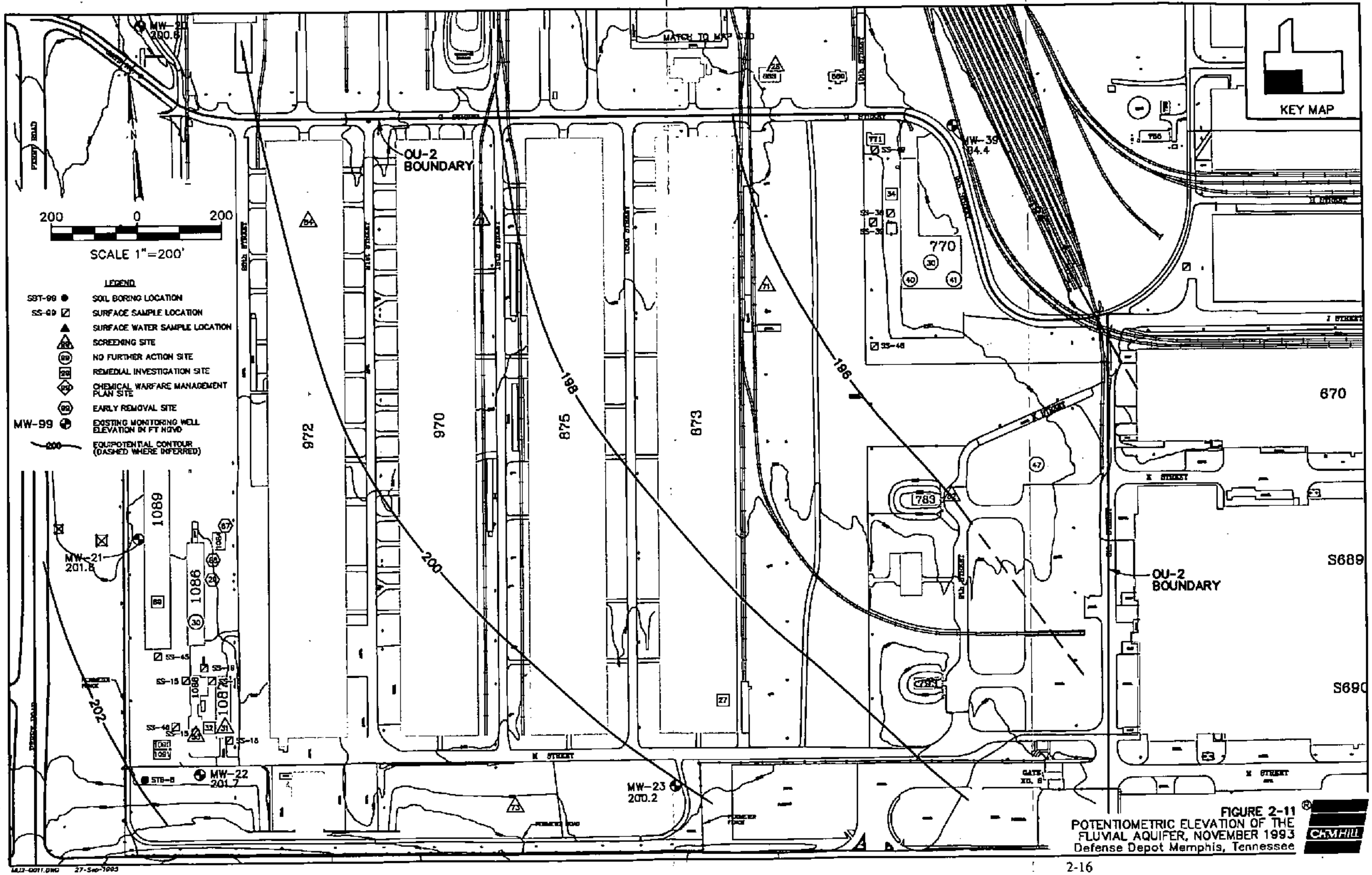


FIGURE 2-11
POTENTIOMETRIC ELEVATION OF THE FLUVIAL AQUIFER, NOVEMBER 1993
Defense Depot Memphis, Tennessee

MJ2-0011.DWG 27-Sep-1993

underlying major aquifers (ref. 7). Where encountered, the elevation of the confining unit's upper surface ranged from 223 ft NGVD to 118 ft NGVD. An investigation to assess the presence of the confining unit and hydraulic communication (if any) between the Fluvial Aquifer and the Memphis Sand Aquifer is planned during the OU-4 RI activities. The continuity and thickness of the confining unit can be only estimated from the available information.

The Memphis Sand Aquifer represents the region's most important source of water resources. The aquifer is reported to underlie the entire Memphis area. At DDMT, the top of the Memphis Sand Aquifer is approximately 125 to 150 ft NGVD. In the monitoring wells completed in the Memphis Sand Aquifer at DDMT, the potentiometric level ranges 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 Fort Pillow Sand Aquifer (also called the "1400-ft sand") underlies DDMT and the Memphis region at great depth, on the order of 1,400 ft bgs, and is reported to average some 200 ft thick in the Memphis area. The unit contains groundwater under strong artesian (confined) conditions. The Fort Pillow Sand Aquifer potentiometric level in the DDMT area was interpolated to be on the order of 180 ft NGVD in the fall of 1985 (ref. 4).

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. 3).

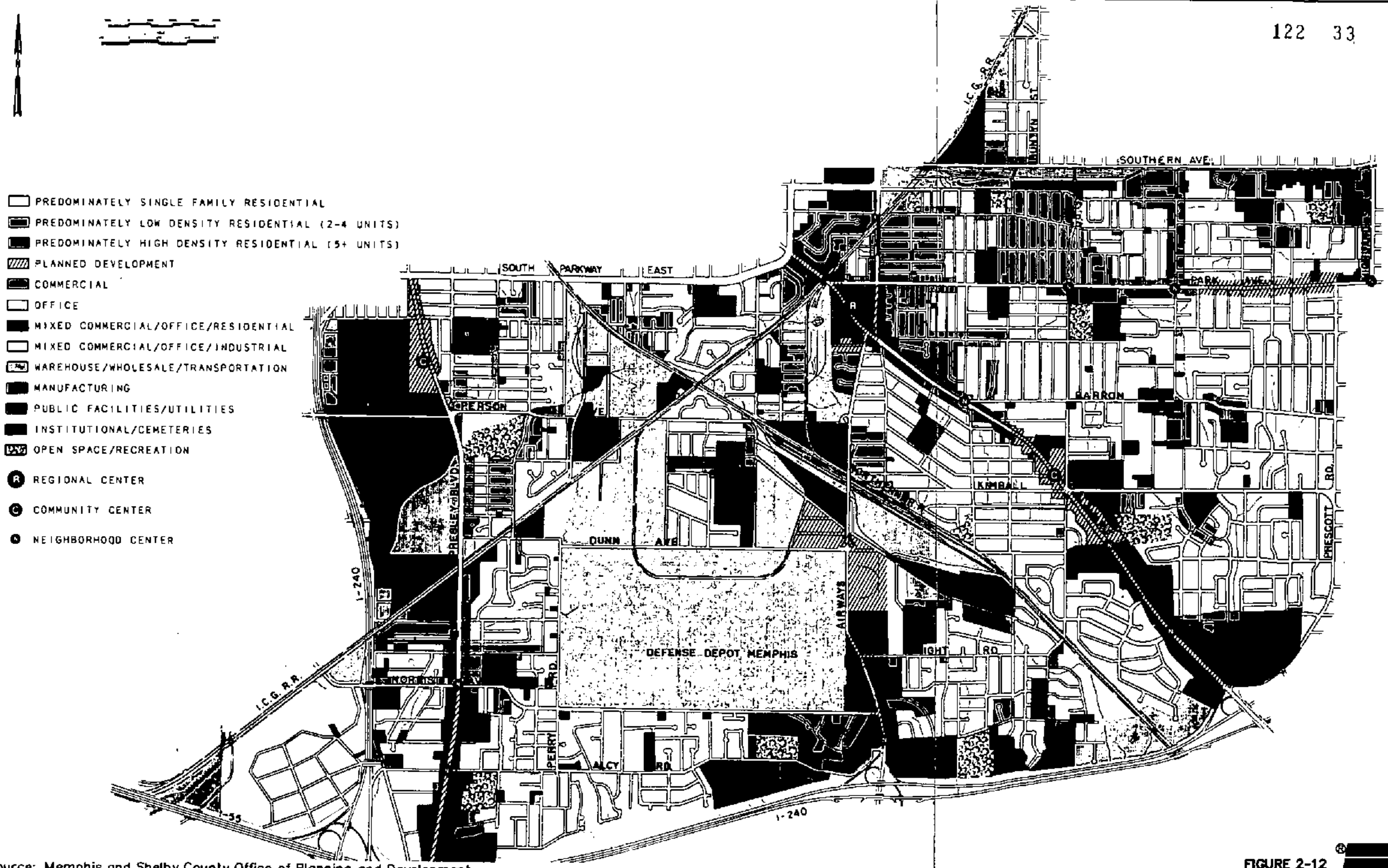
2.8 Land Use

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. 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



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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DDMT. Further detail on surrounding land use can be found in Section 2.4.7 of the *Generic RI/FS WP* (ref. 3).

2.8.2 Operable Unit 2

The land within OU-2 has been graded, paved, and heavily built up; the perimeter areas are the only vegetated areas. OU-2 is primarily characterized as an industrial area. The following activities either occur now or are reported to have occurred in OU-2:

- Vehicle maintenance
- Preservation of heavy equipment
- Storage of waste oils
- Storage (and spills) of pesticides, acids, solvents, and other industrial chemicals
- Sandblasting
- Repacking of various industrial chemicals from damaged containers
- Painting

2.9 History and Existing Data

A discussion of the history of activities at the four RI sites in OU-2 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 are provided in the tables and figures in Appendix B.

2.10 Operable Unit 2 Data Gaps

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

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

Table 2-1
Data Gaps and Future Data Collection for OU-2
Defense Depot Memphis, Tennessee

Data Need/Use	Existing Data	Future Data Collection
Assess the vertical and horizontal extent of soil contamination at each of the RI sites	Installation records and some historical sampling data	Install soil borings and analyze surface soil samples
Evaluate whether releases from a site have adversely affected Fluvial Aquifer groundwater quality	Sampling results from monitoring wells at DDMT's western boundary in OU-2 and next to the northeast border of OU-2	Sample existing wells; install and sample additional upgradient and downgradient monitoring wells, as necessary
Conduct a BRA for exposure to surface soil at the applicable RI site	Some surface soil data from previous investigations	Collect a minimum of 9 surface soil samples for statistical comparisons

BRA = Baseline risk assessment.
OU-2 = Operable Unit 2.
RI = Remedial investigation.

TAB

Section 3- Sampling Stategy for
Operable Unit 2 Remedial Investigation

3.0 Sampling Strategy for Operable Unit 2 Remedial Investigation

This section describes the sampling strategy for OU-2 RI sites. The following information is provided:

- Structure of the investigation
- Data quality objectives (DQOs)
- Data comparisons
- Background data
- Preliminary applicable or relevant and appropriate requirements (ARARs) and preliminary remediation goals (PRGs) development
- Risk-based PRGs
- Statistical data comparison

3.1 Structure of Operable Unit 2 Investigation

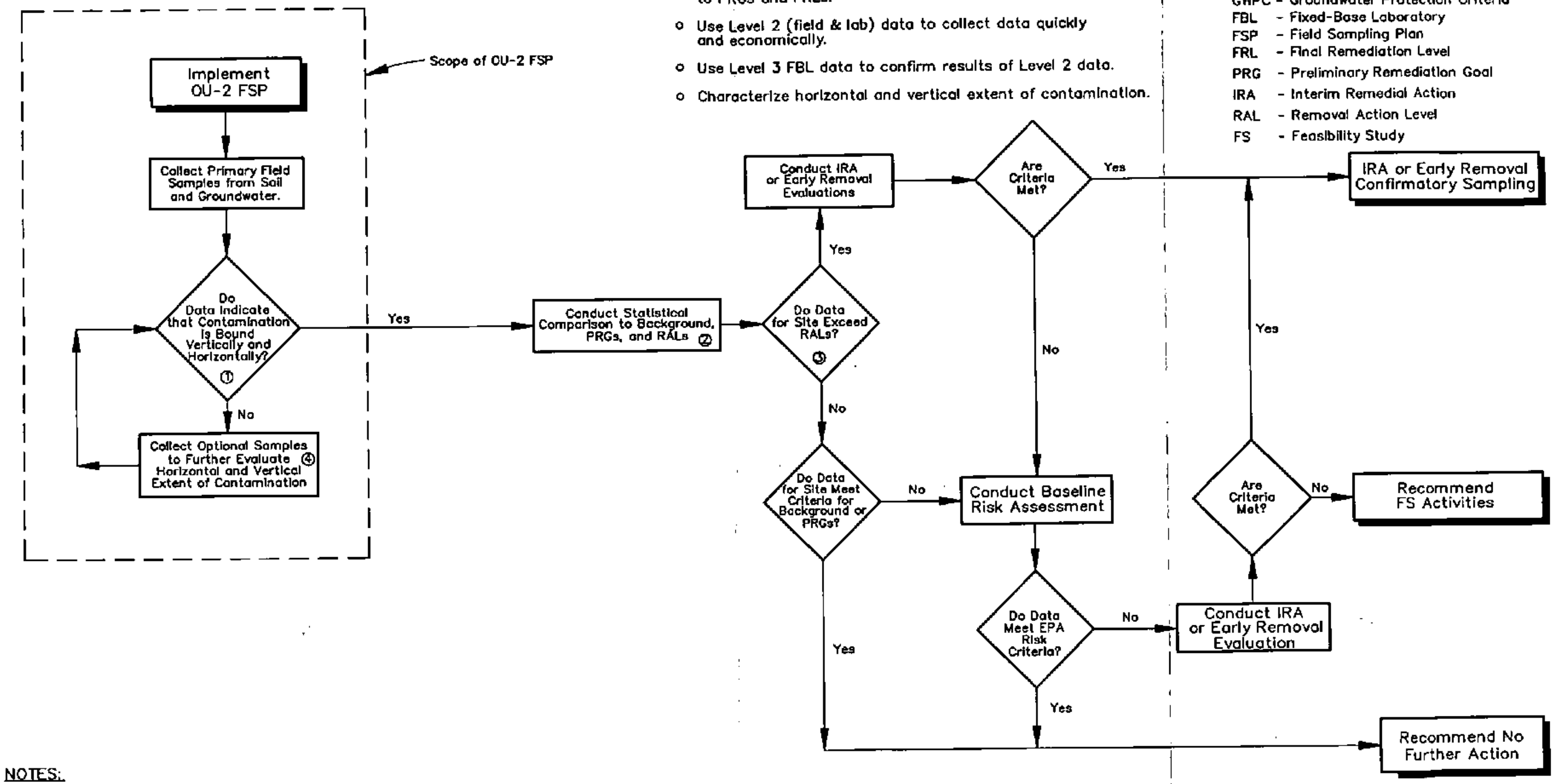
This section is intended to give a detailed description of the overall strategy for the investigation of each RI site in OU-2. The approach presented is intended to support a decision to recommend one of the following options:

- Site upgrade (FS, Remedial Design and Remedial Action)
- Site downgrade (support NFA)
- Interim remedial action or Early Removal

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 by Figure 3-1.

3.1.1 Scope

The scope of the field investigation for OU-2 includes soil (surface and subsurface) and groundwater sampling. Surface soils will be sampled to assess the nature and horizontal extent of contamination and to provide data for statistical comparison to background



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.

FIGURE 3-1
OU-2 LOGIC DIAGRAM
Defense Depot Memphis, Tennessee

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concentrations and PRGs. Subsurface soil samples will be collected to further evaluate the nature of contamination and assess the vertical extent of contamination.

The existing monitoring wells will be sampled at each of the sites. Additional monitoring wells may be installed if existing data or data collected during investigation of soil contamination at the RI sites indicate the need for further groundwater monitoring.

3.1.2 Approach

A phased approach is being used to implement the observational method to the investigation of the RI sites. The RI sites to be investigated as part of this work plan are located in OU-2 in the southwestern quadrant of the Main Installation.

The focus of the approach to the RI site investigation is to assess the nature and extent of potential soil contamination and possibly to investigate whether there may have been releases that have adversely affected the quality of groundwater. Primary soil samples that are planned with respect to location and depth will be collected at each of the sites. If these samples indicate the extent of contamination has been found, no further sampling will be performed.

However, additional "optional" samples may be needed to more fully assess the extent of contamination. The extent of contamination will be evaluated based on comparison to the higher of the background or PRG concentrations of the parameters detected. Background concentrations will be developed as described in Section 5.3.2 of the *Generic RI/FS WP* (ref. 3). The analytical results of the primary samples will be reviewed in the field to evaluate the need for any optional samples. Use of Level 2 (7- to 10-day turnaround) analyses will expedite this process. Additional samples may also be collected if field personnel discover visual evidence of contamination in areas that are not planned for sampling.

At each RI site, groundwater will be investigated through sampling of the existing wells. Upgradient wells will also be installed (as part of the *OU-4 FSP*) near the facility boundary to investigate sources of offsite contamination. The location of the facility boundary wells and the suspected groundwater flow direction at DDMT are shown in Figure 4-4 of the *OU-4 FSP*. The facilitywide groundwater strategy is presented in the *OU-4 FSP* to achieve concise presentation of strategy and to prevent redundancy.

Sample analysis activities include screening analyses using 7- to 10-day turnaround analyses from a fixed-base laboratory (FBL) (Level 2 data quality). Level 3 quality sample analyses and reporting will be used for confirmational analyses of the Level 2 data. Three sites at the DDMT facility have been identified for RI in OU-2 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. Figure 3-1 provides a proposed decision logic diagram.

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 analysis. 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.

The *QAPP* (ref. 15) (Section 3) addresses quality assurance/quality control (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. Three levels of data quality will be used during the RI activities:

- Level 1 analyses may include measurements such as field pH, immunoassay kits, and soil vapor analysis using an organic vapor analyzer (OVA).

- Level 2 analyses include any parameter of concern that is conducted on a quick turnaround time basis in the fixed laboratory using the project specified Level 2 methodology.

- Level 3 analyses may include FBL analyses for volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), metals, pesticides, and polychlorinated biphenyls (PCBs).

The same analytical methods will be used for the Level 2 quick-turnaround FBL analyses as the Level 3 FBL analyses. The primary difference will be the data package deliverable.

Level 4 data may be required in the future at this facility. Samples analyzed using Level 4 quality control (QC) are analyzed using the same analytical methods as Level 3 samples, but different data package deliverables are provided as described in Section 3.2.2.4 of the *QAPP*. Confirmational samples will be analyzed using Level 3 QC, and no Level 4 QC is proposed at this time. However, if in the future Level 4 information becomes necessary, this information will be requested from the analytical laboratory.

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 will be screened using Level 2 analyses. 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,

20 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. Efforts will be made to run TCL/TAL on samples from the area of highest contamination. This will allow the greatest likelihood of detecting any additional types of contamination not previously found. The list of analytical methods that will be used for offsite analysis is presented in Section 4 of the *QAPP* (ref. 1). The field team leader or site hydrogeologist will select the location of confirmational samples (Level 3) based on the results of the Level 2 data, according to the criteria defined in Sections 3.2 and 3.3.

3.1.5 Remedial Actions

Field data can be used to support IRAs, RAs, and Early Removal evaluations. A site may be selected for RA, IRA, or Early Removal and confirmational sampling rather than for FS if contamination levels are found to be above removal action levels (RALs) and if the applicable criteria are met. Conducting remedial actions on a site with contamination covering a limited area may reduce costs because of the reduced investigation costs associated with sites that undergo traditional FS activities. The remedial action 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 initial groundwater samples. These activities are planned with respect to location, depth, and parameters to be analyzed. The analytical soil data, in comparison to background concentrations and PRGS, will be used to evaluate the need for additional field sampling. Collection of the background data set is described in the *Generic RI/FS WP* (ref. 3) (Section 5.3.2). After the primary field work has been completed, additional investigation may be necessary when data are not bound horizontally or vertically. Optional field work could include additional surface soil sampling, subsurface soil sampling, and monitoring well installation and sampling.

By using the field analytical data, DDMT can implement optional activities to achieve the objectives of the field investigation. 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.

3.2 Data Quality Objectives

DQOs are qualitative and quantitative statements that specify the quality of the data required to support the decisionmaking process during the sampling activities. DQOs are developed according to intended final use of the data. Specific objectives of the RI field

sampling effort are divided into the following two parts: general field work DQOs and site-specific DQOS. Site-specific DQOs are presented in Section 4. The general DQOs guiding the field investigation process are the following:

- Collect soil samples (surface and subsurface) that are representative of site conditions.
- Provide reliable data results supported by QC measures implemented during sampling and analysis.
- Use Level 1 screening methods to aid in sample selection.
- Use Level 2 FBL analytical methods to expedite the decisionmaking process and to collect data quickly and economically. Use analytical techniques for Level 2 data that provide data for use in the risk assessment.
- Conduct sufficient Level 3 FBL analyses to support confirmation of Level 2 data and to support risk-based decisions for the NFA alternative.
- Compare the levels of contamination at sites to background concentrations, 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.

3.3 Data Comparisons

Surface and subsurface soil data and groundwater data will be collected during the primary field work investigation. The data will be collected at locations identified in Section 4 of this report. Locations have been selected by reviewing site history to determine where site activities were reported to have occurred and by reviewing existing environmental data. 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. 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 (Sections 3.5 and 3.6) for organic constituents. Contaminants that exceed the PRGs are considered to be representative of contaminated areas at 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 vertical and horizontal extent of contamination,

additional surface soil samples and/or 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 to assess the data usability. This comparison will be conducted after the Level 3 data have been analyzed by the laboratory and validated. The *QAPP* (ref. 15), Section 3.2.2, discusses the approach to assessing data quality usability. The goal is to collect Level 2 data of sufficient quality to be used for statistics and for BRA.

- Level 2 data will be compared to RALs for each data point. The RALs are discussed briefly 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 background concentrations, PRGs, and RALs. This approach is presented in Section 3.7.

3.4 Background Data

Background data for soil (surface and subsurface), groundwater, sediment, and surface water 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. 3). The background data set will be used to establish individual background data numerical criteria for each constituent of concern. The method for establishing these background data numerical criteria is presented in the *Generic RI/FS WP* (ref. 3) (Section 5.3.2). Individual parameters detected at each location sampled as part of the RI activities will be compared to the background data set to assess whether a contaminant release has occurred. If the analytical data from the RI site sample locations do not exceed the background data, the site will be recommended for NFA. If parameters detected at a site exceed background concentrations, the site will be considered for further investigation using the optional field activities (additional surface soil samples, borings, wells, and Early Removals). The optional activities are described in Section 4.

3.5 Preliminary Identification of ARARs and Screening PRGs

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 removal 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 3-1.

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

- The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), specifically 55 FR 8741-8766 for a description of ARARs, and 55 FR 8712-8715 for using ARARs as PRGs; also 53 FR 51394
- CERCLA Compliance Manuals (EPA, 1988 and 1989)
- *Risk Assessment Guidance for Superfund: Volume 1—Human Health Evaluation Manual* (Part B, Development of Risk-based Preliminary Remediation Goals) (RAGS Part B, EPA, 1991; ref. 9)

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

Table 3-1
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 clean-up standards which, while not "applicable," address problems or situations sufficiently similar to those encountered at a 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 clean-up levels are documented in the Record of Decision (ROD). They may differ from 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)	These are initial clean-up goals that (1) are protective of human health and the environment and (2) comply with ARARs. They are developed early in the process by using 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 RI/FS.
Risk-based PRGs	These are 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	These are 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 Goals Options (RQOs)	Remedial goal options are typically developed during the baseline risk assessment to prevent risk managers with a range of possible target FRLs.
Removal action Levels (RALs)	These are concentrations that trigger consideration of removal actions based on the potential for acute or long-term chronic effects.

3.5.2 Chemical-specific Threshold Concentrations

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

The screening PRGs were developed during this phase and represent the most conservative approach to interpreting the site data. These data are intended for use in screening the sites to evaluate the appropriate disposition of the site.

The screening PRGs were developed from information provided in RAGS Part B (ref. 9) 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 in the *Generic RI/FS WP* (ref. 3) are more conservative than the Region III values. The following factors were considered and led to the development of these 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). A more detailed discussion of media-specific PRGs and the numerical PRG values is presented in Section 3.6 of the *Generic RI/FS WP* (ref. 3).

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. 3).

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 1990 RI activities (ref. 8), 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 decisionmakers 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 calculations can be found in Section 3.6 of the *Generic RI/FS WP* (ref. 3).

3.7 Statistical Data Comparison

If a biased sample (assumed to represent a potential "hot spot" or high-concentration locations) shows concentrations exceeding the conservative screening PRGs (but below the RAL), it is possible that the average concentration over the designated exposure area may not represent a potential for adverse effects. Statistical sampling and comparison of estimates of the average concentration would meet 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. Provided that no hot spots (areas of high concentration relative to other areas of the site or elevated above an RAL) are identified, risk estimates are based on the average concentration (EPA RAGS, 1989; ref. 10). 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; 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. 11). Several approaches are identified, including comparison of a calculated upper confidence limit (UCL95) of the mean with the target concentrations.

3.7.1 Statistically Based Samples

Surface soil samples will be collected at each site. A total of nine is the recommended minimum because it is the smallest number of samples that can be used in an estimate of the average concentration to be used in a UCL95 calculation without defaulting to the maximum detected concentration. Nine samples provide information on the chemical distribution of the contamination. The average is used to calculate a UCL95, which gives the upper confidence limit of a data set a 95 percent confidence.

The objective of the sampling program is to allow a set of samples collected from a site to be generalized to the entire site. This form of systematic (probabilistic) sampling is proposed 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

4.1 Sampling Summary

Section 4 describes the activities that will be conducted during the field investigation at OU-2. The activities support the investigative strategy described in Section 3 of this FSP. The proposed sampling plans for OU-2 include surface soil samples, subsurface samples from soil borings, and groundwater samples from the Fluvial Aquifer. The primary Level 2 and Level 3 samples that will be collected at Sites 27, 32, and 34 are summarized in Table 4-1. Further information on the samples that will be collected, including QC samples and analytical methods, is provided in the following sections. A brief discussion of the types of QC samples that will be collected is provided in Section 5.4.

The proposed samples have been specified on the basis of location and sample matrix, in this case either soil or groundwater. Only the primary analytical samples are shown in the tables. Sampling at each site is specified in terms of a defined primary sampling effort, followed by an optional sampling effort, which will depend upon the results of the primary sampling. Since the optional sampling is undefined, these samples are not shown in the tables.

4.2 Site 27: Former Recoupment Area (Building S-873)

4.2.1 Site Description

Building S-873 is an open-sided, metal-roofed shed that formerly served as the DDMT recoupment area, where damaged and leaking containers were repacked. It is located in the south-central portion of OU-2, near M Street and 16th Street, and is shown in Figure 2-3. A detailed map of the site is provided in Figure 4-1. Site 27 includes the southeastern corner of the building and the gravel parking area to the east.

4.2.2 Site History

This site was formerly used for repacking hazardous and nonhazardous materials from damaged and leaking containers. It is estimated that these practices occurred between 1942 and 1986. This practice was discontinued at this location in 1986 and moved to another building that was constructed especially for this purpose. The specific boundaries of this site are unknown, other than the knowledge that these activities occurred in the described areas (i.e., the southeast corner of the building and the gravel parking area to the east). Remediation of soil contamination from previous spills of the pesticides dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE), and aldrin has been performed previously at this location, resulting in removal and disposal of contaminated soil (refs. 12 and 13).

Table 4-1
Samples to Be Collected by Site in OU-2
Defense Depot Memphis, Tennessee

	Site		
	27	34	32
Groundwater			
TCL/TAL	1	1	1
Surface Soil			
VOC	21	7	
PAH	21	7	7
Pest./PCB	21		7
Metals	21	7	7
TCL/TAL	1		1
Subsurface Soil			
VOC	11	13	
PAH	11	13	2
Pest./PCB	11		2
Metals	11	13	2
TCL/TAL		1	

Metals = Priority pollutant metals (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn). Analysis by SW 846 Method 6010/7000 series. Groundwater samples for metals are for total metals only.
PAH = Polynuclear aromatic hydrocarbon. Analysis by SW 846 Method 8100.
Pest./PCB = Pesticides/polychlorinated biphenyls. Analysis by a modified SW 846 Method 8080.
QC = Quality control.
TCL/TAL = Target compound list/target analyte list.
VOC = Volatile organic compound. Analysis by SW 846 Method 8240.

Note:
Summary does not include QC samples. These are given in the field sampling activity tables for each site (Tables 4-2 through 4-4).

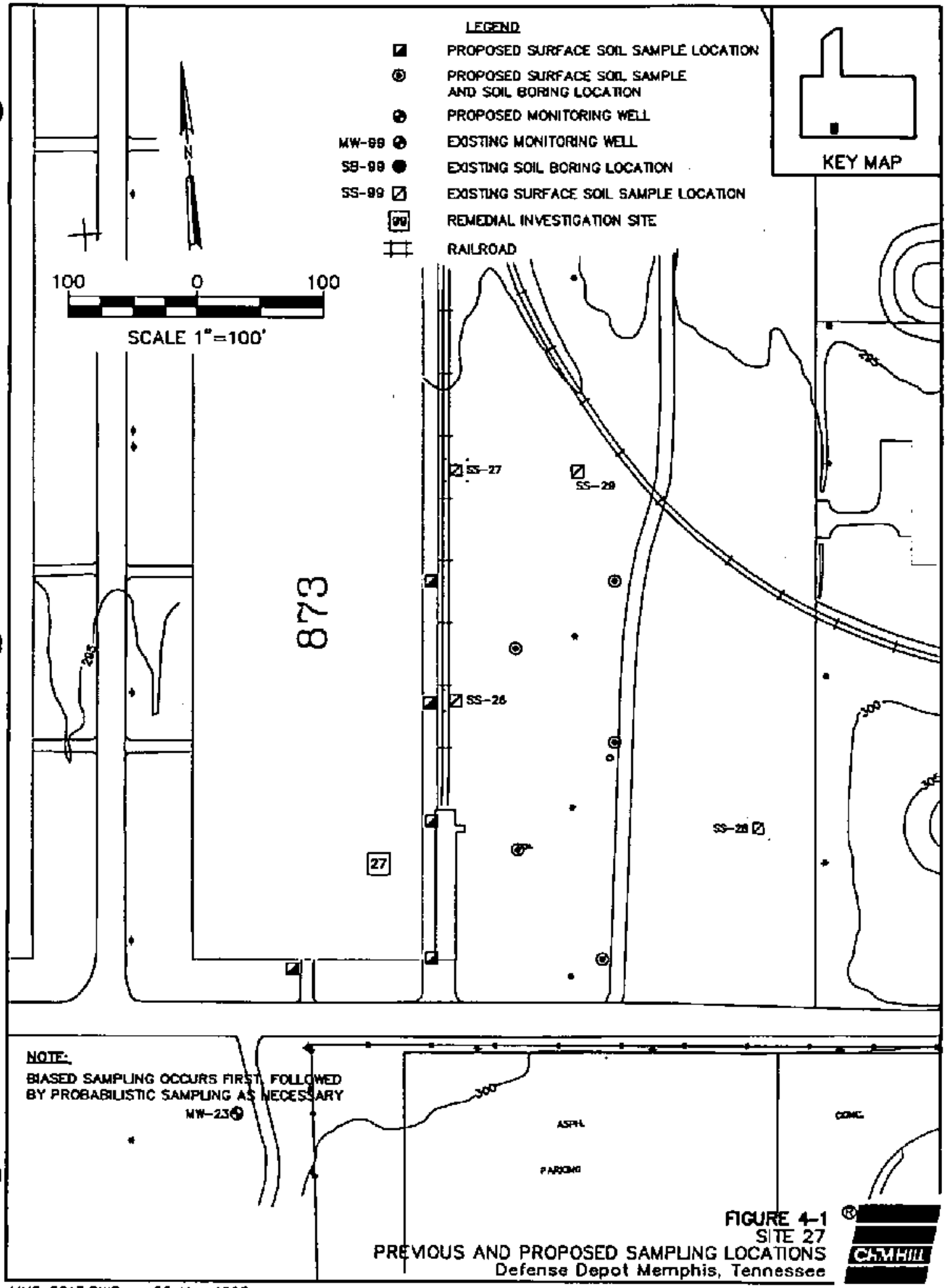

FIGURE 4-1
SITE 27
PREVIOUS AND PROPOSED SAMPLING LOCATIONS
Defense Depot Memphis, Tennessee

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4.2.3 Existing Data

During the RI activities performed in 1990 (ref. 8), surface soil samples (SS-26 and -27) were taken around the former hazardous materials recoupment area near the southeast corner of Building S-873, as shown in Figure 4-1. Samples were collected at a depth of 1 ft beneath the surface to evaluate residual contamination because the upper 6 inches to 1 ft had been removed and backfilled to remediate pesticide contamination in the soil (refs. 12 and 13). The sample results show that pesticides were not detected (Appendix B, Table B-3). Detected compounds for these surface soil samples include toluene, PAHs, and metals. The data are presented in Table B-3.

A groundwater monitoring well (MW-23) was also installed in this area during the 1990 RI activities (ref. 8). Analysis of groundwater samples revealed concentrations of metals (Table B-1). However, the updated potentiometric surface map (Figure 2-11) from November 1993 indicates that this well is located upgradient of Site 27.

In 1985, personnel from the U.S. Army, the Tennessee Department of Health and Environment, and the O.H. Materials Company devised a sampling grid east of Building S-873 to investigate the presence of possible contamination. Each grid measured 75 ft by 75 ft (Figure B-4). Nine discrete surface soil samples from each grid were collected and composited to form a representative sample from each grid area. In Appendix B, Tables B-6, B-7, and B-8 show the results of the sampling and provide analytical results for PCBs, extraction procedure toxicity (metals only), and pesticides, respectively. The parameters were selected after investigation of the past storage history of Building S-873 during the 1985 recoupment effort (ref. 13) at this building. Results indicated metal and pesticide contamination. Some samples were not analyzed because no notable PCB or metals contamination was found in previously analyzed grids. The information provided by this sampling effort prompted excavation of the top 0.5 to 1 ft of soil in this area by DDMT (refs. 8 and 12). No documentation exists for the area where gravel was removed around the southeast portion of Building S-873. All stained gravel was removed, and no visual evidence of contamination remains.

4.2.4 Potential Contaminants of Concern

The results of previous findings and what is known about the site history indicate that the potential contaminants of concern (COCs) at Site 27 are PAHs, pesticides, metals, and VOCs. Since site activities involved hazardous and nonhazardous materials, many different types of contaminants could be present.

4.2.5 Data Gaps and Site-specific Data Quality Objectives

Site 27 Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
Vertical and horizontal extent of soil contamination	Assess the vertical and horizontal extent of soil contamination Expedite the field investigation and decision process by using Level 2 analyses Confirm results of Level 2 analyses with Level 3 analyses
Data for performing a risk assessment	Collect data that support a statistically based comparison to background concentrations and PRGs
	Collect at least one TCL/TAL sample (location to be selected in the field) to assess whether other unknown contamination is present

4.2.6 Soils Sampling and Analysis

Soil samples will be collected to assess the vertical and horizontal extent of soil contamination from past activities outside the southeast corner of Building S-873 and in the gravel parking area east of the building. Spatially distributed surface soil samples will be collected to support statistical comparisons to background concentrations and PRGs. The details of the sampling plan for Site 27 are shown in Table 4-2.

Surface soil samples will be collected along the foundation of Building S-873 south and southeast of the building. Samples will be collected near the foundation of the building as close to the foundation as possible. Because the exact locations of releases are not known, samples will also be collected across the gravel parking area and from biased locations such as doorways and stained areas. A total of 10 locations (5 from borings and 5 from discrete biased locations) will be sampled for surface soils (Figure 4-1). At each location, a sample will be collected at a depth of 0 to 12 inches. The 0- to 12-inch sample should be collected beneath any gravel that may be present. The samples will be analyzed for Level 2 VOCs, PAHs, pesticides, and metals.

Shallow soil borings (to a depth of 10 feet) will be taken at five locations around Site 27 to help assess the vertical extent of contamination. The locations of the borings are shown in Figure 4-1. Subsurface soil samples will be collected at depths of 5 and 10 ft bls and analyzed for Level 2 VOCs, PAHs, pesticides, and metals.

At the depth of 10 ft, a soil sample will also be collected and checked for non-methane organic vapors in the headspace of the sample using an OVA. If organic vapors are

Table 4-2
Samples to Be Collected by Media and Analysis at Site 27
Defense Depot Memphis, Tennessee

Media	Description	Level 2				Level 3				
		VOCs[a]	PAHs[b]	Pesticides[c]	Metals[d]	TCL/TAL[e]	VOCs[f]	PAHs[b]	Pesticides[c]	Metals[d]
Ground-water	1 existing well					1				
QC	QC samples for all wells in OU-2					TB, EB, FB, MS/MSD				
Surface Soil[g]	10 locations, 2 depths at each	20	20	20	20	1	1	1	1	1
QC		TB, FD	FD	FD	FD	TB, EB, FB, MS/MSD				
Subsurface Soil	5 locations, 2 depths at each	10	10	10	10		1	1	1	1
QC		TB					TB, EB, MS/MSD	EB, MS/MSD	EB, MS/MSD	EB, MS/MSD

EB = Equipment blank (1 per day per type of equipment used for sampling).
FB = Field blank (1 per week per source of decontamination water).
FD = Field duplicate (10% of Level 3 and 5% of Levels 1 and 2).
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix, if collected within 14 days).
OU-2 = Operable Unit 2.
PAH = Polynuclear aromatic hydrocarbon.
Pest./PCB = Pesticide/polychlorinated biphenyl.
QC = Quality control.
TB = Trip blank (1 per day per cooler containing VOC samples).
TCL/TAL = Target compound list/target analyte list.
VOC = Volatile organic compound.

[a] Level 2 VOCs will be analyzed in a close support laboratory (CSL) using a gas chromatograph.
[b] PAHs will be analyzed by SW 846 Method 8100.
[c] Pesticides will be analyzed by a modified SW 846 Method 8080.
[d] Metals analysis will include the priority pollutant metals analyzed by SW 846 Method 6010/7000 series (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn). Metals in groundwater will be analyzed for total metals only. Filtered samples will not be collected.
[e] TCL/TAL analysis will include the contract laboratory program (CLP) methods for VOCs, SVOCs, pesticides/PCBs, and metals.
[f] Level 3 VOCs will be analyzed by SW 846 Method 8240.
[g] Surface soil locations will be sampled at 2 depths: 0-12 inches and 12-24 inches.

detected, the boring will continue in 10-ft increments until no non-methane organic vapors are detected. At the deepest point of the boring, an additional soil sample will be collected and analyzed for Level 2 VOCs, PAHs, pesticides, and metals. Since this is an optional sample, it is not indicated in Table 4-2.

Optional surface soil samples and borings may be performed to further evaluate the extent of contamination, if field screening indicates that they are warranted. The locations of additional borings will be chosen from review of the analytical results obtained from the primary sample locations. If contaminated soils are encountered at the 10-ft depth in the primary soil borings, the optional soil borings will include an additional analytical sample from a depth of 20 ft bls. The procedure of using an OVA to check for non-methane organic vapors to determine the depth of the final sample from a boring will also be used for the optional borings. Optional surface and subsurface samples may also be collected from areas where there is visual evidence that contamination may be present. Field personnel will survey the area around the site for stained soil, dead vegetation, or other visual indicators to determine if additional sampling is warranted.

Soil samples obtained from Site 27 for laboratory analysis will be analyzed for VOCs, PAHs, pesticides, and metals. For the metals analysis, the priority pollutant metals were selected because the analyte list provides the best fit with the metals detected in OU-2. The soil sampling plan for Site 27 is detailed in Table 4-2. Duplicate samples will be collected at each sampling point to provide a sample for possible Level 3 analysis. A minimum of 10 percent of the Level 2 samples will be sent for Level 3 confirmational analysis. The field team leader or site hydrogeologist will select the samples for Level 3 analysis by using the Level 2 analytical results to select the samples with higher levels of contamination. One surface soil location will be analyzed for TCL/TAL parameters to assess the presence of any contamination not previously found. Screening results (Level 2 analysis) will be used to select a biased location so that the TCL/TAL analysis is performed near the area with the highest contaminant concentrations. QC samples will be collected in accordance with Section 4.2 of the *QAPP* (ref. 1). QC samples are indicated in Table 4-2.

One sample will be collected from one of the borings (at the 10-foot depth) at Site 27 for geotechnical analyses. The purpose of the analyses is to obtain initial geotechnical and fate and transport data on surface soils for OU-2. The hydrogeologist will select the sample for analysis in the field. 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. 1). 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).

4.2.7 Groundwater Sampling and Analysis

The existing monitoring well (MW-23) will be sampled in accordance with standard groundwater sampling procedures as provided in Section 5.1.2 of the *QAPP* (ref. 1). The sample will be sent to the laboratory for Level 3 TCL/TAL analysis as shown in Table 4-2. Review of the groundwater flow direction in OU-2 indicates that MW-23 is upgradient of Site 27 (approximately 100 ft). Analytical results from MW-23 will provide information on upgradient groundwater quality.

4.3 Site 34: Underground Waste Oil Storage Tanks at Building 770

4.3.1 Site Description

This site is located next to the vehicle maintenance shop (Building 770). Two 1,000-gallon steel underground storage tanks previously located in this area were used to store waste motor oil from vehicles. The location of the site in OU-2 is indicated in Figure 2-3; a detailed map of the site is provided in Figure 4-2.

4.3.2 Site History

The waste oil tanks are estimated to have been in use from the 1960s until their removal by DDMT in 1989 (ref. 12). No information was found related to removal of the tanks or any confirmational sampling around the area of the excavation. The former location of the tanks is assumed to be west of Building 770. Previous samples were focused in this area, and analytical results from the samples indicate the possibility of waste oil contamination. Before being used as a maintenance shop, Building 770 was used for cleaning and preserving heavy equipment before shipment overseas. The equipment cleaning activities at this site were discontinued in 1969 (ref. 14).

4.3.3 Existing Data

The EPA *RCRA Facility Assessment* (*RFA*; ref. 12) noted an extensive amount of stained soil on the ground surface next to the fill hole of the tanks. During the 1990 RI activities (ref. 8), four surface soil samples (depth of 0 to 12 inches) were collected. All four samples detected PAHs, which are potentially indicative of oils or heavy fuel residuals. Other contaminants detected in the samples included VOCs, pesticides, and metals. Appendix B, Table B-2, and Figure B-2 provide details on level of contaminants detected and locations of the samples.

To provide groundwater quality information, MW-39 was installed in the Fluvial Aquifer during the 1990 RI activities. Based on the Fluvial Aquifer flow direction from November 1993 (Figure 2-11), MW-39 is approximately 130 ft downgradient of Site 34. Results from MW-39 indicated some halogenated VOCs at the quantitation limit and metals at levels approximately equivalent to those detected in MW-16 (Table B-1), a facility upgradient well. These results indicate that no significant level of contamination is present in the groundwater at MW-39.

4.3.4 Potential Contaminants of Concern

From the results of previous findings and from what is known about the site history, the potential COCs at Site 34 are believed to be metals, VOCs, and PAHs.

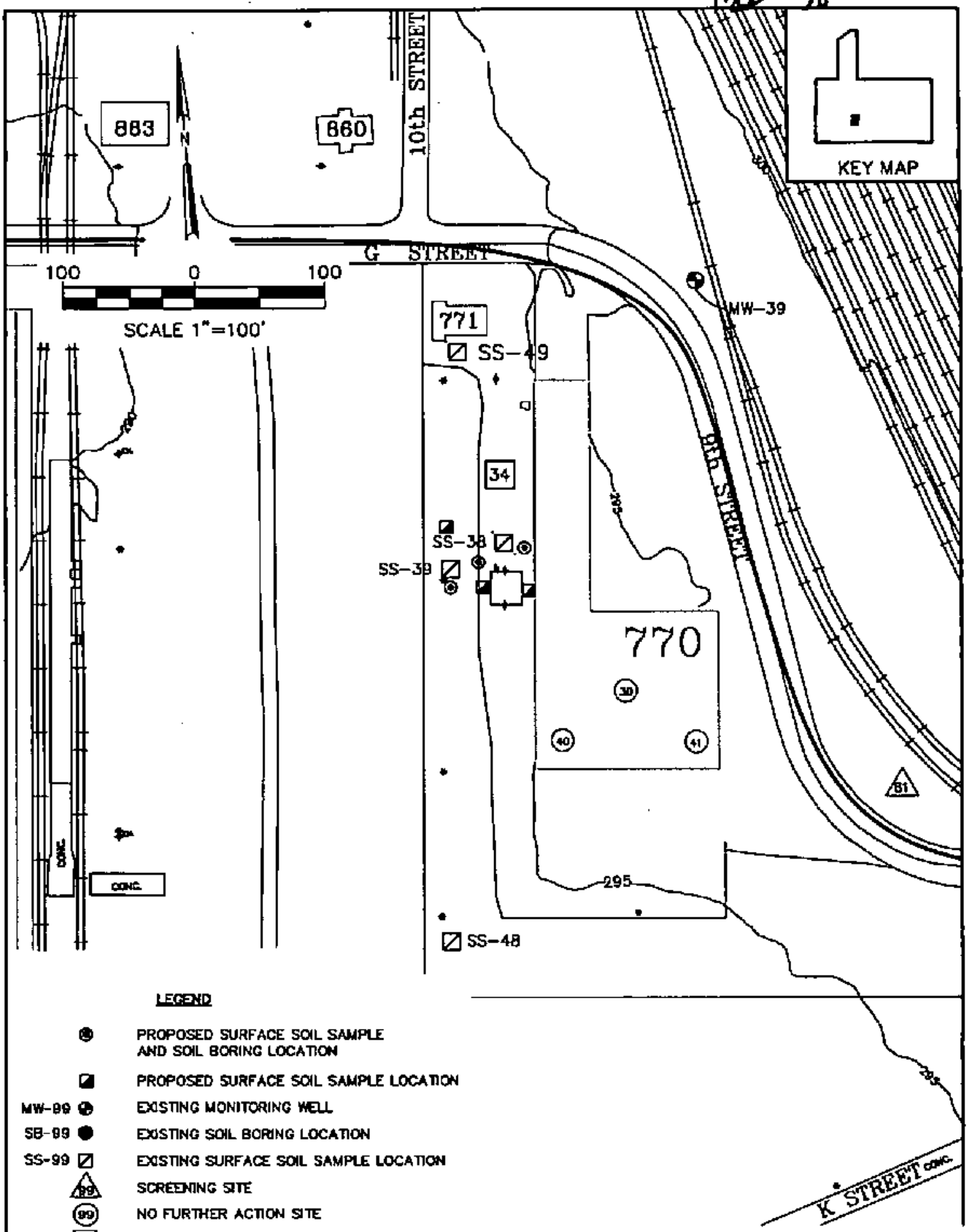

FIGURE 4-2
SITE 34
PREVIOUS AND PROPOSED SAMPLING LOCATIONS
Defense Depot Memphis, Tennessee

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A release of waste oil could have contributed VOC, metal, and PAH contamination to the environment. VOCs could also have been introduced by release of solvents from cleaning heavy equipment, which took place in this area.

Pesticides may be present in the soils but are not believed to be associated with past site activities. Pesticides were used across the entire DDMT facility for pest control. Low levels of pesticides present at the site are believed to be a result of pest control, not a site release. Therefore, pesticides will not be included as a COC.

4.3.5 Data Gaps and Site-specific Data Quality Objectives

Site 34 Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
Vertical and horizontal extent of soil contamination	Assess the vertical and horizontal extent of soil contamination Expedite the field investigation and decision process by using Level 2 analyses Confirm results of Level 2 analyses with Level 3 analyses
Data for performing a risk assessment	Collect data that support a statistically based comparison to background concentrations and PRGs
	Collect at least one TCL/TAL sample (location to be selected in the field) to assess whether other unknown contamination is present

4.3.6 Soils Sampling and Analysis

Soil samples will be collected to assess the vertical and horizontal extent of soil contamination from past activities near Building 770. Spatially distributed surface soil samples will be collected to support statistical comparisons to background concentrations and PRGs.

Surface soil samples will be collected in the area west of Building 770 where the underground waste oil tanks were assumed to be located. Because the exact locations of releases are not known, the samples will be taken from a systematic distribution in the area of potential contamination. This sampling approach will also allow use of an average concentration for risk calculations. Six locations will be sampled at a depth of 0 to 12 inches bls. The samples will be collected beneath any gravel or pavement that may be present. Sampling locations are shown in Figure 4-2.

Subsurface soil samples will be collected to assess the vertical extent of contamination. A total of three soil borings will be drilled to a depth of 20 ft. The borings are located around the area where surface soils from SS-38 were taken during the 1990 RI activities (ref. 8). This area was chosen because it is the area where the highest levels of contamination were detected. Samples will be collected from the borings at depths of 5, 10, 15, and 20 ft bls. Subsurface soil boring samples at Site 34 are being collected at greater depths than at other OU-2 sites because contamination may have been released from a subsurface tank. The tank was probably buried about 2 or 3 ft bls, which could put the tank bottom at close to 10 ft bls.

At the 20-foot depth, a soil sample will also be tested for non-methane organic vapors using an OVA. If organic vapors are detected, the boring may continue in 10-foot increments until no non-methane organic vapors are detected. At the deepest point of the boring, an additional soil sample will be collected and analyzed for Level 2 VOCs, PAHs, and metals. (Since this is an optional sample, it is not indicated in Table 4-3, which provides details about the soil sampling plan for Site 34.)

Optional surface soil samples and soil borings may be performed at the site. The locations will be selected from review of the analytical results obtained from the initial soil sampling locations. The OVA procedure to determine the final depth of the boring will also be used for the optional borings. Optional soil samples may also be collected from areas where there is visual evidence that contamination may be present. Field personnel will survey the site for indicators of contamination (such as stained soil or dead vegetation) to evaluate whether additional sampling is warranted.

Soil samples obtained from Site 34 will be analyzed for Level 2 VOCs, PAHs, and metals, as detailed in Table 4-3. Duplicate soil samples will be collected at each sampling point to provide a sample for possible Level 3 (confirmational) analysis. Approximately ten percent of the Level 2 samples will be sent offsite for Level 3 confirmational analysis. The field team leader or site hydrogeologist will select the samples for Level 3 analysis by using Level 2 results to select samples with elevated levels of contamination. One subsurface soil location will be analyzed for TCL/TAL parameters. Screening results (Level 2) will be used to select a biased location so that the TCL/TAL analysis is performed near the area with the highest contaminant concentrations. QC samples will be collected in accordance with Section 4.2 of the *QAPP* (ref. 1). QC samples are indicated in Table 4-3.

4.3.7 Groundwater Sampling and Analysis

Groundwater quality in the Fluvial Aquifer downgradient of Site 34 will be monitored by sampling MW-39. The field hydrogeologist will verify whether MW-39 is appropriately located for downgradient monitoring of Site 34. The well should be located downgradient of the area of maximum soil contamination as indicated by the soil

Table 4-3
Samples to Be Collected by Media and Analysis at Site 34
Defense Depot Memphis, Tennessee

Media	Description	Level 2			Level 3			
		VOCs[a]	PAHs[b]	Metals[c]	TCL/TAL[d]	VOCs[a]	PAHs[b]	Metals[c]
Ground-water	1 existing well				1			
QC	See Table 4-2							
Surface Soil	6 locations, depths of 0 to 12 inches	6	6	6		1	1	1
QC		TB				TB, EB, MS/MSD	EB, MS/MSD	EB, MS/MSD
Subsurface Soil	3 locations, 4 depths at each	12	12	12	1	1	1	1
QC		TB, FD	FD	FD	TB, EB, FB, MS/MSD			

EB = Equipment blank (1 per day per type of equipment used for sampling).
FB = Field blank (1 per week per source of decontamination water).
FD = Field duplicate (10% of Level 3 and 5% of Levels 1 and 2).
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix, if collected within 14 days).
QC = Quality control.
PAH = Polynuclear aromatic hydrocarbon.
TB = Trip blank (1 per day per cooler containing VOC samples).
TCL/TAL = Target compound list/target analyte list.
VOC = Volatile organic compound.

[a] Level 2 and 3 VOCs will be analyzed at an offsite laboratory by SW 846 Method 8240.
[b] PAHs will be analyzed by SW 846 Method 8100.
[c] Metals analysis will include the priority pollutant metals analyzed by SW 846 Method 6010/7000 series (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn). Metal samples in groundwater will be analyzed for total metals only.
[d] TCL/TAL analysis will include the contract laboratory program (CLP) methods for VOCs, SVOCs, pesticides/PCBs, and metals.

sampling performed at the site. The downgradient direction will be found by referring to the November 1993 potentiometric surface map (Figure 2-11) or to the most recent potentiometric surface map available.

The results of groundwater sampling near Site 34 may indicate the need for additional monitoring wells. If required, additional wells will be installed and sampled during the next phase of field investigations addressing groundwater at DDMT on a facilitywide basis, which is discussed in Section 4 of the *OU-4 FSP*.

4.4 Site 32: Sandblasting Waste Accumulation Area

4.4.1 Site Description

This site is located next to Building 1088 (sandblasting area). The site consists of a corrugated steel shed with a gravel floor. Three hoppers collect the dust from sandblasting operations and deposit it into 55-gallon drums. The location of Site 32 is indicated in Figure 2-3; a detailed map of the site is provided in Figure 4-3.

4.4.2 Site History

Metal parts (e.g., reusable containers and mission stored bar stock) were sandblasted with a low-silica material in Building 1088. This site is estimated to have been in service as a sandblasting area since the 1950s. Before Building 1088 and the hopper system were used, sandblasting operations were performed on the open ground in the general vicinity of Building 1087 (ref. 12).

4.4.3 Existing Data

During the RCRA Facility Assessment (RFA), no evidence of spills or releases were noted on the floor beneath the drums (ref. 12). However, during the 1990 RI activities (ref. 8), five surface soil samples (SS-15, -16, -17, -18, and -19) were taken from a depth of 0 to 12 inches in the immediate vicinity of Buildings 1087 and 1088 (see Figure B-3 for locations). Results from these samples indicated heavy metals contamination. Other parameters detected at significant concentrations included pesticides, PCBs, and PAHs (Table B-4). Samples taken during the 1990 RI activities (SS-45, -46) detected VOCs at levels near the quantitation limit and heavy metal (lead, chromium) contamination (Table B-1). Figure 4-4 shows the level of heavy metal contamination detected at each of the soil sampling locations. During the 1990 RI activities, MW-22 was installed to evaluate groundwater near Site 32. After review of the November 1993 potentiometric surface map (Figure 2-11), MW-22 was found to be upgradient of the site. Results from MW-22 will provide information on the quality of groundwater upgradient of Site 32.

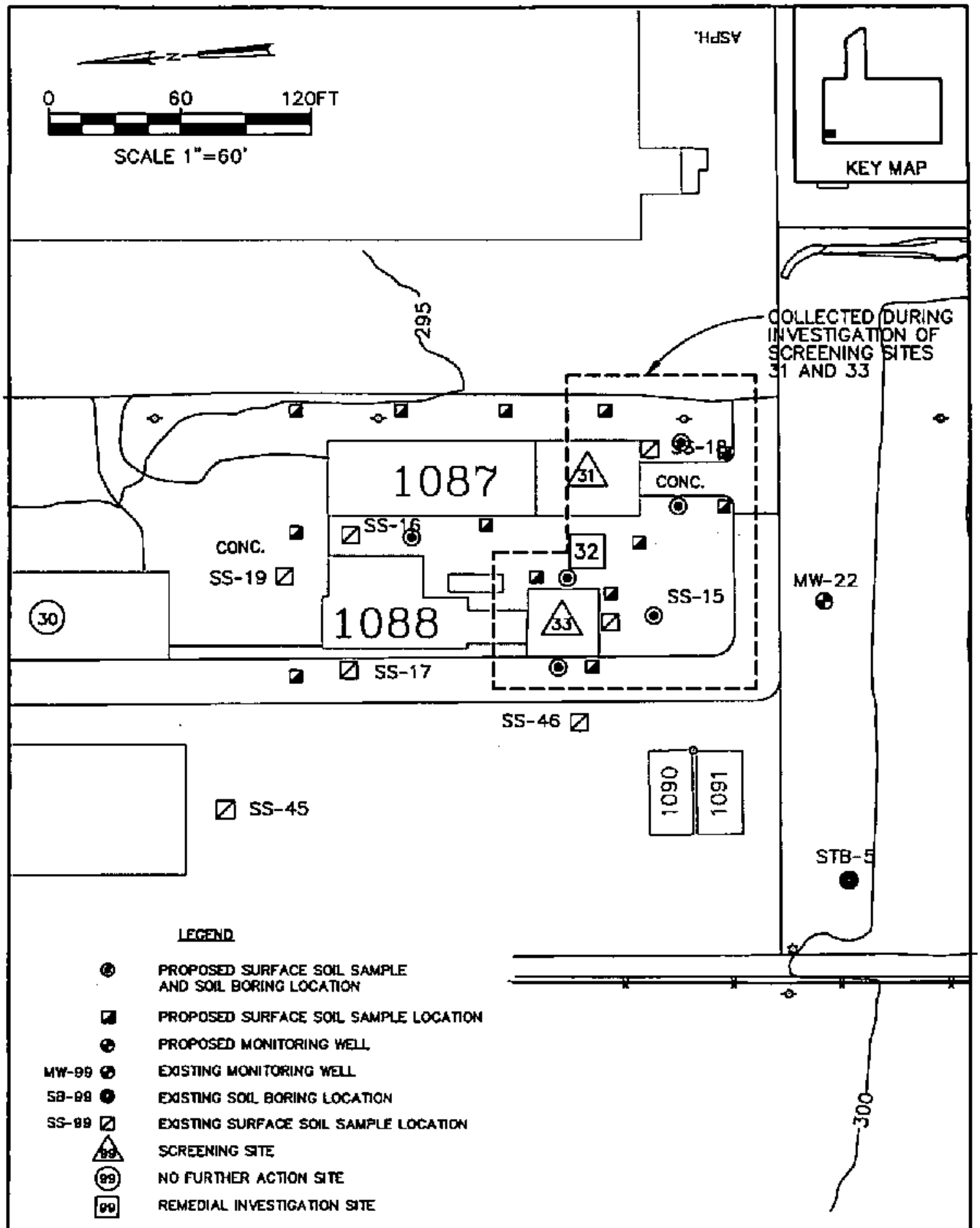
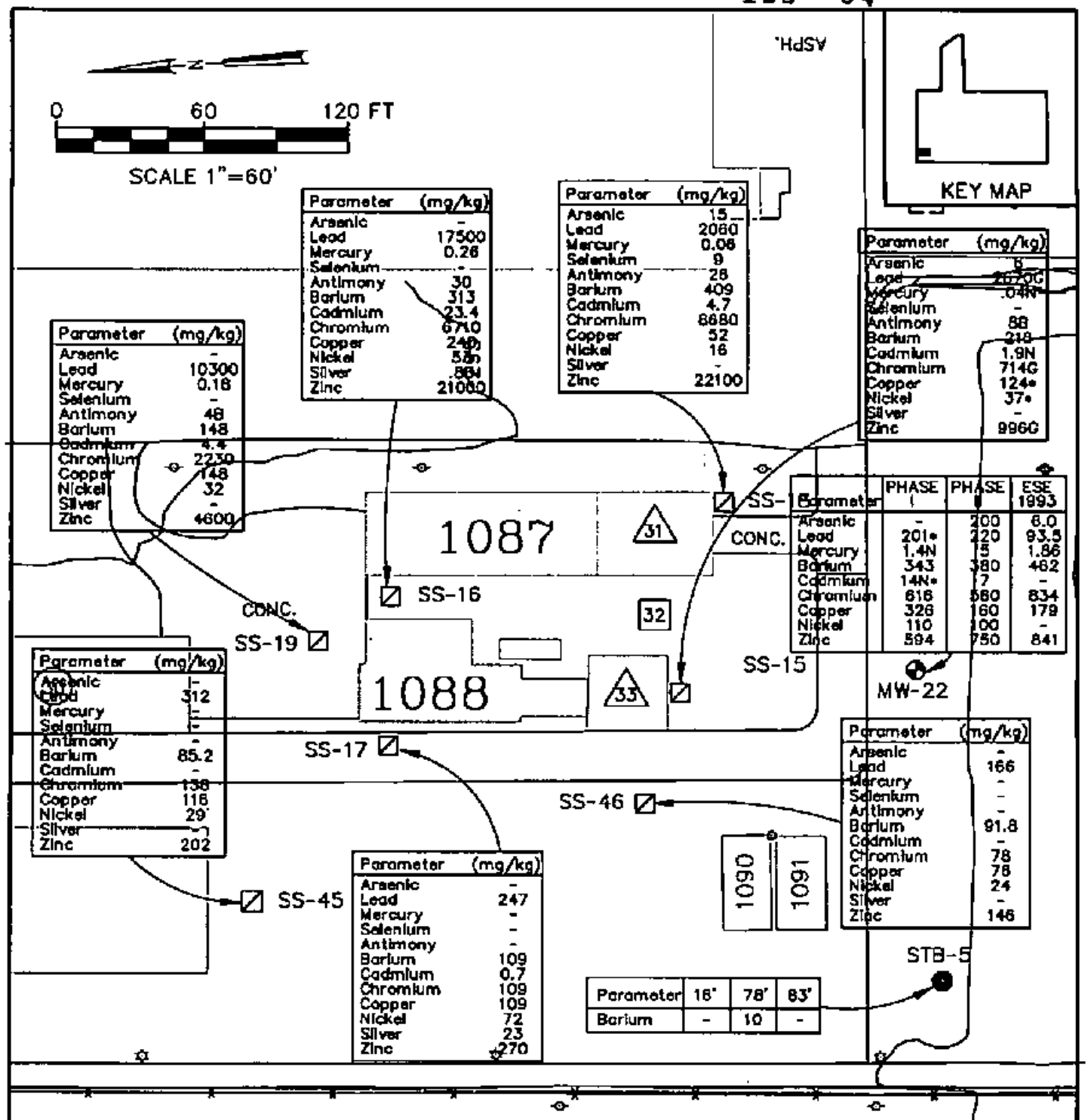


FIGURE 4-3
SITE 32
PREVIOUS AND PROPOSED SAMPLING LOCATIONS
Defense Depot Memphis, Tennessee

MU2-0016.DWG 27-Sep-1995



LEGEND

- MW-99 ⊕ EXISTING MONITORING WELL
- SS-99 ☒ EXISTING SURFACE SOIL SAMPLE LOCATION
- 99 SCREENING SITE
- 99 REMEDIAL INVESTIGATION SITE
- STB-5 ● EXISTING SOIL BORING LOCATION

NOTES

- B = VALUES LESS THAN THE CONTRACTUALLY REQUIRED LIMIT BUT GREATER THAN THE INSTRUMENT DETECTION LIMIT
- G = NATIVE ANALYTE >4X SPIKE ADDED; THEREFORE ACCEPTANCE CRITERIA DO NOT APPLY
- N = SPIKED SAMPLE RECOVERY NOT WITHIN CONTROL LIMITS
- • = DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS

FIGURE 4-4
SITE 32
METALS CONTAMINATION
Defense Depot Memphis, Tennessee

CH2M HILL

MU2-0017.DWG 27-Sep-1995

4.4.4 Potential Contaminants of Concern

From the results of previous findings and from what is known about the site history, potential COCs at Site 32 are believed to be metals, PAHs, pesticides, and PCBs.

Sandblasting operations would be expected to present the possibility of metals contamination because of the nature of the activity. The other COCs were selected because of results of previous soil sampling near Site 32. VOCs were not included as a COC because parameters detected in soil were methylene chloride, acetone, and toluene. Detections were near or below quantitation limits, and these are all common laboratory contaminants. The detections were not likely representative of field conditions. VOCs were detected at significant concentrations in MW-22, but this well is upgradient of Site 32. An offsite source is suspected. This will be investigated by installing a Fluvial Aquifer well upgradient of Site 32 along the DDMT facility boundary.

4.4.5 Data Gaps and Site-specific Data Quality Objectives

Site 32
Data Gaps and DQOs
Defense Depot Memphis, Tennessee

Data Gaps	DQOs
Vertical and horizontal extent of soil contamination	Assess the vertical and horizontal extent of soil contamination Expedite the field investigation and decision process by using Level 2 analyses Confirm results of Level 2 analyses with Level 3 analyses
Offsite, upgradient groundwater quality	Collect groundwater data at DDMT facility boundary upgradient of the site
Data for performing a risk assessment	Collect data that support a statistically based comparison to background concentrations and PRGs
	Collect at least one TCL/TAL sample (location to be selected in the field) to assess whether other unknown contamination is present

4.4.6 Soils Sampling and Analysis

Soil samples will be collected to assess the vertical and horizontal extent of soil contamination from past activities in and around Buildings 1087 and 1088. Seven surface soil samples will be collected at locations as indicated in Figure 4-3. These surface soil samples will be collected less than 12 inches below the soil's surface, and below the bottom of any gravel or pavement. Laboratory analysis will include Level 2 PAHs,

pesticides, PCBs, and metals (Table 4-4). The exact locations of any releases are not known, so samples will be collected across the entire area around the site. The locations were selected to provide a systematic coverage of the area. Surface soil samples will also be collected in the area around Site 32 as part of the field sampling effort for Screening Sites 31 and 33. Results from these samples will provide additional information that can be used to evaluate the extent of contamination in the area.

One soil boring will be made to collect subsurface soil samples to assess the vertical extent of contamination (Figure 4-3). Two analytical samples will be collected from the boring from 5 and 10 ft bls. Additional information on the vertical extent of contamination can be found from the borings collected during the investigation of Screening Sites 31 and 33.

Optional soil borings may be performed to further assess the vertical extent of contamination. The number and location of surface soil samples should be more than adequate to assess the horizontal extent of contamination. The locations of additional borings will be selected by using analytical results obtained from the surface soil sampling and soil borings near Site 32. If contaminated soils are encountered at depths of 10 ft in the planned soil borings, the optional soil borings will include an additional sample collected from a depth of 20 ft bls. While working onsite, field personnel will survey the area around the site for visual indicators of contamination. If areas are found with indicators such as stained soil or distressed vegetation, additional surface soil samples may be collected. This decision will be made in the field by the field team leader.

Soil samples obtained from Site 32 will be analyzed for Level 2 metals, PAHs, pesticides, and PCBs, as detailed in Table 4-4. Duplicate samples will be collected at each sample point to provide a sample for possible Level 3 (confirmational) analysis. A minimum of 10 percent of the Level 2 samples will be sent offsite for Level 3 confirmational analysis. The field team leader or site hydrogeologist will select the samples for Level 3 analysis by using Level 2 analytical results to select samples with elevated contaminant levels. One surface soil location will be analyzed for TCL/TAL parameters. Screening results (Level 2) will be used to select a biased location so that the TCL/TAL analysis is performed near the area with the highest contaminant concentrations. QC samples will be collected in accordance with Section 4.2 of the *QAPP* (ref. 1).

4.4.7 Groundwater Sampling and Analysis

The existing monitoring well (MW-22) will be sampled during the investigation of Site 32. Review of the groundwater flow direction in OU-2 indicates that MW-22 is upgradient of Site 32. Analytical results from MW-22 will provide information on contamination that is unrelated to activities at Site 32 but that may affect the quality of downgradient samples.

Table 4-4
Samples to Be Collected by Media and Analysis at Site 32
Defense Depot Memphis, Tennessee

Media	Description	Level 2			Level 3
		Pest./PCBs[a]	PAHs[b]	Metals[c]	TCL/TAL[d]
Ground-water	1 existing well				1
QC	See Table 4-2				
Surface Soil	7 locations, depth of 0 to 12 inches	7	7	7	1
QC					TB, EB, FB, SS, MS/MSD
Subsurface Soil	1 location, 2 depths	2	2	2	
QC		EB, FD	EB, FD	EB, FD	

EB = Equipment blank (1 per day per type of equipment used for sampling).
FB = Field blank (1 per week per source of decontamination water).
FD = Field duplicate (10% of Level 3 and 5% of Levels 1 and 2).
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix, if collected within 14 days).
QC = Quality control.
PAH = Polynuclear aromatic hydrocarbon.
Pest./PCBs = Pesticides/polychlorinated biphenyls.
SS = Split sample.
TB = Trip blank (1 per day per cooler containing VOC samples).
TCL/TAL = Target compound list/target analyte list.
VOC = Volatile organic compound.

[a] Pesticides/PCBs will be analyzed by a modified SW 846 Method 8080.
[b] PAHs will be analyzed by SW 846 Method 8100.
[c] Metals analysis will include the priority pollutant metals analyzed by SW 846 Method 6010/7000 series (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn). Metal samples in groundwater are for total metals only.
[d] TCL/TAL analysis will include the contract laboratory program (CLP) methods for VOCs, SVOCs, pesticides/PCBs, and metals.

Historical analytical results from MW-22 indicate concentrations of trichloroethene above maximum contaminant levels (MCLs). Review of the groundwater flow direction across the site indicates that MW-22 is upgradient of Site 32. The historical contamination suggests an offsite source may be responsible for the groundwater VOC contamination. This will be investigated by installing a Fluvial Aquifer monitoring well upgradient of MW-22 and Site 32 along the DDMT facility boundary. The installation, location, and sampling of this well is addressed in Section 4 of the *OU-4 FSP* (ref. 15).

Groundwater from the existing well will be sampled in accordance with standard groundwater sampling practices as outlined in Section 5.1.2 of the *QAPP*. The groundwater sample will be sent to the laboratory for Level 3 TCL/TAL analysis.

TAB

Section 5 - Additional Data Collection

5.0 Additional Data Collection

5.1 Fluvial Aquifer Characteristics

After well development, the hydraulic conductivity of the water-bearing zone in which each new monitoring well in OU-2 is screened will be estimated using a pneumatic slug test method. The existing wells will not be tested, because they have been tested previously (RI Report, 1990). The primary advantages of slug testing are twofold: it creates little, if any, investigation-derived wastes to dispose of, and performing the test and collecting the data is relatively simple. The values of hydraulic conductivity derived from the slug tests will provide information useful in estimating groundwater flow rates within the Fluvial Aquifer. This information will also be useful in remedial design if sampling results indicate that remedial action is needed in OU-2 to address groundwater contamination.

Slug tests are accomplished by causing an instantaneous change in the water level in the well and observing the recovery of the water level to its static level as a function of time. Changes in water level can be accomplished by suddenly introducing or removing a known volume of water into or from the well. This can be done by suddenly introducing or removing a cylindrical object of known volume (a slug) or by using a pneumatic device to evacuate the wellbore under pressure, followed by an instantaneous release of pressure. The water level response in the wellbore is generally observed with a pressure transducer placed below the water table coupled to an automatic data logger.

The pneumatic slug test method will allow testing to be performed quickly, and the results will eliminate much of the noise in the very-early-time-data that is often present in manual slug test methods. All materials used in the slug test (water level tapes, pressure transducers) will be decontaminated before use in accordance with Section 5.4.2.9 of the *QAPP* (ref. 1).

To analyze the slug test data, the project hydrogeologist will select a published, generally accepted analytical method (such as Bouwer, 1989) (ref. 16) that is appropriate for the hydrogeologic conditions at DDMT.

5.2 Preliminary Data Needs for Remedial Alternatives

After the RI field work has been completed, the data will 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 data will be used to support evaluation of remedial alternatives, to refine selection of alternatives, or to collect data to support remedial design activities.

5.2.1 Initial Alternatives

A cursory review of the RI sites at OU-2 has been conducted to develop a list of preliminary remedial alternatives. These initial alternatives have been identified from existing data, the preliminary contaminants of concern, and knowledge about treatment technologies available. The initial alternatives do not represent a complete, detailed evaluation of alternatives, nor do they represent the final remedy. They are intended to represent an initial attempt at identifying alternatives that are likely to be on the final list for evaluation of site remedial action. Initial alternatives for remediation of soil at each site are provided in Table 5-1 (alternatives listed are for soil media only).

Evaluation of remedial alternatives for groundwater will occur during a later phase of site investigation. After this initial phase of the investigations at OU-2 is completed, groundwater at DDMT will be evaluated facilitywide. To improve the efficiency of the groundwater remediation process, remedial strategies for groundwater will be implemented for the entire facility, and for those sites that are sources of potential groundwater contamination. The facilitywide strategy for groundwater is discussed in Section 4 of the *OU-4 FSP*.

5.2.2 Data Collection

For the remedial alternatives listed for each site in Table 5-1, a preliminary set of data has been identified for collection during the field effort. These data will help evaluate the identified alternatives. A decision will be made in the field for each site as to whether the identified data need to be collected during the RI field investigation. This decision will depend upon the following:

- Concentration of contamination at levels indicating FS activities may be required
- Spatial magnitude of contamination beyond an appropriate extent for a removal action
- Character of contaminants (VOCs, PAHs, metals, etc.) indicating applicable remedial options

The decision about collecting the data to evaluate remedial alternatives will be made by the field team leader, site hydrogeologist, project manager, and the U.S. Corps of Engineers, Huntsville Division (CEHND). Data collection for future phases of field investigation should be identified by using data collected in the RI field investigation and by completing a detailed identification of remedial alternatives for each site.

Table 5-1
Preliminary Screening of Remedial Alternatives for OU-2 RI Sites
Defense Depot Memphis, Tennessee

Site Number[a]	Description	Potential Contaminants to Be Remediated[b]	Potential Remedial Options[c]	Data Need for Initial Evaluation of Alternatives[d]
27	Former Recoupment Area (Building S-873)	VOCs, PAHs, pesticides, metals	Land disposal	TCLP, hazardous characteristics
			Incineration	Total metals, Btu, ash content
			Cover	Soil boring blow counts
			Soil vapor extraction	Grain size, moisture content
34	Underground Waste Oil Storage Tanks at Building 770	VOCs, PAHs, metals	Land disposal	TCLP, hazardous characteristics
			Incineration	Total metals, Btu, ash content
			Soil vapor extraction	pH, moisture content, grain size, porosity
			Cover	Soil boring blow counts
			Bioremediation	Moisture content, porosity, pH, temperature, TOC, microbial population, dissolved oxygen (soil and groundwater)
32	Sandblasting Waste Accumulation Area	PAHs, pesticides, PCBs, metals	Land disposal	TCLP, hazardous characteristics
			Incineration	Total metals, Btu, ash content
			Cover	Soil boring blow counts

Btu = British thermal unit.
OU-2 = Operable Unit 2.
PAH = Polynuclear aromatic hydrocarbon.
PCB = Polychlorinated biphenyl.
RI = Remedial investigation.
TCLP = Toxicity characteristic leaching procedure.
TOC = Total organic carbon.
VOC = Volatile organic compound.

[a] Only RI sites are included in this table.

[b] General categories of potential contaminants are listed. The list is not all inclusive, nor is it a limitation on the analytical data to be collected, because limited analytical data are available for many sites. The listed potential contaminants are based on reported activities and existing data.

[c] Alternatives that will not require data collection during the RI field activities are not included. Similar technologies would be grouped under a general name (i.e., incineration would generally also represent as similar technologies thermal desorption, cement kilns, incinerators, pyrolysis, or wet air oxidation).

[d] This table is a generalized list of potential data needs for the RI field activities and is not intended to represent data for all potential remedial alternatives to be evaluated.

5.3 Water Level Measurements

The flow direction of the Fluvial Aquifer in OU-2 is not well defined because of the location of the existing monitoring wells and the lack of water level data. Flow direction needs to be better understood to evaluate future well locations.

Quarterly water level data will be collected from all existing wells and wells planned for installation in OU-2 for a period of 1 year. These data will provide valuable information on groundwater flow direction in OU-2.

5.4 Quality Assurance/Quality Control in the Field

The goal of QA in the field is to provide data of known quality to the project team to support the decisionmaking process. Implementing QA goals is the field team leader's responsibility. As the lead field representative, the field team leader will be responsible for consistently implementing QA/QC measures at the site and for performing field activities in accordance with approved work plans, policies, and field procedures. Sections 3 and 4 the *QAPP* (ref. 1) provide details to meet the goals of QA during the field investigation.

Numerous procedures have been developed for the field activities that will occur at DDMT. These procedures will provide for greater consistency in the work performed and provide a basis for organized sample collection and analysis. The procedures outlined in the *QAPP* that address the field effort are as follows:

- Field documentation
- Sample numbering and containers
- Sample chain of custody
- Sample shipment
- Field QC samples
- Disposal of investigation-derived wastes
- Field instrument calibration
- Soil, groundwater, sediment, and surface water sampling
- Soil boring and monitoring well drilling

- Geophysical survey and logging
- Surveying

Field QC samples will be collected to evaluate the quality and validity of the analytical data. QC samples will also assist in evaluating whether any of the contamination that may be detected could have been introduced by the sample collection and handling procedures.

The types of field QC samples that will be collected and the rules for determining the number of samples are as follows:

- **Trip blanks:** one per day per cooler containing VOC samples
- **Equipment blanks:** one per day per type of equipment used for collecting a sample
- **Field blanks:** one per week per source of water used for decontamination
- **Field duplicates:** 5 percent of Level 2 samples and 10 percent of Level 3 samples
- **Matrix spike/matrix spike duplicates:** 5 percent of the samples collected from each matrix; at least one per matrix every 14 days
- **Split samples:** to be collected at a rate of approximately 1 percent; one will be collected during the OU-2 investigation

The type and number of field QC samples that will be collected at each of the RI sites are shown in the sample summary tables in Section 4 (Tables 4-2 through 4-4).

TAB

Appendix A - References

Appendix A
References

Appendix A
References

1. CH2M HILL. *Generic Quality Assurance Project Plan for Defense Distribution Depot Memphis*. December 1993.

2. National Oceanographic and Atmospheric Administration (NOAA). *Climatic Atlas of the United States*. Asheville, North Carolina. 1983.

3. CH2M HILL. *Generic Remedial Investigation/Feasibility Study Workplan for Defense Distribution Depot Memphis, Tennessee*. February 1995.

4. Graham, D.D. and Parks, W.S. Potential for Leakage Among Principal Aquifers in the Memphis Area, Tennessee. U.S. Geological Survey. Water-Res. Invest. Rep. 85-4295. 1986.

5. Wells, F.G. Groundwater Resources of Western Tennessee, with a discussion of the chemical character of the water, by F.G. Wells and M.D. Foster. U.S. Geological Survey Water-Supply Paper 656. 1933.

6. Moore, G.K. Geology and Hydrology of the Claiborne Group in Western Tennessee. Geol. Surv. Water-Supply Paper 1809-F. 1965.

7. Nyman, D.J. Predicted Hydrologic Effects of Pumping from the Lichterman Well Field in the Memphis Area, Tennessee. Geol. Surv. Water-Supply Paper 1819-B. 1985.

8. Law Environmental. *Remedial Investigation at Defense Depot Memphis, Tennessee: Final Report*. August 1990.

9. U.S. Environmental Protection Agency. *Risk Assessment Guidance for Superfund: Volume I–Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)*. Publication 9285.7-01B. December 1991.

10. Environmental Protection Agency. *Risk Assessment Guidance for Superfund: Volume I–Human Health Evaluation Manual (Part A)*. Interim Final. EPA/540/1-89/002. December 1989.

11. United States Environmental Protection Agency. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media*. EPA 230/02-89-042. 1989.

12. United States Environmental Protection Agency. *RCRA Facility Assessment*. Defense Depot Memphis Tennessee. January 1990.

13. *Summary Report, On-Site Remedial Activities at the Defense Depot Memphis,* O.H. Materials Company. February 1986.

14. U.S. Army Toxic and Hazardous Materials Agency. *Installation Assessment of Defense Depot Memphis, Tennessee.* July 1982.

15. CH2M HILL. *Operable Unit 4 Field Sampling Plan.* Draft Final. March 1995.

16. Bouwer, H. "The Bouwer and Rice Slug Test—An Update." *Groundwater.* Vol. 27, No. 3.

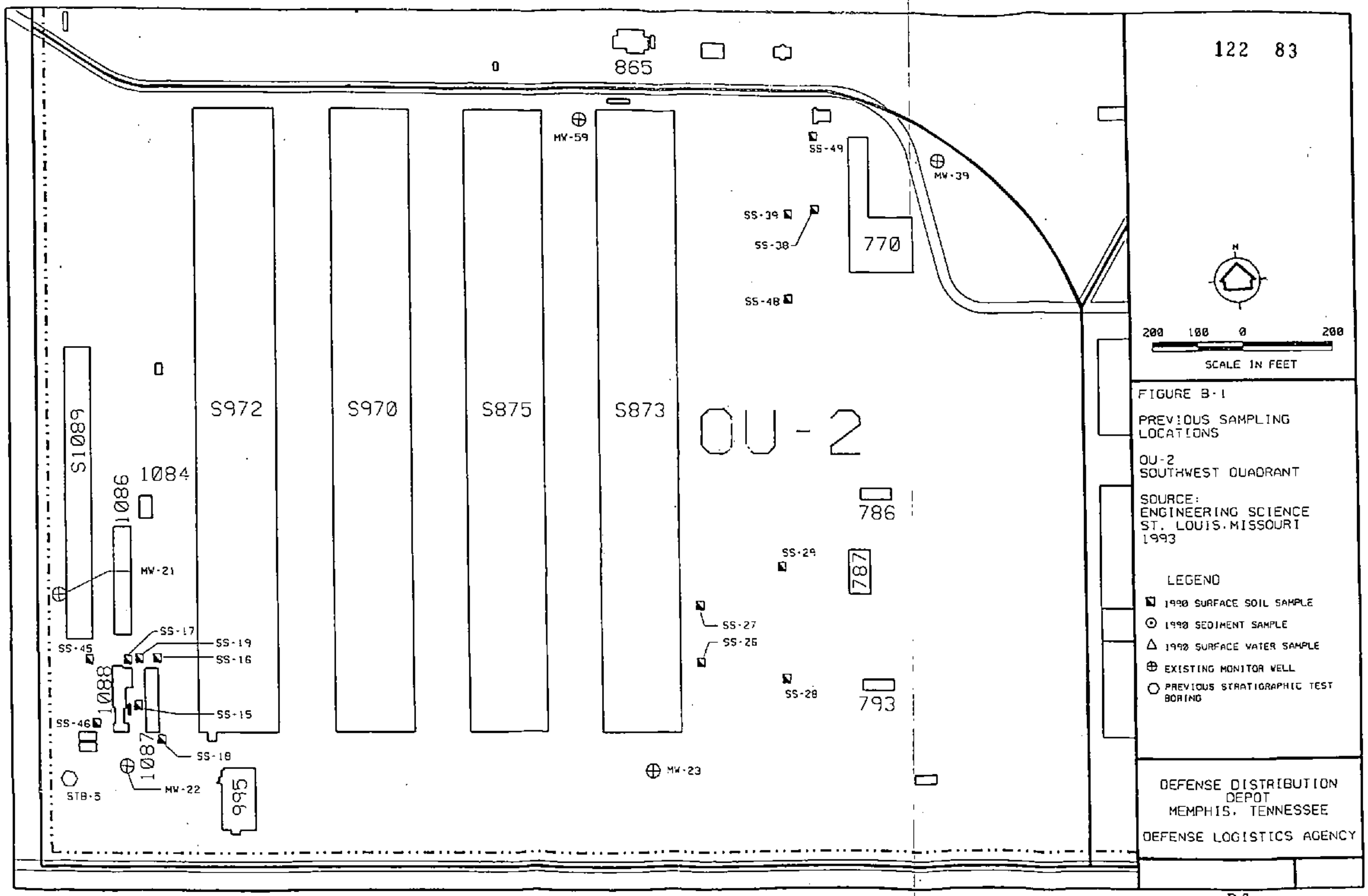
TAB

Appendix B-Existing Sampling Data

Appendix B
Existing Sampling Data

Appendix B—Table of Contents
Existing Sampling Data
Defense Depot Memphis, Tennessee

Generic Remedial Investigation/
Feasibility Study Work Plan
U.S. Army Corps of Engineers
December 1993


865
MW-59
SS-49
MW-39
SS-39
SS-38
SS-48
770
122 83
N
200 100 0 200
SCALE IN FEET
S1089
S972
S970
S875
S873
OU-2
1084
1086
MW-21
SS-45
SS-17
SS-19
SS-16
1088
SS-15
SS-46
1087
SS-18
MW-22
STB-5
995
786
SS-29
787
SS-27
SS-26
SS-28
793
MW-23
FIGURE B-1
PREVIOUS SAMPLING LOCATIONS
OU-2
SOUTHWEST QUADRANT
SOURCE:
ENGINEERING SCIENCE
ST. LOUIS, MISSOURI
1993
LEGEND
1990 SURFACE SOIL SAMPLE
1990 SEDIMENT SAMPLE
1990 SURFACE WATER SAMPLE
EXISTING MONITOR WELL
PREVIOUS STRATIGRAPHIC TEST BORING
DEFENSE DISTRIBUTION DEPOT
MEMPHIS, TENNESSEE
DEFENSE LOGISTICS AGENCY

Remedial Investigation/Feasibility Study
Law Environmental
August 1990

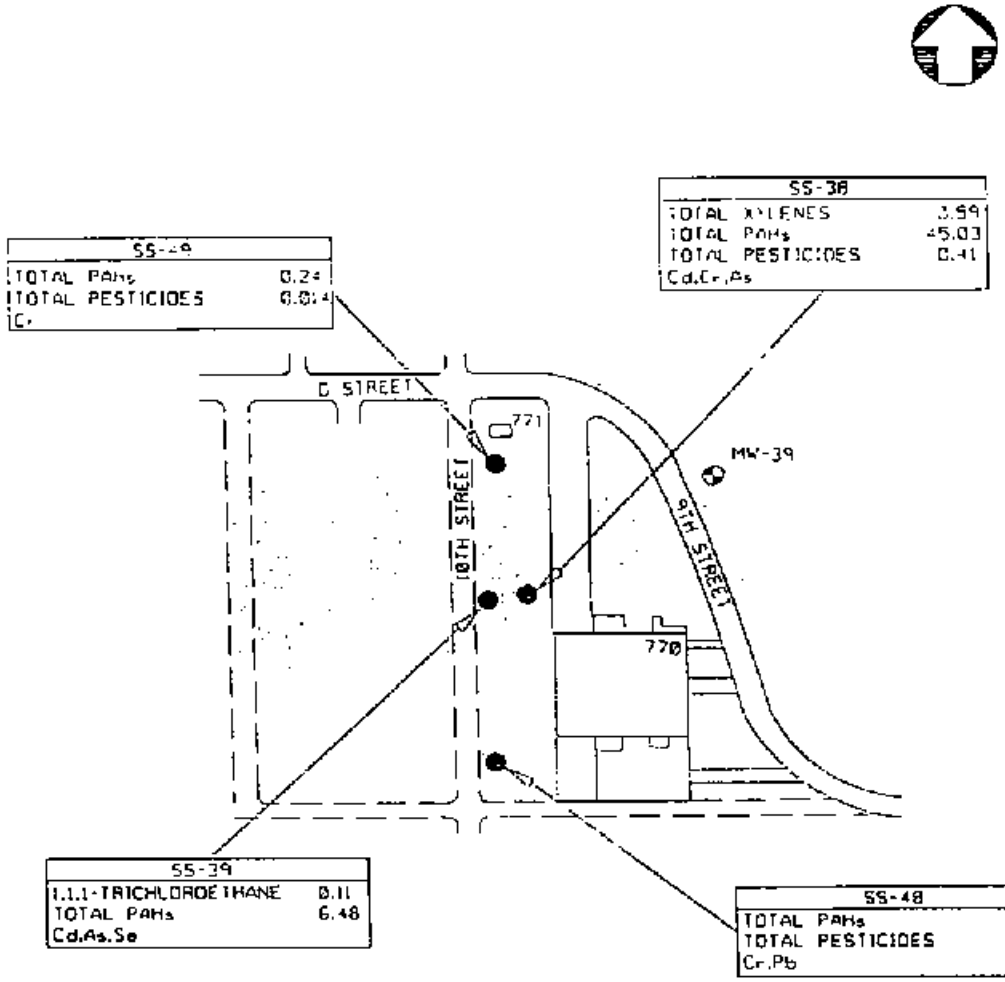
FIGURE B-2

SITE LOCATION MAP

SURFACE SOIL SAMPLE POSITIVE RESULTS

COLLECTED NEAR BUILDING 770 (SITES 30, 34 AND 40)

DEFENSE DEPOT MEMPHIS, TENNESSEE



NOTES:
ALL NUMBERS GIVEN ARE IN mg/kg
PAHs = POLYNUCLEAR AROMATIC HYDROCARBONS
TCE = TRICHLOROETHENE
METALS LISTED ARE THOSE THAT EXCEED STATE OF TN SOIL GUIDELINES

LEGEND
- SURFACE SOIL SAMPLING LOCATION
- MONITORING WELL LOCATION
- GRAVEL

0 300 600
SCALE IN FEET

Source: Law Study, 1990

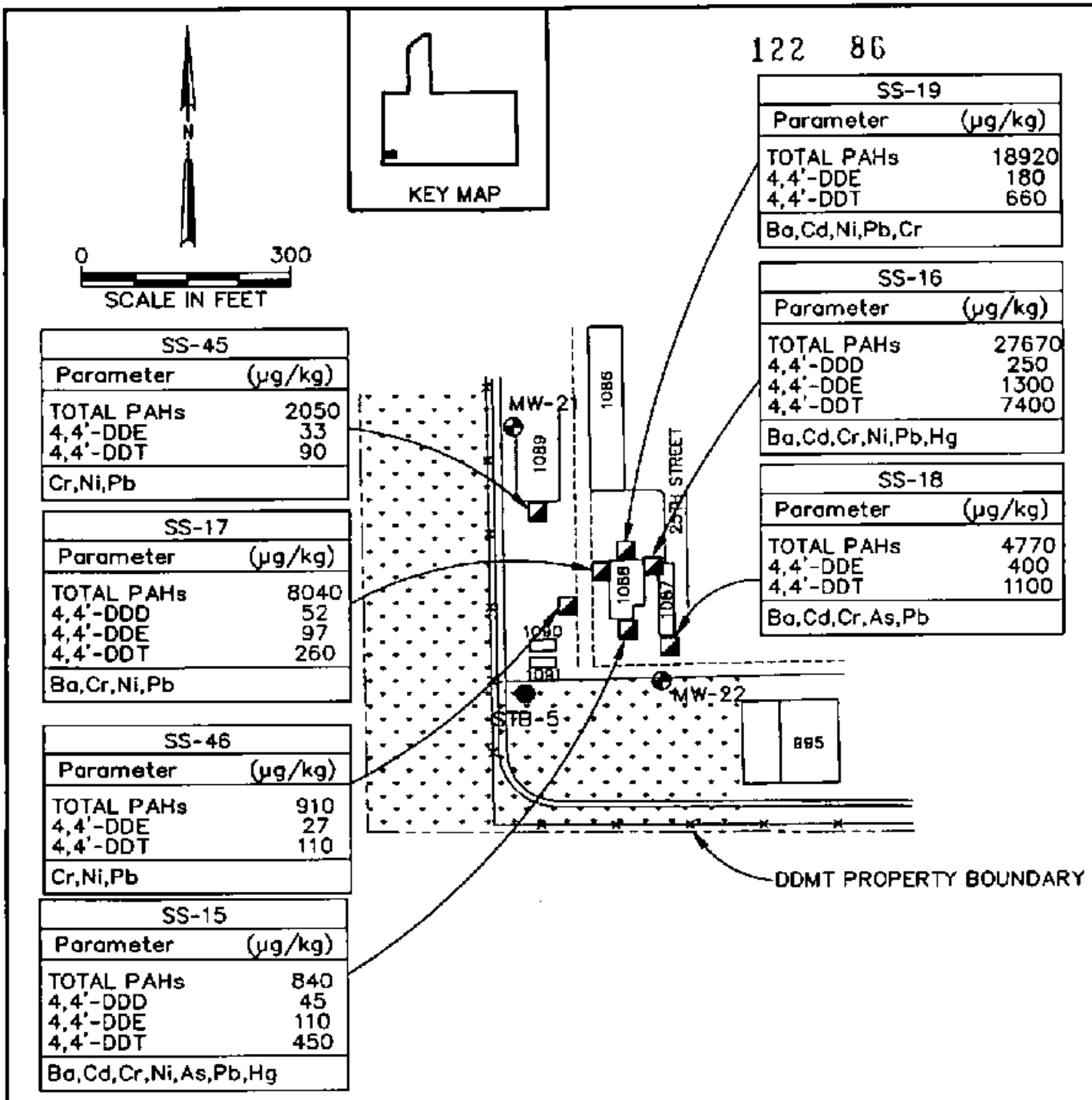


FIGURE B-3
POSITIVE SURFACE SOIL SAMPLE RESULTS
COLLECTED NEAR SITES 29-33 (OU-2)
Defense Depot Memphis, Tennessee

Source: RI Report, 1990

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Table B-1
Positive Results in Groundwater
Main Installation - Fluvial Aquifer
Defense Depot Memphis, Tennessee

PARAMETER (UG/L)	DATE	BACKGROUND WELL MW16	MCL	MW17	MW19	MW20	MW21	MW22	MW23	MW24	MW25	MW26	MW38	MW39
HALOGENATED VOLATILES (ug/l)														
Carbon Tetrachloride	PHASE I	--	5	--	--	--	--	--	--	--	2J	5J	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	5	--	--
Chloroform	PHASE I	--	100(c)	--	--	--	--	--	--	--	--	1J	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	2J	--	--
Methylene chloride	PHASE I	--	5	--	--	--	--	--	--	--	--	1BJ	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	PHASE I	--	5	--	--	--	39	--	--	--	8	10	--	--
	PHASE II	--		--	--	--	15	2J	--	--	7	5	--	1J
Trichloroethene	PHASE I	--	5	--	--	--	--	5J	--	--	--	3J	--	--
	PHASE II	--		--	--	--	2J	11	--	--	--	3J	--	9
NONHALOGENATED VOLATILES (ug/l)														
Acetone	PHASE I	3J	--	3J	--	4J	2J	3J	3J	3J	2BJ	4J	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--
NONHALOGENATED SEMIVOLATILES (ug/l)														
Di-n-butyl phthalate	PHASE I	--	--	--	--	3J	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	PHASE I	2J	--	--	--	7J	--	--	4J	--	--	3J	--	--
N-Nitrosodiphenylamine	PHASE I	2J	--	--	--	--	3J	3J	--	2J	5J	--	--	--
Phenol	PHASE II	--	--	--	--	--	--	--	--	--	--	--	--	3J
bis(2-Ethylhexyl) phthalate	PHASE I	5J	--	3J	5J	12J	--	4J	8J	5J	--	9J	--	--
	PHASE II	3J		--	2J	--	--	--	--	--	--	--	--	54
METALS (ug/l)														
Arsenic	PHASE I	55	50	324	38	--	--	--	--	--	--	--	--	--
	PHASE II	40		--	--	70	60	200	120	--	--	50	--	--

GNV/10016F79.XLS

Source: RI Report, 1990

Table B-1
Positive Results in Groundwater
Main Installation - Fluvial Aquifer
Defense Depot Memphis, Tennessee

PARAMETER (UG/L)	DATE	BACKGROUND WELL MW16	MCL	MW17	MW19	MW20	MW21	MW22	MW23	MW24	MW25	MW26	MW38	MW39
Lead	PHASE I	79	50/15 (e)	205	42	79*	97*	201*	334*	152*	128	--	--	--
	PHASE II	80		--	--	50	110	220	140	--	70	50	--	70
Mercury	PHASE I	--	2	6.8	--	.9N	1N	1.4N	1.6N	.4N	1.7	.4N	--	--
	PHASE II	--		--	--	--	1	5	1	--	--	--	--	--
Antimony	PHASE I	--	6	47B	--	--	--	--	--	--	--	--	--	--
	PHASE II	--		--	--	--	--	--	--	--	60	50	--	--
Barium	PHASE I	218	2000	603	296	247	229	343	567	167	1960	908	--	--
	PHASE II	410		190	310	290	240	380	390	81	410	380	80	130
Cadmium	PHASE I	--	5	8	6	11N*	7N*	14N*	15N*	18N*	--	--	--	--
	PHASE II	--		--	--	--	--	7	8	--	--	--	--	--
Chromium (d)	PHASE I	55	100	408	17	100	171	616	306	31	337	150	--	--
	PHASE II	50		10	20	90	110	560	150	--	40	30	--	20
Copper	PHASE I	198	1300 (f)	322	108	242	148	326	1570	88	209	268	--	--
	PHASE II	180		60	80	130	90	160	230	50	20	40	--	30
Nickel	PHASE I	29	100	238	--	35	49	110	73	26	125	58	--	--
	PHASE II	40		--	--	40	40	100	40	--	--	--	--	--
Zinc	PHASE I	116	5000 (h)	910	59	150	242	594	413	193	408	400	--	--
	PHASE II	180		180	53	140	190	750	290	170	120	120	23	86

MCL - SDWA Maximum Containment Level
(c) Total trihalomethanes
(d) No distinction between Chromium III and Chromium VI.
(e) MCL/ Action Level
(f) MCLG. Primary MCL is 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.
J = Estimated value less than the sample quantitation limit but greater than zero.
N = Spiked sample recovery not within control limits.
* = Duplicate analysis not within control limits.
-- = Not detected.
NA = Not Available.

GNV/10016F79.XLS

Source: RI Report, 1990

Table B-2
Positive Results in Surface Soils
Building 770
Defense Depot Memphis, Tennessee

122 89

PARAMETER	PHASE I		PHASE II	
	SS38	SS39	SS48	SS49
HALOGENATED VOLATILES ug/kg				
1,1,1-Trichloroethane	110	--	--	--
Methylene chloride	36B	8B	5BJ	6B
Tetrachloroethene	31	--	--	--
Trichloroethene	--	--	1J	2J
NONHALOGENATED VOLATILES ug/kg				
4-Methyl-2-pentanone	--	8J	--	--
Acetone	47J	200	51	22
Ethylbenzene	9J	6	--	--
Toluene	43	16	13	32
Total xylenes	590	53	1J	2J
NONHALOGENATED SEMIVOLATILES ug/kg				
2-Methylnaphthalene	610J	4000	--	--
bis(2-Ethylhexyl) phthalate	4800B	--	340B	160BJ
Dibenzofuran	--	350J	--	--
Butyl benzyl phthalate	--	1300J	--	--
Di-n-butyl phthalate	--	480J	--	--
Polynuclear Aromatic Hydrocarbons (PAHs)				
3-Nitroaniline	--	--	--	36J
Benzo(a)anthracene	7600	--	80J	--
Benzo(a)pyrene	3600J	--	62J	--
Benzo(b)fluoranthene	2800J	--	150J	90J
Benzo(k)fluoranthene	4600	--	--	--
Chrysene	2200J	--	110J	--
Fluoranthene	12000	--	160J	66J
Fluorene	620J	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	53J	--
Naphthalene	--	1500J	--	--
Phenanthrene	18000	1100J	85J	37J
Pyrene	13000	880J	170J	150J
Total PAHs	45,030	6,480	670	240

GNV/10016F7A.XLS

Source: RI Report, 1990

Table B-2
Positive Results in Surface Soils
Building 770
Defense Depot Memphis, Tennessee

PARAMETER	PHASE I		PHASE II	
	SS38	SS39	SS48	SS49
PESTICIDES ug/kg				
4,4'-DDD	--	--	10J	--
4,4'-DDE	--	--	17X	--
4,4'-DDT	--	--	52	--
beta-BHC	290Z	--	26Z	14Z
gamma-BHC (Lindane)	120Z	--	--	--
METALS mg/kg				
Arsenic	9	13	--	--
Lead	48	24	90	4
Selenium	--	15	--	--
Antimony	--	17	--	--
Barium	20.9B	15.8	19.3	11.7
Cadmium	1	3	0.5	0.8
Chromium **	10	--	19	6
Copper	13	18	10	4
Nickel	3	7	6	5
Zinc	411	122	55.2	59.4

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.

J = Estimated value less than the sample quantitation limit, but greater than zero.

X = Estimated value due to a confirmed compound which is off-scale in both columns.

Z = Matrix interference; compound not positively identifiable.

** = No distinction between Chromium (III) and Chromium (VI)

-- = Not detected.

Source: RI Report, 1990

Table B-3
Positive Results in Surface Soils
Gravel Area East of S-873
Defense Depot Memphis, Tennessee

122 91

PARAMETER	PHASE I			
	SS28	SS27	SS26	SS29
HALOGENATED VOLATILES (ug/kg)				
Methylene chloride	23B	12B	4J	4J
NONHALOGENATED VOLATILES (ug/kg)				
Acetone	58J	3JB	9J	5J
Toluene	3J	4J	33	1J
Total xylenes	--	--	2J	--
NONHALOGENATED SEMIVOLATILES (ug/kg)				
bis(2-Ethylhexyl) phthalate	440B	320BJ	380BJ	340BJ
Diethyl phthalate	77J	--	--	--
Di-n-butyl phthalate	44J	--	--	--
N-Nitrosodiphenylamine	--	49BJ	--	--
Polynuclear Aromatic Hydrocarbons (PAHs)				
Benzo(a)anthracene	45J	--	--	--
Benzo(b)fluoranthene	70J	--	--	--
Chrysene	44J	--	--	--
Fluoranthene	75J	--	--	--
Phenanthrene	55J	--	--	--
Pyrene	55J	--	--	--
Total PAHs	344	--	--	--
METALS (mg/kg)				
Arsenic	26	36	17	23
Lead	17	13	15	11
Mercury	0.03	--	0.02	0.03
Antimony	7	8	5	6
Barium	143	105	18.3	18.5
Chromium **	16	17	6	10
Copper	22	22	5	8
Nickel	20	18	5	6
Zinc	70.5	57	9	--

B (Organic) = Found in method blank.

J = Estimated value less than the sample quantitation limit, but greater than zero.

-- = Not detected.

** = Not distinction between Chromium (III) and Chromium (VI).

Source: RI Report, 1990

Table B-4
Positive Results in Surface Soils
Building 1088
Defense Depot Memphis, Tennessee

122 92

PARAMETER	PHASE I					PHASE II	
	SS15	SS16	SS17	SS18	SS19	SS45	SS46
HALOGENATED VOLATILES ug/kg							
Methylene chloride	16B	29B	11B	9B	11B	11B	8B
NONHALOGENATED VOLATILES ug/kg							
Acetone	15	17	12B	6BJ	11BJ	13	9J
Toluene	5J	4J	--	2J	6	2J	--
NONHALOGENATED SEMIVOLATILES ug/kg							
2,4-Dimethylphenol	--	--	--	--	720J	--	--
2-Methylphenol	--	--	--	--	1100J	--	--
4-Methylphenol	--	--	--	--	500J	--	--
Benzoic acid	--	--	--	--	320J	--	--
Benzyl alcohol	--	--	--	1000J	--	--	--
bis(2-Ethylhexyl) phthalate	1700B	4300B	600BJ	8100B	--	1200B	1400B
Butyl benzyl phthalate	96J	370J	--	--	--	--	--
Dibenzofuran	--	--	--	--	210J	--	--
Dimethyl phthalate	--	--	--	--	--	180J	--
Di-n-butyl phthalate	160J	470J	--	950J	--	--	--
N-Nitrosodiphenylamine	150J	590J	--	--	--	--	--
Phenol	--	--	--	--	550J	--	--
Polynuclear Aromatic Hydrocarbons (PAHs)							
Acenaphthene	--	--	--	--	250J	--	--
Anthracene	--	670J	200J	--	260J	--	--
Benzo(a)anthracene	--	2100J	620J	--	2200	160J	90J
Benzo(a)pyrene	--	1700J	--	370J	1500J	140J	84J
Benzo(b)fluoranthene	120J	2400J	1300J	830J	4600	160J	160J
Benzo(g,h,i)perylene	--	1400J	840J	--	--	--	--
Benzo(k)fluoranthene	100J	2200J	--	--	--	--	--
Chrysene	110J	2500J	790J	1000J	2500	220J	130J
Fluoranthene	220J	5800	1800J	1300J	3200	340J	210J
Fluorene	--	--	--	--	310J	--	--
Indeno(1,2,3-cd)pyrene	--	1200J	630J	--	1500J	120J	--
Naphthalene	--	--	--	--	480J	--	--
Phenanthrene	130J	3000J	760J	780J	2500	210J	120J
Pyrene	160J	4700	1100J	860J	2600	440J	250J
Total PAHs	840	27,670	8,040	4,770	18,920	2,050	910

Source: RI Report, 1990

Table B-4
Positive Results in Surface Soils
Building 1088
Defense Depot Memphis, Tennessee

122 93

PARAMETER	PHASE I					PHASE II	
	SS15	SS16	SS17	SS18	SS19	SS45	SS46
PESTICIDES ug/kg							
4,4'-DDD	45D	250	52D	--	--	--	13J
4,4'-DDE	110D	1300D	97D	400D	180	33	27
4,4'-DDT	450D	7400D	260D	1100D	660	90D	110D
alpha-BHC	12Z	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	25J	--
beta-BHC	26Z	--	43Z	--	--	--	--
delta-BHC	--	--	11Z	--	--	--	--
Dieldrin	110Z	410Z	--	--	220	--	--
Endosulfan-I	19Z	--	--	--	--	--	--
gamma-BHC (Lindane)	11Z	--	--	--	--	--	--
gamma-Chlordane	--	--	--	--	--	31J	--
Heptachlor epoxide	69Z	--	--	--	--	--	--
PCBs ug/kg							
Aroclor-1016	100Z	--	140Z	--	--	--	--
Aroclor-1221	95Z	--	--	--	--	--	--
Aroclor-1232	270Z	--	550Z	--	--	--	--
Aroclor-1242	130Z	--	200Z	--	--	--	--
Aroclor-1254	--	10000D	--	--	--	--	--
Total PCbs	595	10,000	890	--	--	--	--
METALS mg/kg							
Arsenic	6	--	--	15	--	--	--
Lead	2670G*	17500	247	2060	10300	312	166
Mercury	0.04N	0.26	--	0.06	0.18	--	--
Selenium	--	--	--	9	--	--	--
Antimony	8B	30	--	26	4B	--	--
Barium	216	313	109	409	148	85.2	91.8
Cadmium	1.9N	23.4	0.7	4.7	4.4	--	--
Chromium **	714G	6710	109	8580	2230	138	78
Copper	124*	240	72	52	148	116	76
Nickel	37*	53	23	16	32	29	24
Silver	--	0.8B	--	--	--	--	--
Zinc	996G	21000	270	22100	4600	202	146

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.

G = Native analyte > 4 times spike added, therefore acceptance criteria do not apply.

J = Estimated value less than the sample quantitation limit, but greater than zero.

N = Spiked sample recovery not within control limts.

Z = Matrix interference; compound not positively identifiable.

* = Duplicate analysis not within control limits.

** = No distinction between Chromium (III) and Chromium (VI)

-- = Not detected.

GNV/10016F7C.XLS

Source: RI Report, 1990

Table B-5

Positive Results in Subsurface Soils

Operable Unit 2

Defense Depot Memphis, Tennessee

122 94

PARAMETER	STB-5-1	STB-5-2	STB-5-3
Depth of Sample:	16.0'	78.0'	83.0'
HALOGENATED VOLATILES ug/kg			
Chloroform	--	--	--
Methylene chloride	13B	21B	12B
NONHALOGENATED VOLATILES ug/kg			
2-Butanone	--	--	--
Acetone	18	14B	14
Toluene	--	--	--
NONHALOGENATED SEMIVOLATILES ug/kg			
Benzoic acid	--	--	--
bis(2-Ethylhexyl) phthalat	450B	440B	320BJ
Di-n-butyl phthalate	--	--	--
N-Nitrosodiphenylamine	--	--	--
Polynuclear Aromatic Hydrocarbons (PAHs)			
Fluoranthene	--	--	--
Pyrene	--	--	--
TOTAL PAHs	--	--	--
METALS			
Barium (EPTOX in ug/l)	--	10	--
Cadmium (EPTOX in ug/l	--	--	--

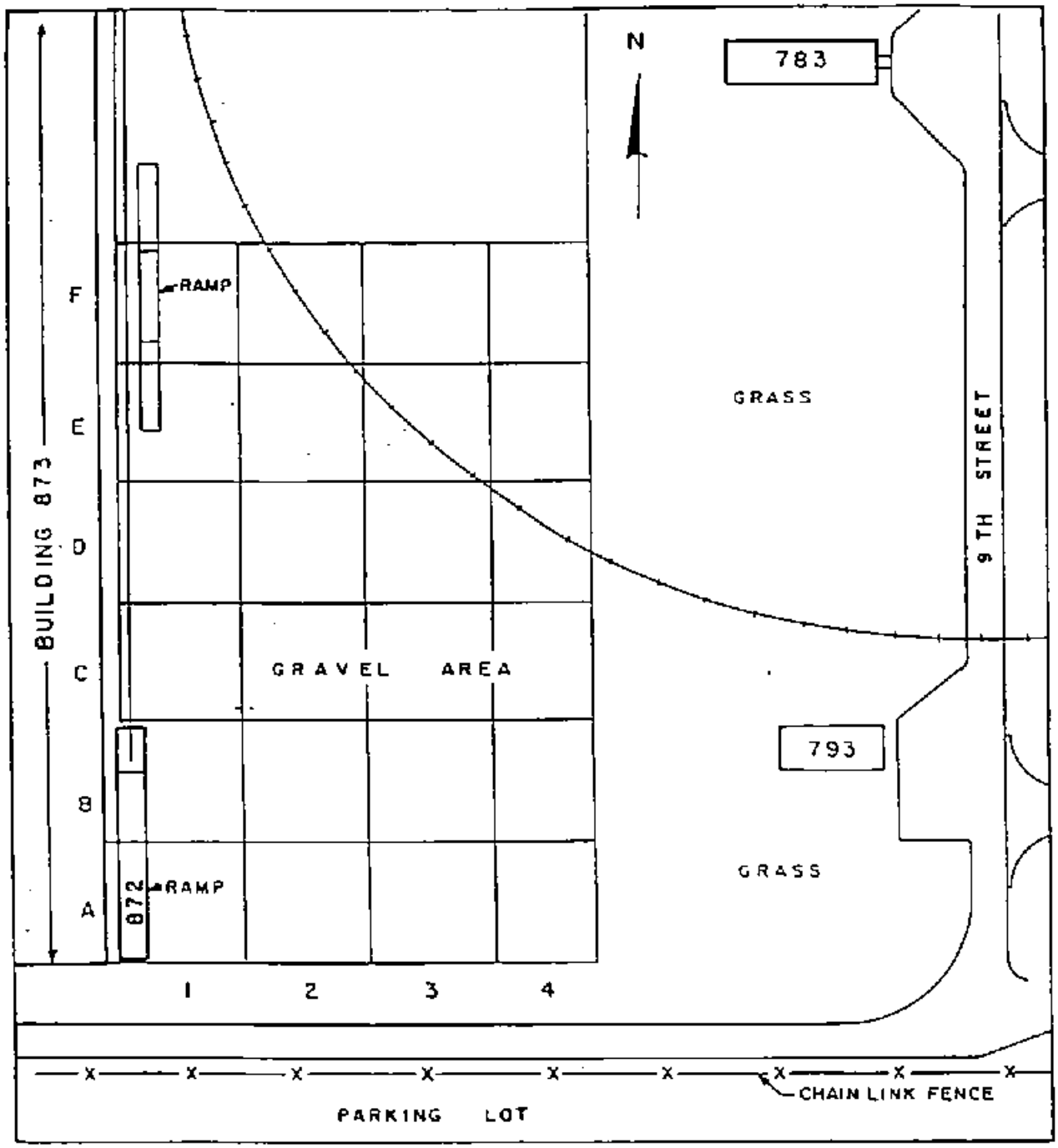
B (Organic) = Found in method blank.
J = Estimated value less than the sample quantitation limit, but greater than zero.
-- = Not detected

Source: RI Report, 1990

Summary Report,
On-Site Remedial Activities at the
Defense Depot Memphis
O.H. Materials
February 1986

FIGURE B-4. SAMPLING GRID EAST OF BLDG. S-873

Source: O.H. Materials, 1986



(NOT TO SCALE)

TABLE B-6

RESULTS OF PCB ANALYSES
FROM RECOUPMENT AREA

(see Figure B-4 for grid location)

SAMPLE NO.	GRID LOCATION	DEPTH	PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248	PCB 1254	PCB 1260
45	A-1	0-4"	ND	ND	ND	ND	ND	ND	ND
46	A-2	"	ND	ND	ND	ND	ND	ND	ND
47	A-3	"	ND	ND	ND	ND	ND	ND	ND
48	A-4, B-4	"	ND	ND	ND	ND	ND	ND	ND
49	B-1	"	ND	ND	ND	ND	ND	ND	ND
50	B-2	"	ND	ND	ND	ND	ND	ND	ND
51	B-3	"	ND	ND	ND	ND	ND	ND	ND
52	C-1	"	ND	ND	ND	ND	ND	ND	ND
53	C-2	"	ND	ND	ND	ND	ND	ND	ND
54	C-3	"	ND	ND	ND	ND	ND	ND	ND
55	C-4, D-4	"	ND	ND	ND	ND	ND	ND	ND
56	D-1	"	ND	ND	ND	ND	ND	ND	ND
57	D-2	"	ND	ND	ND	ND	ND	ND	ND
58	D-3	"	ND	ND	ND	ND	ND	ND	ND
59	E-1	"	ND	ND	ND	ND	ND	ND	ND
60	E-2	"	ND	ND	ND	ND	ND	ND	ND

Source: O.H. Materials, 1986

TABLE B-7
EP TOXICITY METALS SAMPLE
RESULTS FROM RECOUPMENT AREA

(in mg/l)
(For Grid Location, See Figure B-4)

SAMPLE NO.	GRID LOCATION	DEPTH	ARSENIC	BARIUM	CADMIUM	CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
45	A-1	0-4"	ND	ND	ND	ND	ND	ND	ND	ND
46	A-2	"	ND	ND	ND	ND	ND	ND	ND	ND
47	A-3	"	ND	ND	ND	ND	ND	ND	ND	ND
48	A-4, B-4	"	ND	ND	ND	ND	ND	ND	ND	ND
49	B-1	"	ND	ND	ND	ND	ND	ND	ND	ND
50	B-2	"	ND	ND	ND	ND	ND	ND	ND	ND
51	B-3	"	ND	ND	ND	ND	ND	ND	ND	ND
52	C-1	"	ND	ND	ND	ND	ND	ND	ND	ND
53	C-2	"	ND	ND	ND	ND	ND	ND	ND	ND
54	C-3	"	ND	ND	ND	ND	ND	ND	ND	ND
55	C-4, D-4	"	ND	ND	ND	ND	ND	ND	ND	ND
56	D-1	"	ND	ND	ND	ND	ND	ND	ND	ND
57	D-2	"	ND	ND	ND	ND	ND	ND	ND	ND
58	D-3	"	ND	ND	ND	ND	ND	ND	ND	ND
59	E-1	"	ND	ND	ND	0.1	1.6	ND	ND	ND
60	E-2	"	0.008	ND	ND	ND	ND	ND	ND	ND

Source: O.H. Materials, 1986

TABLE B-8
RESULTS OF PESTICIDE ANALYSES FROM RECOUPMENT AREA

(in ug/kg)
(For Grid Location, See Figure B-4)

SAMPLE NO.	GRID LOCATION	DEPTH	ALDRIN	ALPHA-BHC	BETA-BHC	GAMMA-BHC	DELTA-BHC	CHLORDANE
45	A-1	0-4"	ND	ND	ND	ND	ND	ND
46	A-2	"	ND	ND	ND	ND	ND	ND
47	A-3	"	9.0	ND	ND	ND	ND	ND
48	A-4, B-4	"	ND	ND	ND	ND	ND	ND
49	B-1	"	ND	ND	ND	ND	ND	ND
50	B-2	"	ND	ND	ND	ND	ND	ND
51	B-3	"	ND	ND	ND	ND	ND	ND
52	C-1	"	5.2	ND	ND	ND	ND	ND
53	C-2	"	ND	ND	ND	ND	ND	ND
54	C-3	"	37	ND	ND	ND	ND	ND
55	C-4, D-4	"	37	ND	ND	ND	ND	ND
56	D-1	"	54	ND	ND	ND	ND	ND
57	D-2	"	21	ND	ND	ND	ND	ND
58	D-3	"	ND	ND	ND	ND	ND	ND
59	E-1	"	6.3	ND	ND	ND	ND	ND
60	E-2	"	15	ND	ND	ND	ND	ND
138	C-2	8"	ND	ND	ND	ND	ND	ND

Source: O.H. Materials, 1986

TABLE B-8 (cont)
(ug/kg)
(For Grid Location, See Figure B-4)

SAMPLE NO.	GRID LOCATION	DEPTH	ENDOSULFAN SULFATE	ENDRIN	ENDRIN ALDEHYDE	HEPTACHLOR	HEPTACHLOR EPOXIDE	TOXAPHENE
45	A-1	0-4"	ND	ND	ND	ND	ND	ND
46	A-2	"	ND	ND	ND	ND	ND	ND
47	A-3	"	ND	ND	ND	5.7	ND	ND
48	A-4, B-4	"	ND	5.9	ND	ND	ND	ND
49	B-1	"	ND	ND	ND	ND	ND	ND
50	B-2	"	ND	ND	ND	5.6	ND	ND
51	B-3	"	ND	ND	ND	ND	ND	ND
52	C-1	"	ND	ND	ND	ND	ND	ND
53	C-2	"	ND	ND	ND	ND	10	ND
54	C-3	"	ND	ND	ND	25	7.2	ND
55	C-4, D-4	"	ND	29	ND	32	7.1	ND
56	D-1	"	ND	ND	ND	20	460	ND
57	D-2	"	ND	6.2	ND	22	13	ND
58	D-3	"	ND	8.6	ND	ND	ND	ND
59	E-1	"	ND	ND	ND	ND	ND	ND

Source: O.H. Materials, 1986

TABLE B-8 (cont)

(in ug/kg)
(For Grid Location, See Figure B-4)

SAMPLE NO.	GRID LOCATION	DEPTH	P,P'-DDD	P,P'-DDE	P,P'-DDT	DIELDRIN	ENDOSULFAN I	ENDOSULFAN II
45	A-1	0-4"	12	6.8	54	ND	ND	ND
46	A-2	"	ND	5.3	42	ND	ND	ND
47	A-3	"	21	28	38	ND	ND	ND
48	A-4,B-4	"	20	5.3	71	ND	7.7	ND
49	B-1	"	22	9.8	69	ND	11	ND
50	B-2	"	21	18	1200	ND	ND	ND
51	B-3	"	14	20	160	ND	ND	ND
52	C-1	"	29	14	180	ND	22	ND
53	C-2	"	270	47	1000	5.9	12	ND
54	C-3	"	19	56	240	ND	ND	ND
55	C-4,D-4	"	140	220	1100	ND	110	ND
56	D-1	"	23	30	430	ND	350	ND
57	D-2	"	450	170	750	ND	120	ND
58	D-3	"	26	44	160	ND	ND	ND
59	E-1	"	55	400	910	ND	11	ND
60	E-2	"	160	180	780	ND	160	ND
138	C-2	8"	ND	ND	11	ND	ND	ND

Source: O.H. Materials, 1986

TABLE B-8 (cont)
(ug/kg)

(For Grid Location, See Figure B-4)

SAMPLE NO.	GRID LOCATION	DEPTH	ENDOSULFAN SULFATE	ENDRIN	ENDRIN ALDEHYDE	HEPTACHLOR	HEPTACHLOR EPOXIDE	TOXAPHEN.
60	E-2	0-4"	ND	ND	ND	ND	13	ND
138	C-2	8"	ND	ND	ND	ND	ND	ND
139	C-2	5'	ND	ND	ND	ND	ND	ND
140	E-1	5'	ND	ND	ND	ND	ND	ND
141	D-3	8"	ND	ND	ND	ND	ND	ND
142	F-1	4"	ND	ND	ND	ND	ND	ND
143	F-2	4"	30	ND	ND	14	ND	ND
144	F-3	4"	ND	ND	ND	ND	ND	ND
145	F-4	4"	40	ND	ND	ND	31	ND
146	A-2	8"	ND	ND	ND	ND	ND	ND
147	B-4	8"	ND	ND	ND	ND	ND	ND

Source: O.H. Materials, 1986

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FINAL PAGE

ADMINISTRATIVE RECORD

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ADMINISTRATIVE RECORD

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