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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

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Operable Unit 3
Field Sampling Plan

for

Defense Distribution Depot Memphis

September 1995

Prepared for

U.S. Army Corps of Engineers
Huntsville Division

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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 3 (OU-3) as a supplement to the *Generic RI/FS WP*. The objective of the *OU-3 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-3 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 electrical transformers that contained polychlorinated biphenyls (PCBs), storage and mixing of pesticides and herbicides, and storm water runoff from the industrial and recreational areas. Principal contamination in OU-4 probably resulted from a wood treatment operation and hazardous material storage.

In OU-3, similar types of contamination were detected during previous sampling activities at the Golf Course Pond (Site 25) and Lake Danielson (Site 26). Sediment samples showed pesticides and metals; in fish tissue samples, pesticides and PCBs were detected. Surface water samples were generally free from the analytes tested. Another of the RI sites in OU-3 was a former storage area for electrical transformers that were found to be contaminated with PCBs. Soil samples collected in the area detected PAHs and pesticides. PCBs were not detected. The other two RI sites in OU-3 (Sites 58 and 59) are areas where pesticides and herbicides were stored and mixed for application to DDMT grounds. At Site 58, no soil data are available, but at Site 59, soil sampling has detected elevated levels of PAHs and pesticides.

In the groundwater at OU-3, the primary types of contaminants detected were VOCs and metals. In two of the three existing monitoring wells, elevated levels of carbon tetrachloride and tetrachloroethene were detected. Metals found at elevated concentrations included lead, antimony, cadmium, and chromium. The existing wells will be sampled and new monitoring wells will be installed and sampled to investigate groundwater contamination at OU-3. The VOC contamination found in the groundwater may be from offsite sources; to investigate that possibility, groundwater will be monitored along the DDMT facility boundary upgradient of the wells that have shown VOC contamination.

The results of the sampling activities that will be conducted may indicate the need for additional monitoring wells. If required, additional wells will be installed during the next phase of field investigations at DDMT.

Summary of FSP

This FSP describes the DDMT facility, history of OU-3, data gaps, and data needed for OU-3. General information is also provided on OU-3 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-3. The final section of the plan describes the data needs required to propose remedial alternatives for OU-3. 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, sediment, surface water, and groundwater samples will be collected at OU-3 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 to aid in supporting the appropriate recommendation for action at a given site.

Proposed Sampling

The *OU-3 FSP* describes RI sites that have been identified on the basis of their potential for contamination as a result of past practices. Surface soil, subsurface soil, surface water, and groundwater samples are proposed to be taken at the sites. Surface soil and sediment samples will provide information to assess the horizontal extent of contamination and will provide data to evaluate risk associated with the exposure pathways. Soil borings will also be installed at the proposed site locations, and subsurface samples will be collected from the borings to assess the vertical extent of contamination.

Surface water sampling will help to evaluate the source of the contamination that has been detected in the water body sediments. The potential source areas (onsite industrial area or onsite areas adjacent to surface water bodies) have not been characterized; therefore, the source of contaminants has not been identified.

Groundwater samples will be collected from existing wells in OU-3 to assess whether the RI sites have affected groundwater quality. Monitoring wells will also be installed along the property boundary of DDMT to evaluate whether offsite sources are contributing to contamination found at DDMT, as part of the work described in Section 4 of the *OU-4 FSP*.

By implementing the *OU-3 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-3 at DDMT.

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Acronyms

ARARs	Applicable or relevant and appropriate requirements
bls	Below land surface
BRA	Baseline risk assessment
CEHND	Corps of Engineers, Huntsville Division
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of concern
DDE	Dichlorodiphenyldichloroethlene
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
ER	Early removal
ESE	Environmental Science and Engineering
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
HQ/HI	Hazard quotient/hazard index
HRS	Hazardous Ranking System
IRA	Interim remedial action
μm	Micrometer
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 monitor
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
ppb	Parts per billion
ppm	Parts per million
PRG	Preliminary remediation goal
QA/QC	Quality assurance/quality control

Acronyms (cont'd.)

QAPP	Quality assurance project plan
QC	Quality control
RA	Remedial action
RAL	Removal action level
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RGO	Remedial goal option
RI	Remedial investigation
RI/FS	Remedial investigation/feasibility study
RI/FS WP	RI/FS Work Plan
ROD	Record of decision
SMP	Site Management Plan
TCL/TAL	Target compound list/Target analyte list
TDEC	Tennessee Department of Environment and Conservation
THI	Target hazard index
TOC	Total organic carbon
TRL	Target risk level
TSS	Total suspended solids
UCL	Upper confidence limit
USAEHA	U.S. Army Environmental Hygiene Agency
VOC	Volatile organic compound

TAB

Section 1 - Introduction

1.0 Introduction

1.1 Objective

The objective of this Field Sampling Plan (FSP) for Operable Unit 3 (OU-3) is to present a detailed description of the proposed sampling and analysis activities that will be performed for characterization of the sites in OU-3 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, sediment, and groundwater contamination attributable to past operations
- To gather data to evaluate the feasibility of remedial actions for the sites
- To evaluate risk to human health and the environment

Once the site has been characterized, data will be evaluated and used to make decisions concerning remediation of OU-3. Possible decisions include downgrading the site to a no further action (NFA) site, recommending the site for early removal (ER), or selecting a remedial alternative to address contamination at the site. The southeast section of the Main Installation has been designated by the U.S. Environmental Protection Agency (EPA) and DDMT as OU-3.

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 (FR)*, 57 *FR* 47180 No. 199, on October 14, 1992. The Remedial Investigation (RI) presented herein, and future investigations, are intended to satisfy the requirements of CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and RCRA Part B permit.

DDMT has entered into a Federal Facilities Agreement (FFA) between the Defense Logistics Agency (DLA), EPA, and TDEC. This agreement establishes a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at DDMT in accordance with existing regulations and for achieving RCRA/CERCLA integration. As a result of DDMT's status as an NPL site, it was agreed that the investigation of all applicable sites would proceed under the CERCLA process for remediation (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 investigations/feasibility studies (RI/FSs) for each of the OUs. These 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-3 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 concurrently addresses the sites within OU-3 that have been previously identified as requiring an RI (i.e., Sites 48, 58, and 59). The remainder of the identified sites within OU-3 are proposed for one of four categories: screening site, NFA site, feasibility study site, or ER site (Table 1-1). Activities related to these sites will be addressed in the *Screening Sites FSP, NFA Report, ER Memorandum*, or other future work plans. Each of these documents will be submitted to TDEC and EPA for review. Table 1-1 presents a summary of all the sites at OU-3 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) RI/FS 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,

Table 1-1
OU-3 (Southeast Water Shed of Main Installation)
Federal Facility Agreement
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 (1 of 3 total–Bldg. 260)	30	–	NFA	NFA	NFA Report
40	Safety Kleen Units–4 of 9 total units (Bldgs. 253, 469, 490, 689)	40	–	NFA	NFA	NFA Report
41	Satellite Drum Accumulation Area–2 of 4 total areas (Bldgs. 469, 260)	41	–	NFA	NFA	NFA Report
49	Medical Waste Storage Area	49	46	NFA	NFA	NFA Report
25	Golf Course Pond	25	42	RFI	FS	OU-3 FSP
26	Lake Danielson	26	43	RFI	FS	OU-3 FSP
48	Former PCB Transformer Storage Area	48	39	PRFI	RI	OU-3 FSP
58	Pesticides, herbicides (Pad 267)	–	38	–	RI	OU-3 FSP
59	Pesticides, cleaners (Bldg. 273)	–	40	–	RI	OU-3 FSP
51	Lake Danielson Outlet Ditch	AOC-B	–	PRFI	Screening	Screening Site FSP
52	Golf Course Pond Outlet Ditch	AOC-C	–	PRFI	Screening	Screening Site FSP
65	XXCC-3 (Bldg. 249)	–	34	–	Screening	Screening Site FSP
66	POL (Bldg. 253)	–	35	–	Screening	Screening Site FSP
67	MOGAS (Bldg. 253)	–	36	–	Screening	Screening Site FSP
68	POL (Bldg. 263) (20 x 40 ft)	–	37	–	Screening	Screening Site FSP
69	2,4-D, M2A1 & M4 Flamethrower Liquid Fuels (surface appl.)	–	41	–	Screening	Screening Site FSP
73	2,4 Dichlorophenoxyacetic Acid (all grassed areas)	–	73	–	Screening	Screening Site FSP
75	Unknown Wastes near Bldg. 689	–	50	–	Screening	Screening Site FSP
76	Unknown Wastes near Bldg. 690	–	51	–	Screening	Screening Site FSP
77	Unknown Wastes near Bldg. 689 & 690	–	52	–	Screening	Screening Site FSP
78	Alcohol, Acetone, Toluene, Naptha; Hydrofluoric Acid Spill	–	53	–	Screening	Screening Site FSP

FS = Feasibility Study.
FSP = Field sampling plan.
MOGAS = Military operation gasoline.
NFA = No further action.
OU-3 = Operable Unit 3.
PCB = Polychlorinated biphenyl.
POL = Petroleum, oil, and lubricants.
PRFI = Preliminary RCRA facility investigation.
RFA = RCRA Facility Assessment.
RFI = RCRA facility 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.

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).

TAB

Section 2 - Facility & Operable Unit Decsription

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-3 consists of approximately 320 acres and is located in the southeast quadrant of the Main Installation at DDMT. It is bounded by C Street on the north, 5th and 6th Streets on the west, Ball Road on the south (installation boundary), and Airways Boulevard on the east (installation boundary). The location of OU-3 in relation to the entire DDMT facility and other proposed OUs is shown in Figure 2-2.

2.2 Operable Unit Description

OU-3 is defined as the southeastern water shed of DDMT's Main Installation. OU-3 contains a total of 21 identified sites: 4 NFA sites, 3 RI sites, 2 FS sites, and 12 screening sites. The sites identified for RI in OU-3 include the former polychlorinated biphenyl (PCB) transformer storage area (Site 48); Pad 267, used for storing and mixing pesticides and herbicides (Site 58); and Building T-273, used for mixing pesticides and herbicides (Site 59). Studies on Lake Danielson and the Golf Course Pond have shown that the sediment and fish in these water bodies exhibit pesticides and PCBs (ref. 2). Since these water bodies receive surface runoff from the surrounding industrial and recreational areas, OU-3 contains the entire southeast water shed of DDMT's Main Installation. These two sites have been identified as FS sites; however, some limited source identification sampling will occur as part of the RI field effort. Figure 2-3 shows the location and status of each of the identified sites in OU-3. 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, Dunn Field and the Main Installation, 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.

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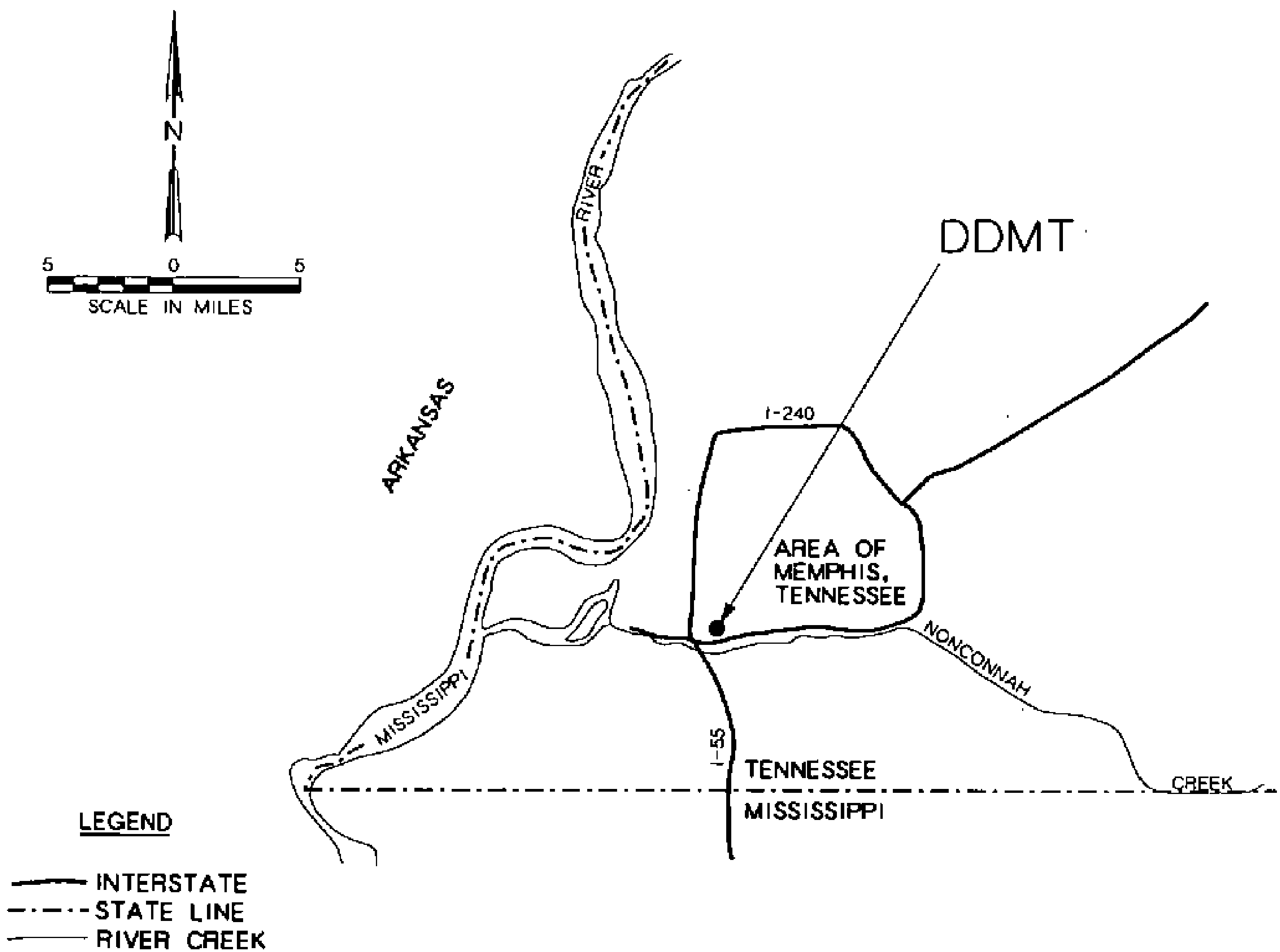

FIGURE 2-1
DDMT LOCATION IN MEMPHIS METROPOLITAN AREA
Defense Depot Memphis, Tennessee

Source: Engineering-Science, 1993

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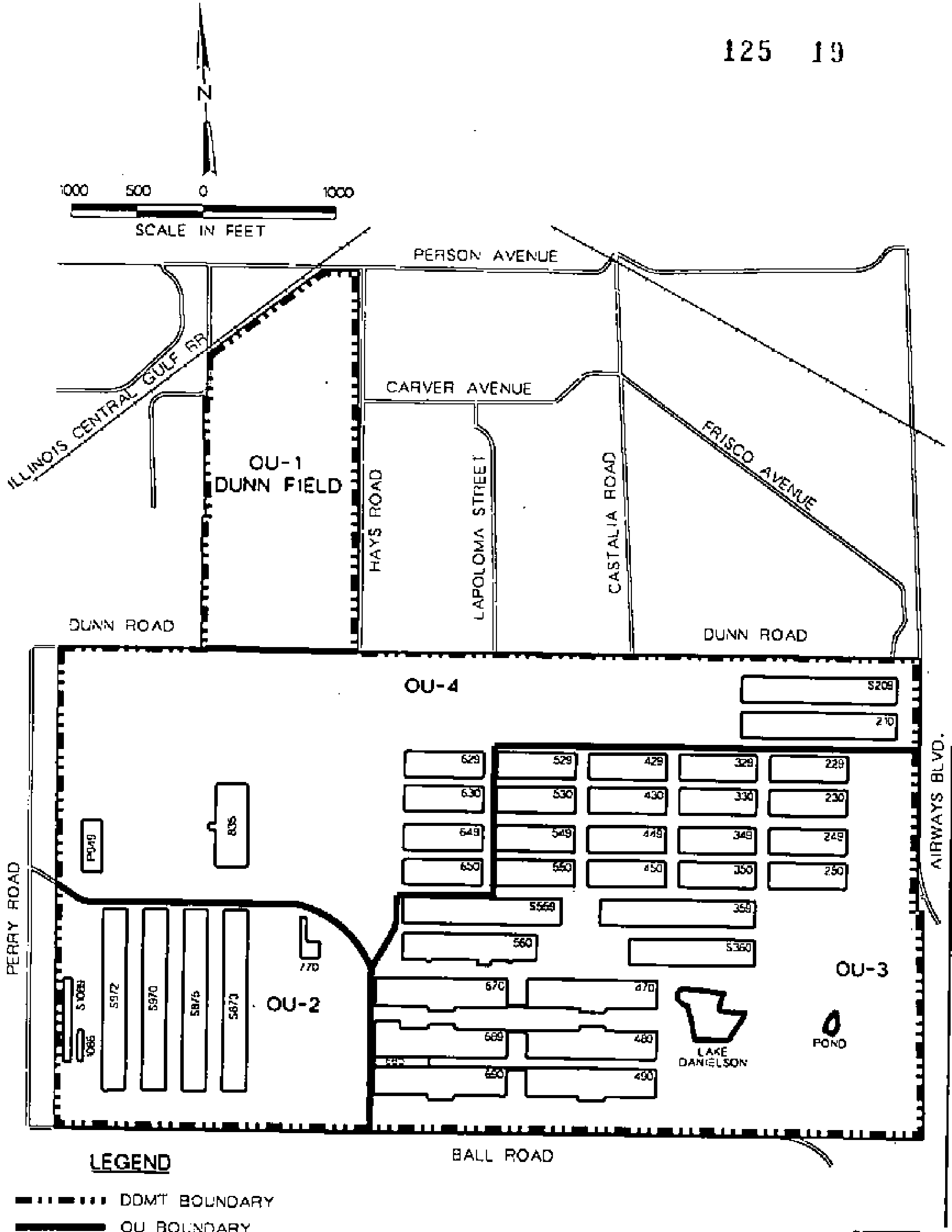

FIGURE 2-2
OPERABLE UNIT LOCATIONS
Defense Depot Memphis, Tennessee

Source: Engineering-Science, 1993

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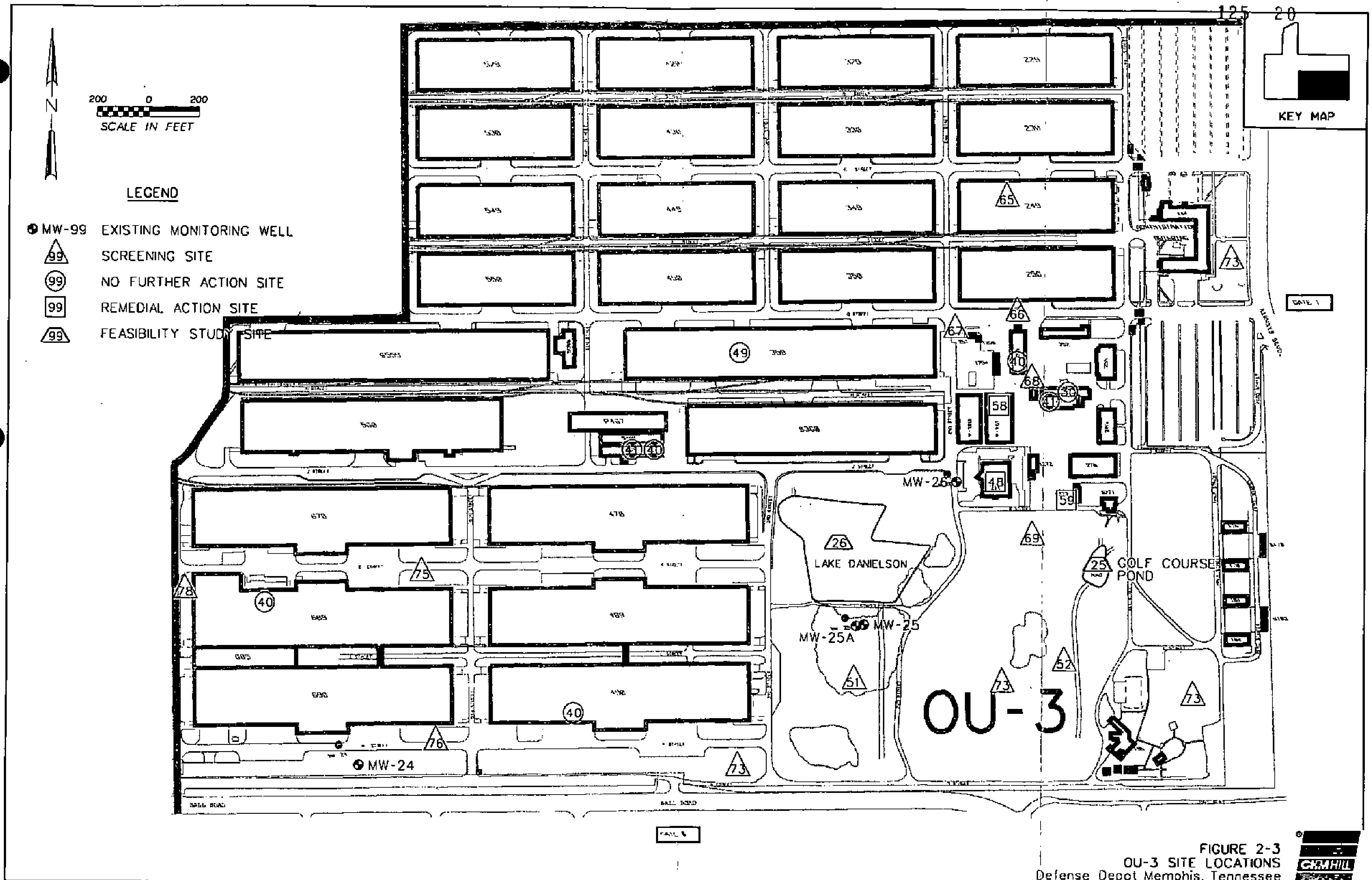

FIGURE 2-3
OU-3 SITE LOCATIONS
Defense Depot Memphis, Tennessee

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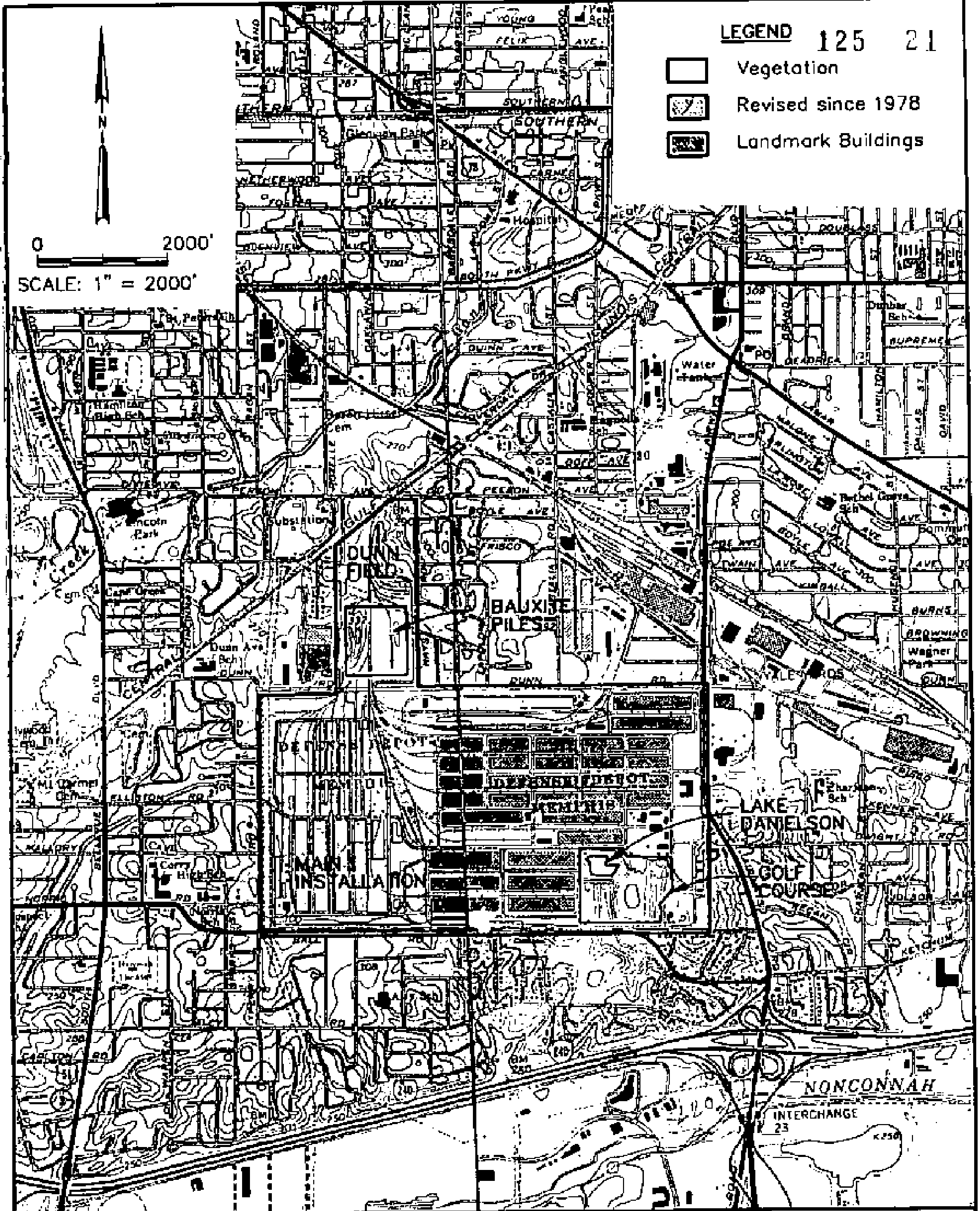

Source:: USGS 7.5 Series Topographic Quadrangle Maps - South West Memphis Tenn. - Ark. and Southeast Memphis, Tenn..

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

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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. Figure 2-5 shows the topography of OU-3.

Two perennial surface water bodies are located within the geographic boundaries of OU-3 (Lake Danielson and the Golf Course Pond). The topography of the entire OU is generally flat, with the only noticeable changes in elevation occurring in the golf course area and the wooded area just south of Lake Danielson.

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. 4). 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. 4).

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-3.

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.

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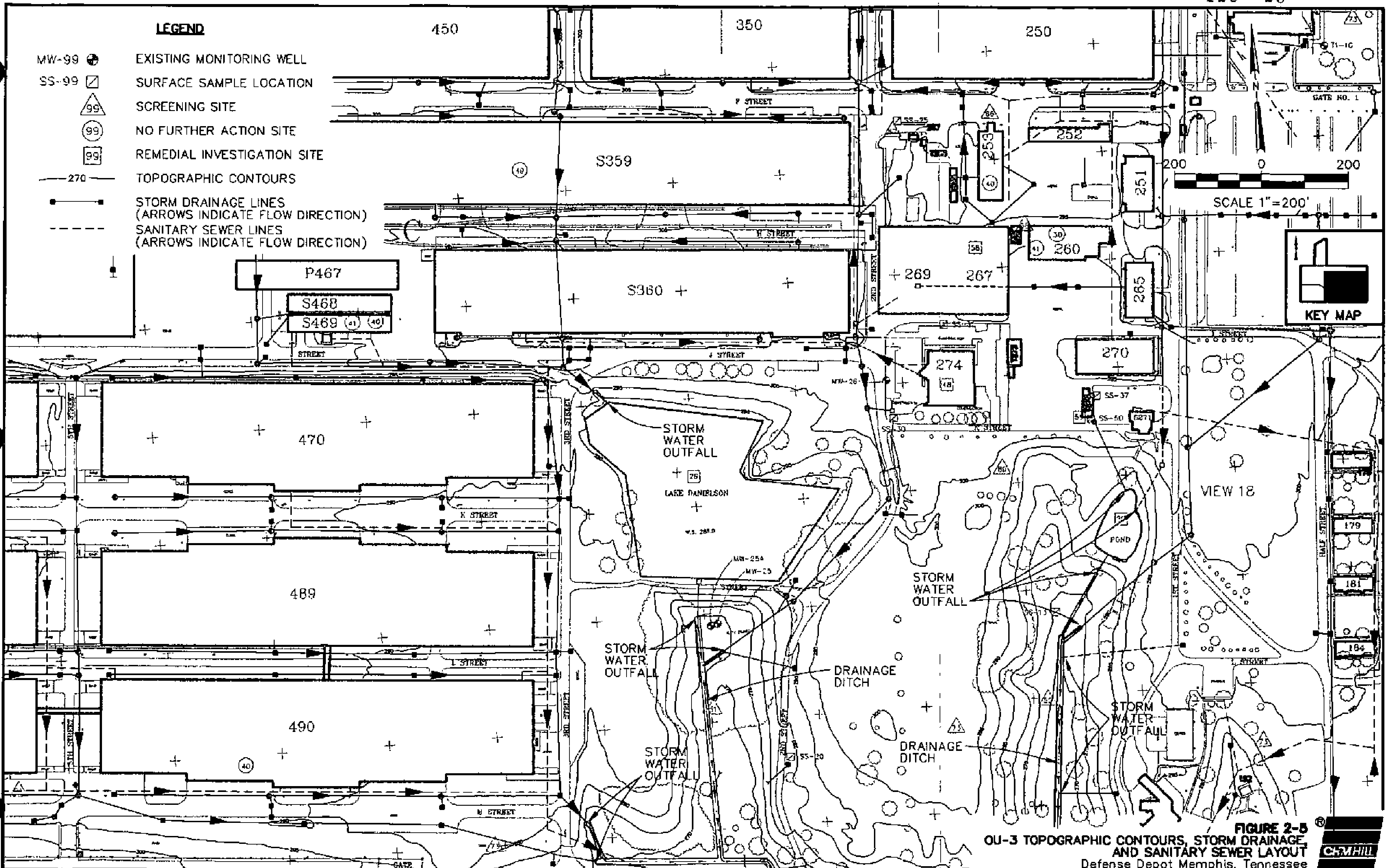

FIGURE 2-5
OU-3 TOPOGRAPHIC CONTOURS, STORM DRAINAGE, AND SANITARY SEWER LAYOUT
Defense Depot Memphis, Tennessee

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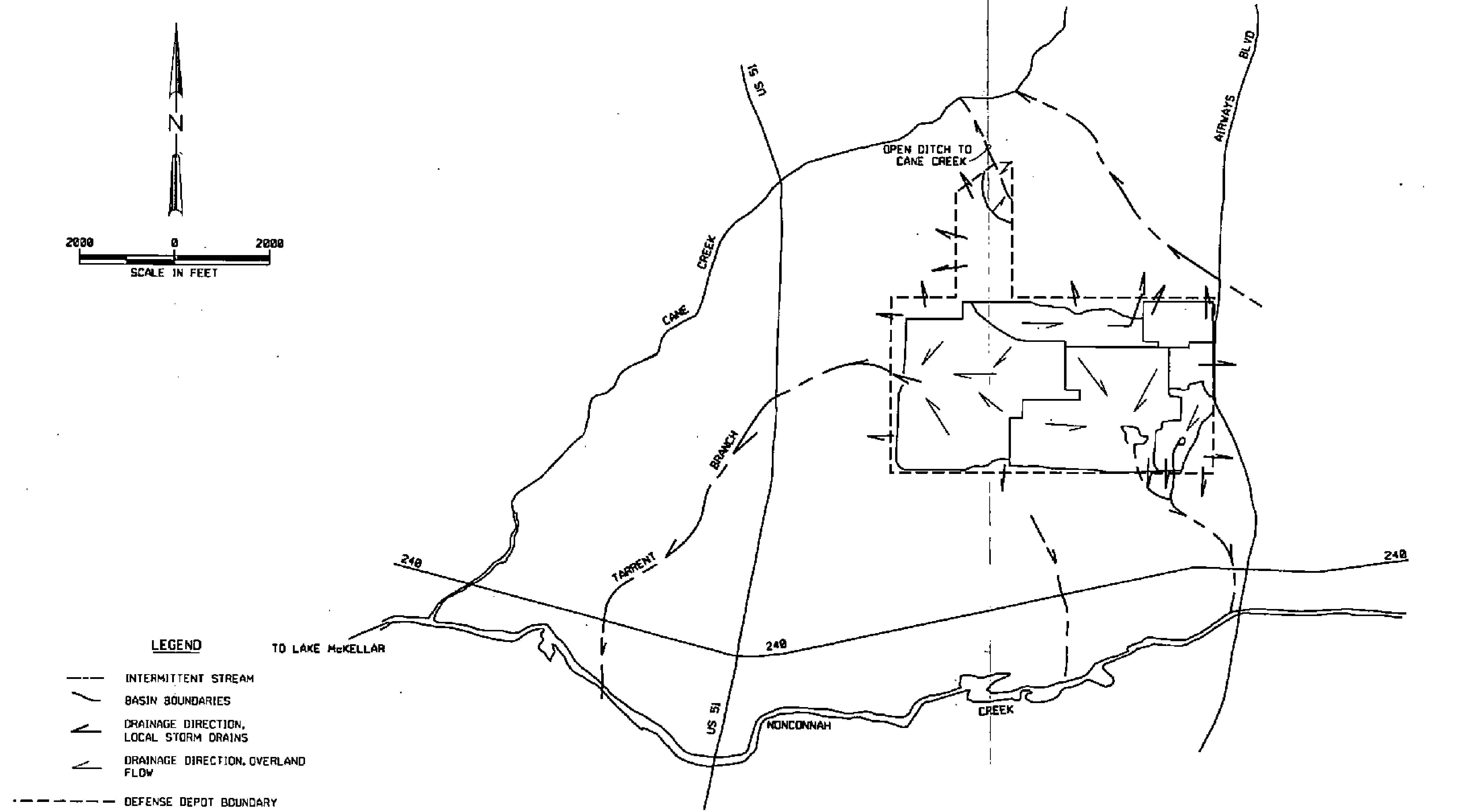

SOURCE: MODIFIED FROM DDMT, 1982. DRAFT SPILL PREVENTION. CONTROL AND COUNTERMEASURES PLAN.
MODIFIED FROM HARLAND, BARTHOLOMEW & ASSOCIATES, INC., 1988. MASTER PLAN REPORT, DDMT.
MODIFIED FROM DDMT, 1992. NPDES STORM DRAINAGE SAMPLING MAP, DRAWING NUMBER 45-90.

Source: RI Report, 1990

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

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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 of DDMT are equal to or higher than elevations of adjacent properties. More detail on the surface water hydrology of DDMT can be found in Section 2.4.3 of the *Generic RI/FS WP* (ref. 3).

Two perennial surface water bodies, Lake Danielson and the Golf Course Pond, are located within the geographic boundaries of OU-3. Lake Danielson consists of an unlined, manmade pond approximately 4 acres in surface area and approximately 15 ft deep at the deepest point. Lake Danielson receives storm water runoff from the central area (approximately 65 acres) of DDMT. Storm water from the catchment area enters Lake Danielson via a 48-inch diameter pipe in the northwest corner of the lake. A smaller amount of storm water is contributed via sheet flow from the area immediately surrounding Lake Danielson (ref. 5). Overflow from this impoundment flows to an open, concrete-lined storm drain that eventually drains into Nonconnah Creek, a tributary of the Mississippi River.

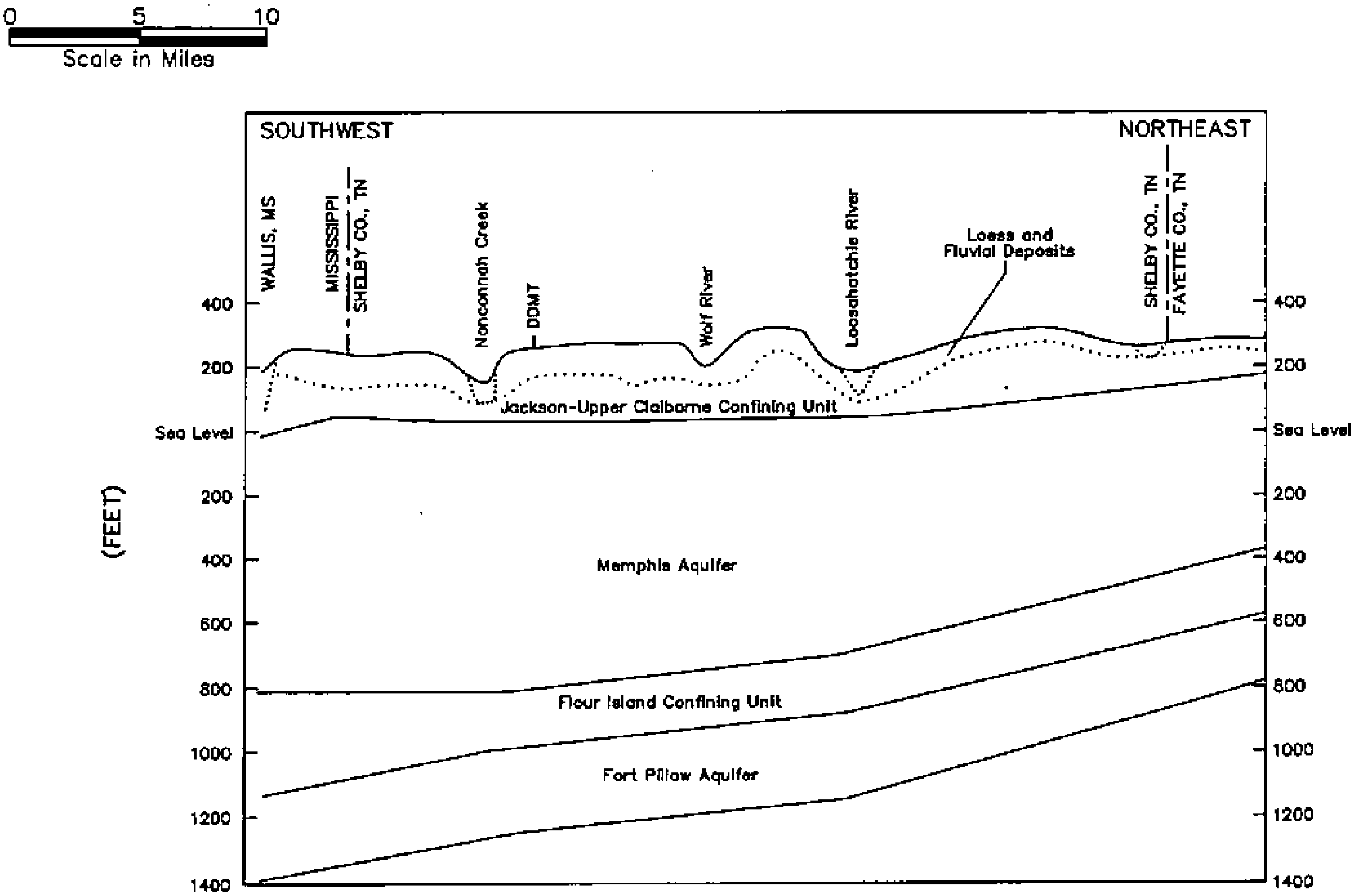
The Golf Course Pond is an unlined, manmade pond approximately 75 ft wide and 125 ft long with an earthen dam. The pond receives surface water runoff from the golf course and the southeast portion of the installation. Storm water enters the pond in one of two ways: through sheet flow from the surrounding land area and through an 8-inch-diameter and a 36-inch-diameter storm water drainage pipe. Overflow from this impoundment flows to an open, concrete-lined storm drain that eventually drains into Nonconnah Creek, a tributary of the Mississippi River.

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. 6).

Information describing major regional geologic units has been obtained from Wells (ref. 7), Moore (ref. 8), Nyman (ref. 9), and Graham and Parks (ref. 6). The Quaternary and Tertiary strata in the Memphis area are composed of loosely consolidated



Source: Parks, 1990

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

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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).

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. 10). On the basis of the soil borings and monitoring wells installed during the RI, cross sections were developed (by others) that illustrate the postulated occurrence, attitude, and relationships of the geologic units encountered. The cross sections are generalizations, and local variations in subsurface conditions should be expected. The strata encountered during RI activities (ref. 10) included loess, fluvial deposits, Jackson Formation/Upper Claiborne Group clays (based on interpretation), and what has been interpreted to be the Memphis Sand Formation. Figure 2-8 illustrates a geologic cross section of DDMT that includes the OU-3 area.

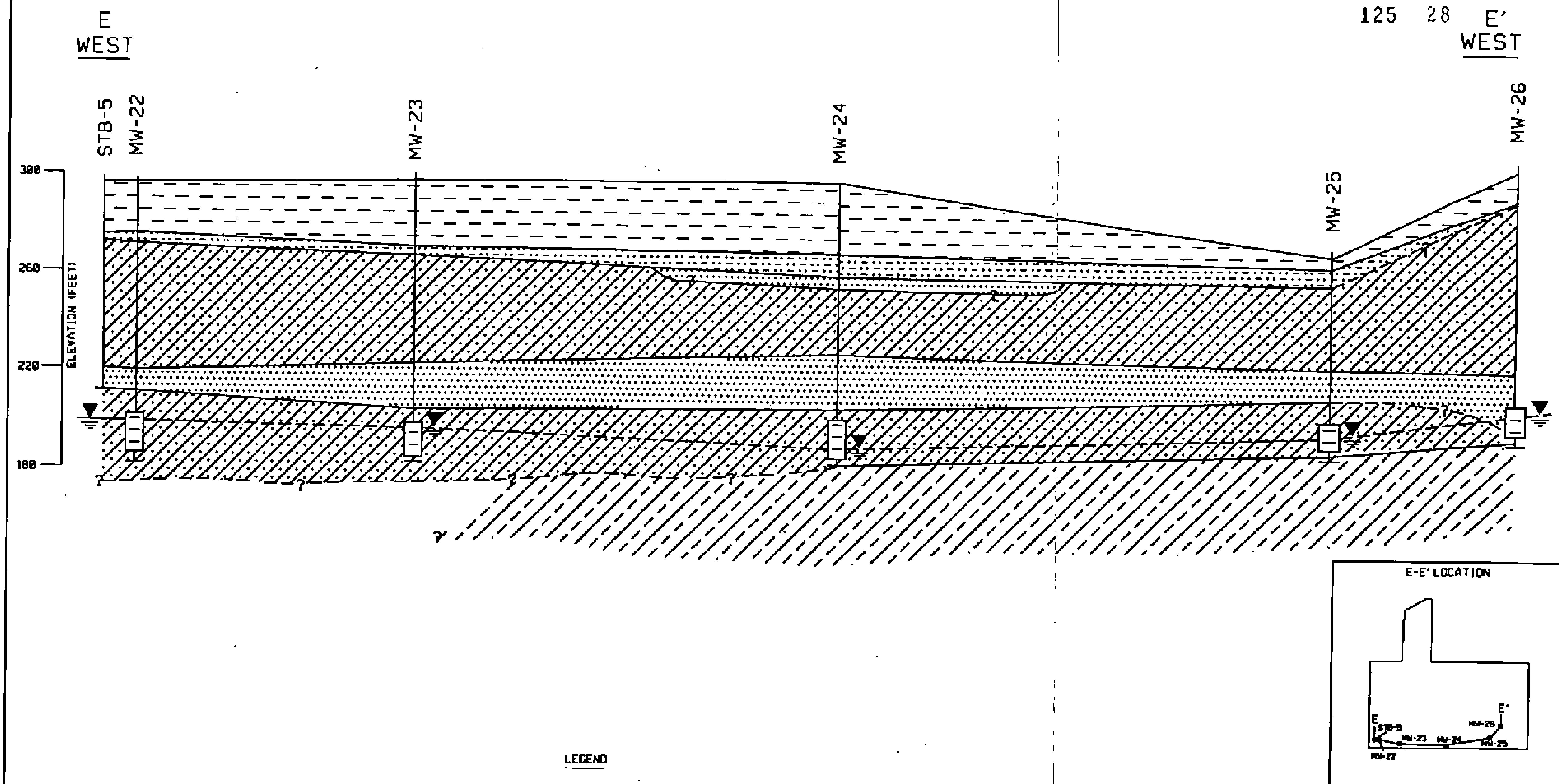
The uppermost geologic unit at or near ground surface in the study area is loess (eolian deposits consisting of brown silty clay, clayey silt, and fine sandy clayey silt). Loess was encountered at all drilling locations. This unit is described as a brown to yellowish low plasticity silt (ML) or low plasticity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

Fluvial deposits underlie the loess and were encountered at all drilling locations during the RI activities (ref. 10). The unit is composed of three generalized members that can be traced through the study area:

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

Beneath the silty clay/sandy clay/clayey sand are layers of sand and sandy gravel. These layers may alternate. The sand layers range from poorly graded to well graded, fine- to coarse-grained, very well sorted to poorly sorted quartz grains. The lower sand layers are poorly graded and are tan to white. The sand layers show a coarsening downwards into a gravelly sand, with chert being the primary gravel constituent.

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



LEGEND

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

NOTE: THIS ILLUSTRATION REPRESENTS AN INTERPRETATION OF NATURAL CONDITIONS.

Source: RI Report, 1990

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FIGURE 2-8
CROSS SECTION E-E', WEST TO EAST
Defense Depot Memphis, Tennessee

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The upper portion of the Memphis-Sand Formation was encountered in the same five borings as was the Jackson Formation/Upper Claiborne Group. This formation is represented in the study area by a gray, very fine-grained, silty sand. More detailed information on DDMT geology is available in Section 2.4.5.2 of the *Generic RI/FS WP* (ref. 3).

2.7 Hydrogeology

2.7.1 Regional 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.

2.7.2 DDMT Hydrogeology

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 the RI activities (ref. 10).

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). These perched water zones are temporal and are not considered part of the Fluvial Aquifer. The Fluvial Aquifer is not used as a drinking water source within the City of Memphis. The Memphis Sand Aquifer underlies the Fluvial Aquifer and is the primary source of drinking water for the City of Memphis.

Fluvial (Terrace) deposits underlie the loess within the installation. The fluvial deposits form the site's shallow (water table) aquifer, which ranges in depth from 40 to 131 ft at DDMT. Recharge to this unit is primarily from the infiltration of rainfall (ref. 6). According to the water levels measured in the monitoring wells during RI activities (ref. 10), only the base of the unit is saturated. Published seasonal water levels indicate that the groundwater levels fluctuate several feet. Figure 2-9 presents the water table surface map of the Fluvial Aquifer at DDMT. The map was compiled by contouring water levels recorded by Environmental Science and Engineering (ESE) in November 1993 (ref. 11). The groundwater flow direction in the Fluvial Aquifer within OU-3 is towards the depression in the top of the clay unit on the northern portion of DDMT. Depths to Fluvial Aquifer groundwater generally range from about 60 to 100 ft. The groundwater flow direction in the Memphis Sand Aquifer is westward toward the Allen Well Field.

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 underlying major aquifers (ref. 9). Where encountered, the elevation of the confining unit's upper surface ranges from 223 ft to 118 ft NGVD. An investigation to evaluate 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 maximum and minimum thicknesses of the confining unit encountered by soil borings in OU-3 are 40 and 10 ft, respectively.

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 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 bls, and is reported to average some 200 ft thick in the study 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. 6).

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).

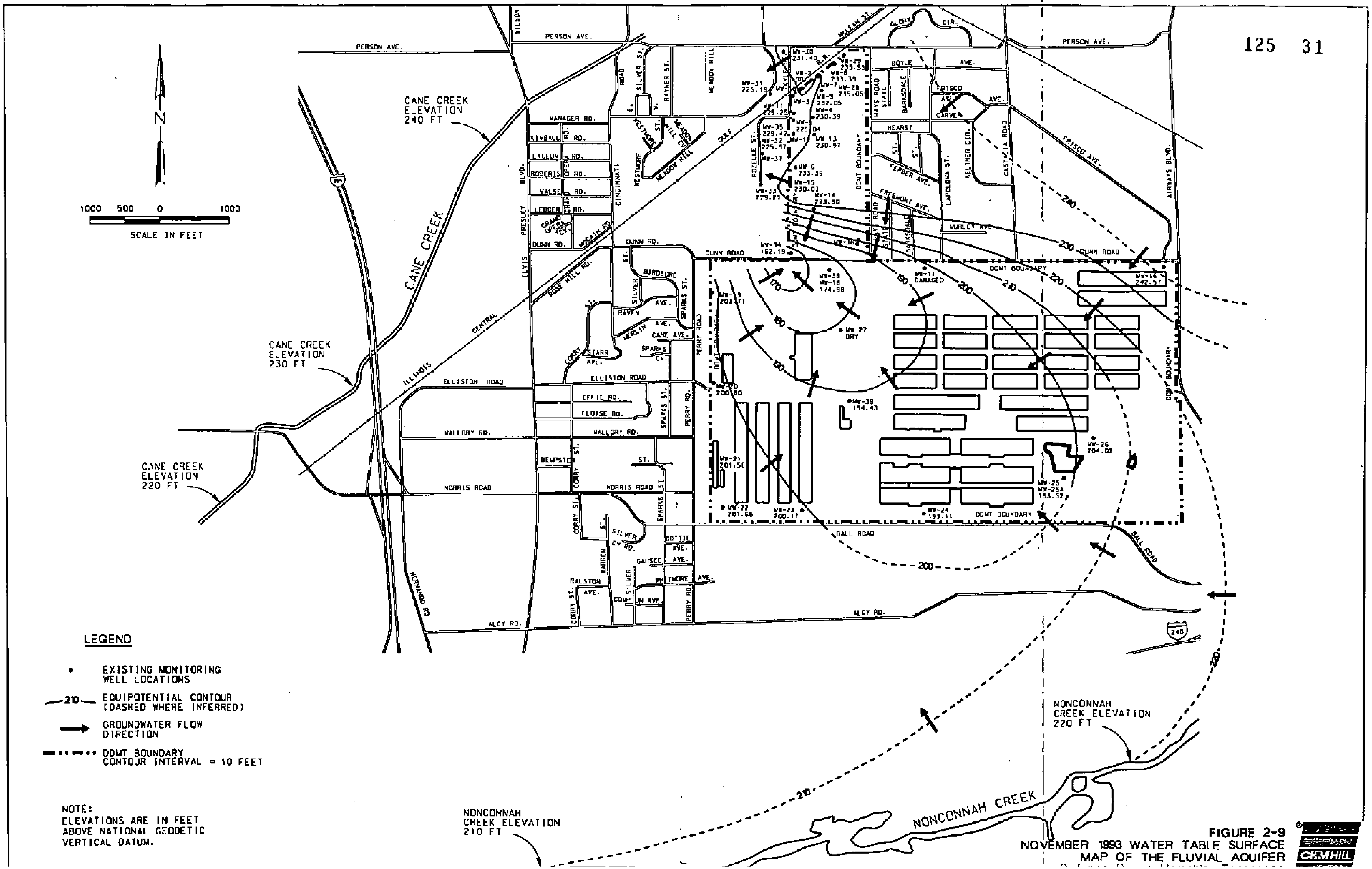


FIGURE 2-9
NOVEMBER 1993 WATER TABLE SURFACE
MAP OF THE FLUVIAL AQUIFER

2.8 Land Use

2.8.1 Surrounding Area

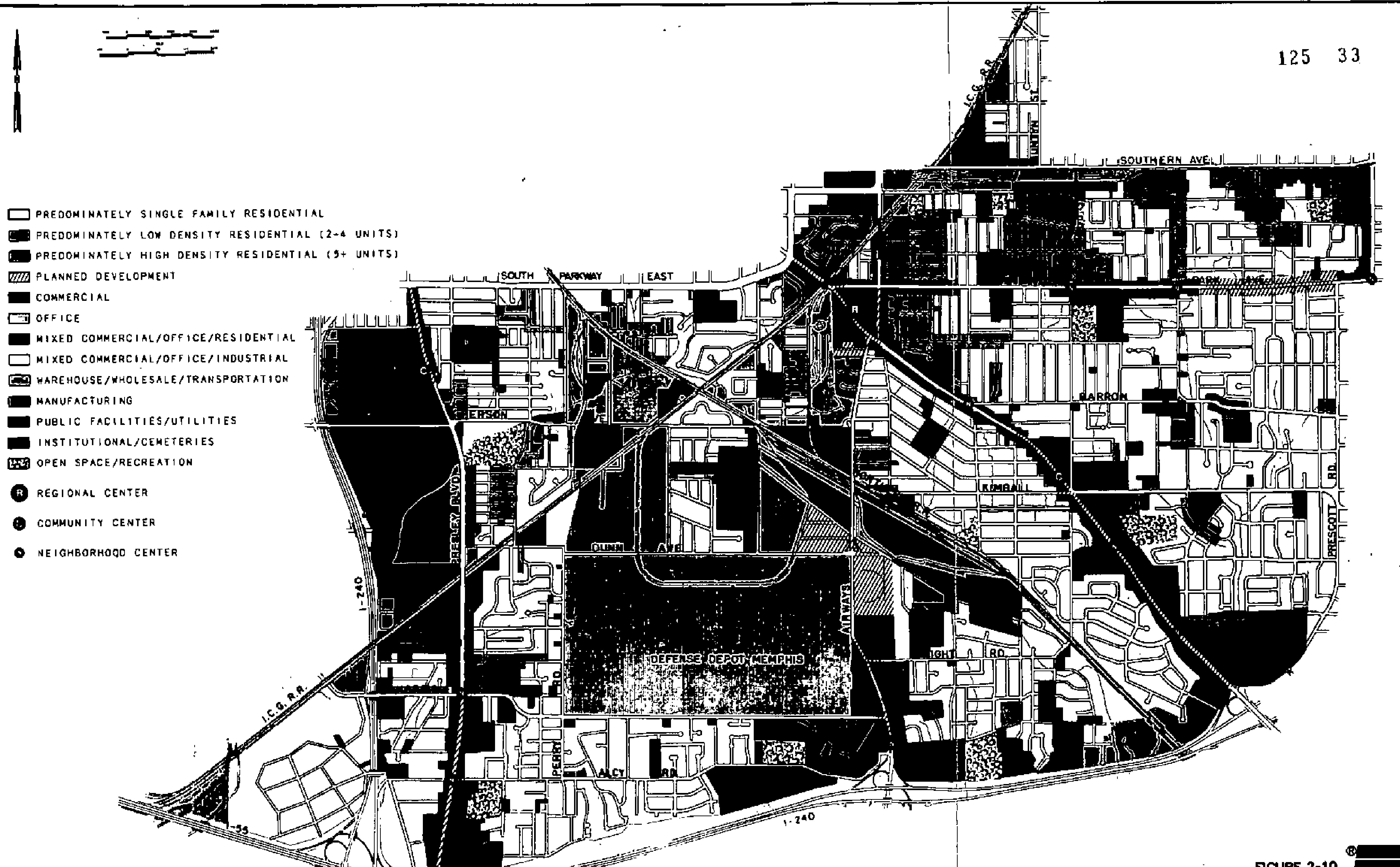
DDMT is located in south-central Memphis in an area of widely varying uses. Most of the land surrounding DDMT is intensely developed. To the north of DDMT are the rail lines of the Frisco Railroad and Illinois Central Gulf Railroad. Large industrial and warehousing operations are located along the rail 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 2-10 provides land use information for the area surrounding 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 3

OU-3 is characterized by a variety of uses: light industrial activities (maintenance, warehousing, facilities engineering shops, former gasoline station); administrative areas (headquarters building, parking lots, and other office buildings); recreational areas (golf course, swimming pool, picnic area); and a small family housing area for active duty military personnel. The most prominent features of OU-3 include 16 World War II vintage (a.k.a. "typical") warehouses used for bulk storage; 6 Korean War vintage (typical) warehouses used for bin storage; Lake Danielson and the Golf Course Pond; the DDMT Golf Course; and the administration, headquarters, and family housing areas. Most of the land area within OU-3 has been graded, paved, and heavily built up. The only vegetated areas are the perimeter areas (south of Buildings 690 and 490) and the majority of the southeast corner of OU-3 (Lake Danielson, the golf course, family housing area).



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

FIGURE 2-10
LAND USE
Defense Depot Memphis, Tennessee

2.9 History and Existing Data

A discussion of the history of activities and a summary of the existing data for the five RI sites in OU-3 are provided in Section 4.0. Sampling data for OU-3 was collected during the RI activities (ref. 10) in 1990 and during the ESE groundwater monitoring field effort (ref. 11). Details of the chemical analyses are provided in Appendix B.

The following activities either occur now or are reported to have occurred in the past at the RI sites:

- Storage of electrical transformers that contain PCBs
- Fire tank truck testing
- Pesticide and herbicide storage
- Pesticide and herbicide mixing and application

2.10 Operable Unit 3 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-3 sites is to characterize potential releases from the sites; assess the nature and extent of soil and groundwater contamination; identify sources of sediment contamination; collect data to support an evaluation of risk to human health and the environment; and gather data to evaluate the feasibility of remedial actions. The data gaps and information needed for OU-3 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-3
Defense Depot Memphis, Tennessee

Data Need/Use	Existing Data	Future Data Collection
Evaluate 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 and subsurface soil samples
Evaluate whether releases from a site have adversely affected Fluvial Aquifer groundwater quality	Sampling results from monitoring wells in OU-3	Sample existing wells; install and sample additional upgradient and downgradient monitoring wells, as necessary
Conduct a BRA for exposure to surface soils and/or sediments at the applicable RI sites	Some surface soil data from previous investigations	Collect a minimum number of surface soil and sediment samples for statistical comparisons
Investigate source areas for lake contaminants in sediments and fish	Some sampling data; fish tissue analysis from AEHA (ref. 2)	Collect surface water samples

AEHA = U.S. Army Environmental Hygiene Agency.
BRA = Baseline risk assessment.
OU-3 = Operable Unit 3.
RI = Remedial investigation.

TAB

Section 3 - Sampling Strategy for Operable Unit 3 Remedial Investigations

3.0 Sampling Strategy for Operable Unit 3 Remedial Investigation

This section describes the sampling strategy for OU-3 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 3 Investigation

This section is intended to give a detailed description of the overall strategy for the investigation of each RI site in OU-3. The approach presented is intended to support a decision to recommend one of the following options:

- Site upgrade (FS, Remedial Design, and RA)
- Site downgrade (support NFA)
- Interim Remedial Action (IRA) 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-3 includes soil (surface and subsurface), groundwater (Fluvial Aquifer), and surface water sampling. Surface soils and sediments will be sampled to assess the nature and the horizontal extent of contamination and to

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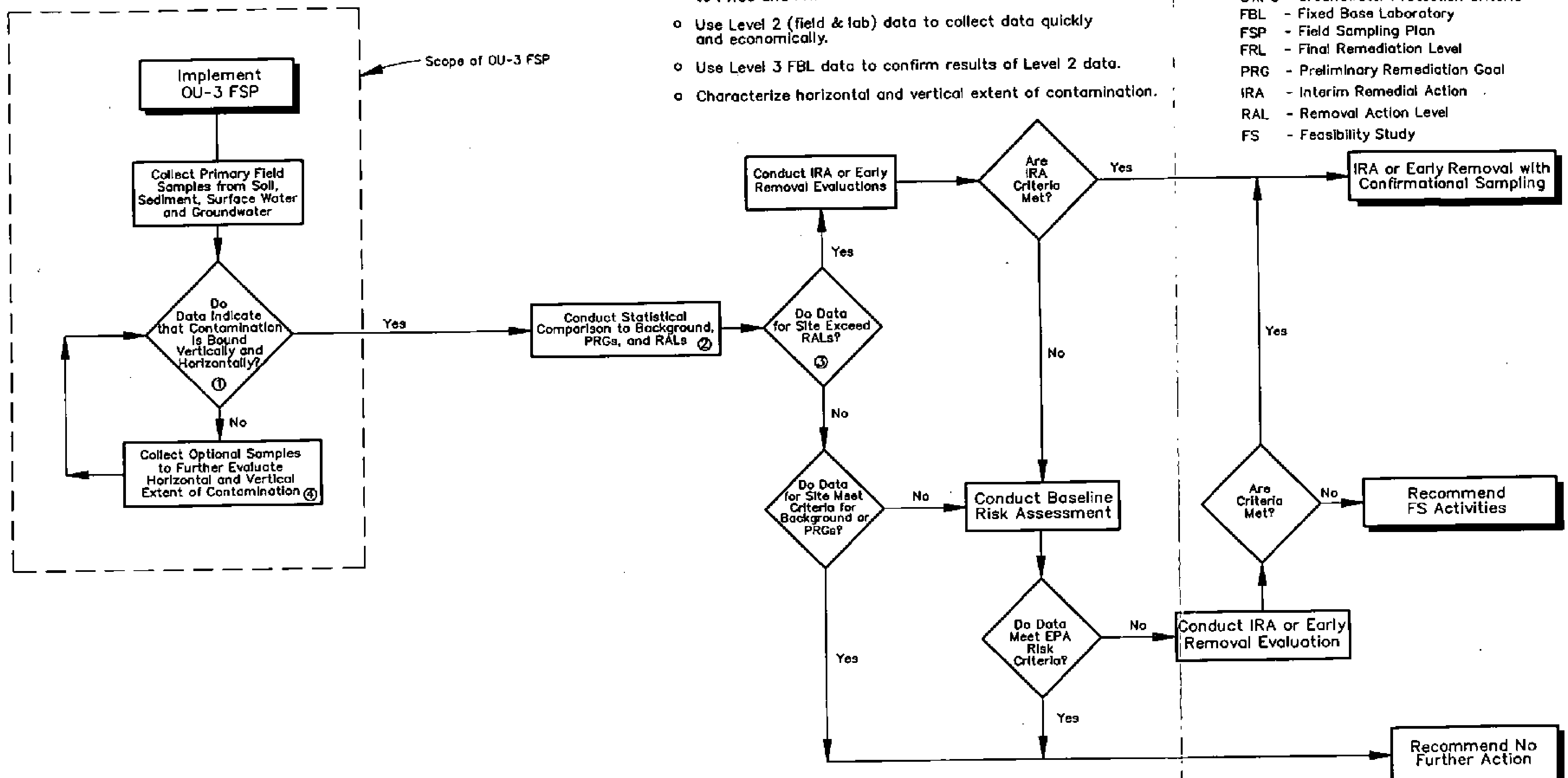

DQOs

- o Collect the specified samples for each exposure pathway (site specific) to conduct a statistically based comparison to PRGs and FRLs.
- o Use Level 2 (field & lab) data to collect data quickly and economically.
- o Use Level 3 FBL data to confirm results of Level 2 data.
- o 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 Generic RI/FS WP. Comparison criteria are developed using TSCL, RHBC, and GWPC, as well as 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 (soil borings, sampling, or monitoring wells) will not be initiated without prior approval of CEHND. Optional samples will be collected only after a field change request form is signed by CEHND.

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

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provide data for statistical comparison to background concentrations and PRGs. Subsurface soil samples will be collected to further assess the nature of contamination and the vertical extent of contamination. Surface water samples will help to assess the source of contaminants in the lake sediments and determine if the contaminants are being transported offsite by surface water. The existing monitoring wells will be sampled during the field investigation. Additional monitoring wells may be installed (future) if existing data or data collected during the field investigation of the RI sites indicate the need for further groundwater monitoring.

3.1.2 Approach

A phased approach is being used to implement the observational approach to the investigation of the RI sites. The RI sites to be investigated as part of this work plan are located in OU-3 in the southeastern quadrant of the Main Installation.

The focus of the approach to the RI site investigations at Site 48 (former PCB transformer storage area), Site 58 (Pad 267), and Site 59 (Building 273) is to assess the nature and the extent of potential soil contamination and to investigate whether there may have been releases that have adversely affected the quality of groundwater. The approach to the sampling at Site 25 (Golf Course Pond) and Site 26 (Lake Danielson) addresses the identification of potential contaminant sources only.

Primary samples, those that are planned with respect to location and depth, will be collected at each of the sites. If these samples indicate that 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 background or PRG concentrations of the parameters detected, whichever is higher. Background concentrations will be developed as described in the 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 if any optional samples are needed. Use of Level 2 (7- to 10-day turnaround) analyses will expedite this process. Additional samples may be needed if field personnel find visual evidence of contamination in areas that are not planned for sampling.

In OU-3, 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 locations 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 a concise presentation of strategy and to prevent redundancy.

Sample analysis activities include screening methods using 7- to 10-day turnaround analyses from a fixed-base laboratory (FBL) (Level 2 data quality). Level 3 quality sample analyses will be used to confirm the results of the Level 2 analyses. Three sites have been identified for RI in OU-3 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 for OU-3.

3.1.3 Field Screening

Field screening will provide soil and groundwater data that can be used to effectively investigate the site. The Level 2 data will be coupled with Level 3 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 may include any parameter of concern that is conducted on a 7- to 10-day turnaround time basis in the fixed laboratory using the project-specific Level 2 methodology.

- Level 3 analyses may include FBL analysis by standard approved methods for volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), metals, pesticides, herbicides, and PCBs.

The same analytical methods will be used for the Level 2 7- to 10-day turnaround FBL analyses as for the Level 3 FBL analyses. The primary difference will be the data package deliverable.

There is the potential for Level 4 data to be required in the future at this facility. Samples analyzed using Level 4 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-base 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 by 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 in this document.

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 RAs on a site with contamination covering a limited area may reduce costs because the investigation costs of performing a traditional FS will be eliminated. The RA evaluation will be conducted as a parallel effort to the initial field investigations at DDMT.

3.1.6 Primary and Optional Activities

Primary field activities include field sampling for surface and subsurface soil, pond sediments, surface water, and initial groundwater samples. These activities are planned with respect to location, depth, and parameters to be analyzed. The analytical results from soils and sediments, compared 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 Section 5.3.2 of the *Generic RI/FS WP* (ref. 3). Additional investigation (optional samples) may be necessary when data are not bound horizontally or vertically. Optional field work could include additional surface soil, subsurface soil, or sediment sampling, and installation and sampling of new monitoring wells.

By using the screening 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 decision-making process during the sampling activities. DQOs are developed according to the 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 actual site conditions.
- Provide reliable data results supported by quality control (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 decision-making 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 soil, subsurface soil, sediment, 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. The comparisons are 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.) When attempting to estimate the vertical and horizontal extent of contamination, additional soil or sediment samples 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 3.2.2.2, discusses the approach to assessing Level 2 data quality and usability. The goal is to collect Level 2 data of sufficient quality to be used for statistics and for baseline risk assessment (BRA).

- Level 2 data will be compared to 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. Information on the statistical 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 initial 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 data set will be used to establish background numerical criteria for each constituent of concern. The method for establishing this background numerical criteria is presented in Section 5.3.2 of the *Generic RI/FS WP*. Individual parameters detected at each location sampled as part of the RI activities will be compared to the background data set to assess whether contaminant concentrations indicate a release to the environment. 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 by 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 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. 12)

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 is provided in Section 3.5 of the *Generic RI/FS WP* and 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

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 Goal Options (RGOs)	Remedial goal options are typically developed during the baseline risk assessment to present risk managers with a range of possible target FRLs.
Removal Action Levels (RALs)	These are concentrations that trigger consideration of removal actions based on the potential for acute or long-term chronic effects.

as remedial alternatives are considered, federal and state requirements will be narrowed to those that are potential ARARs for each alternative.

3.5.2 Chemical-specific Threshold Concentrations

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

The screening PRGs developed 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. 12) and guidance from EPA Region IV. Region III publishes screening PRGs, and the table is updated semiannually. Region III PRGs were used for guidance in developing the PRGs. However, the screening values for DDMT are more conservative than the Region III values. The following factors were considered and led to the development of these screening PRGs for DDMT:

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

Remedial goal options (RGOs), consistent with EPA Region IV guidance, will be developed during the RI process and will provide a more realistic basis for the development of final remediation levels (FRLs). Also, a more detailed discussion of media-specific PRGs and the PRG tables are 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. 10), 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 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 would 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 a RAL) are identified, risk estimates are based on the average concentration (ref. 13). 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. 14). 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

Samples for each exposure medium (surface soil and sediment) will be collected at each site. A minimum number of samples is required to estimate a statistical mean for a data set. A total of nine is the recommended minimum because it is the smallest number of samples that can be used in an estimate of a statistical mean 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 mean is used to calculate a UCL95, which gives the upper confidence limit of a data set at 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

125 50

4.1 Sampling Summary

Section 4 describes the activities that will be conducted during the field investigation at OU-3. The activities support the investigative strategy described in Section 3 of this report. The proposed sampling plans for OU-3 include surface soil samples, subsurface soil samples, sediment samples, surface water samples, and groundwater samples from the Fluvial Aquifer. The primary Level 2 and 3 samples that will be collected at Sites 25, 26, 48, 58, and 59 are summarized in Table 4-1. The relationship between primary and optional samples is described in Section 3.1. Further information on the samples that will be collected, including QC samples and analytical methods, is described in the following sections. A brief discussion of the types of QC samples that will be collected is provided in Section 5.5. The proposed samples have been specified on the basis of location and sample matrix. 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 25: Golf Course Pond

4.2.1 Site Description

The Golf Course Pond is an unlined, manmade pond approximately 75 ft wide and 125 ft long with an earthen dam. This site is located in the northeast corner of the DDMT Golf Course, just south of Building 270 (Figure 4-1). The site is currently listed as an FS site; however, sampling will occur as part of the RI effort to identify source areas of contamination.

4.2.2 Site History

The Golf Course Pond has been in existence since the 1940s. The pond receives surface water runoff from the golf course and the southeast portion of the installation. Storm water enters the pond in one of two ways: through overland flow from the surrounding land area and through 8-inch-diameter and 36-inch-diameter storm water drainage pipes. Overflow from this impoundment flows to an open, concrete-lined storm drain that eventually drains into Nonconnah Creek, a tributary of the Mississippi River.

4.2.3 Existing Data

In 1986, the U.S. Army Environmental Hygiene Agency (USAEHA) conducted a water quality biological survey on both Lake Danielson and the Golf Course Pond. The results

Table 4-1
Samples to Be Collected by Site in OU-3
Defense Depot Memphis, Tennessee

	Site Number				
	25*	26*	48	58	59
Surface Soil					
VOC			5		
PAH					9
Pest./PCB			5	9	9
Herbicides				9	9
TCL/TAL			1	1	1
Subsurface Soil					
VOC					
PAH					5
Pest./PCB					5
Herbicides					5
Metals					
TCL/TAL					
Groundwater					
TCL/TAL			1		
Surface Water					
Pest./PCB	14	14			
Metals	14	14			
TSS/TOC	8	8			
TCL/TAL	2	2			
Sediment					
Pest./PCB					
Metals					
Misc.					
TCL/TAL					

*Listed as a Feasibility Study site. Sampling for source identification only.

Herbicides = Analysis by SW 846 Method 8150.
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. Suface water samples will be analyzed for total and disolved metals. Groundwater samples will be analyzed for total metals only.
PAH = Polynuclear aromatic hydrocarbon. Analysis by SW 846 Method 8100.
Pest./PCB = Pesticide/polychlorinated biphenyl. Analysis by a modified SW 846 Method 8080.
QC = Quality control.
TCL/TAL = Target compound list/target analyte list.
TOC = Total organic carbon. Analysis by EPA Method 415.1.
TSS = Total suspended solids. Analysis by EPA Method 160.2.
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 4-6).

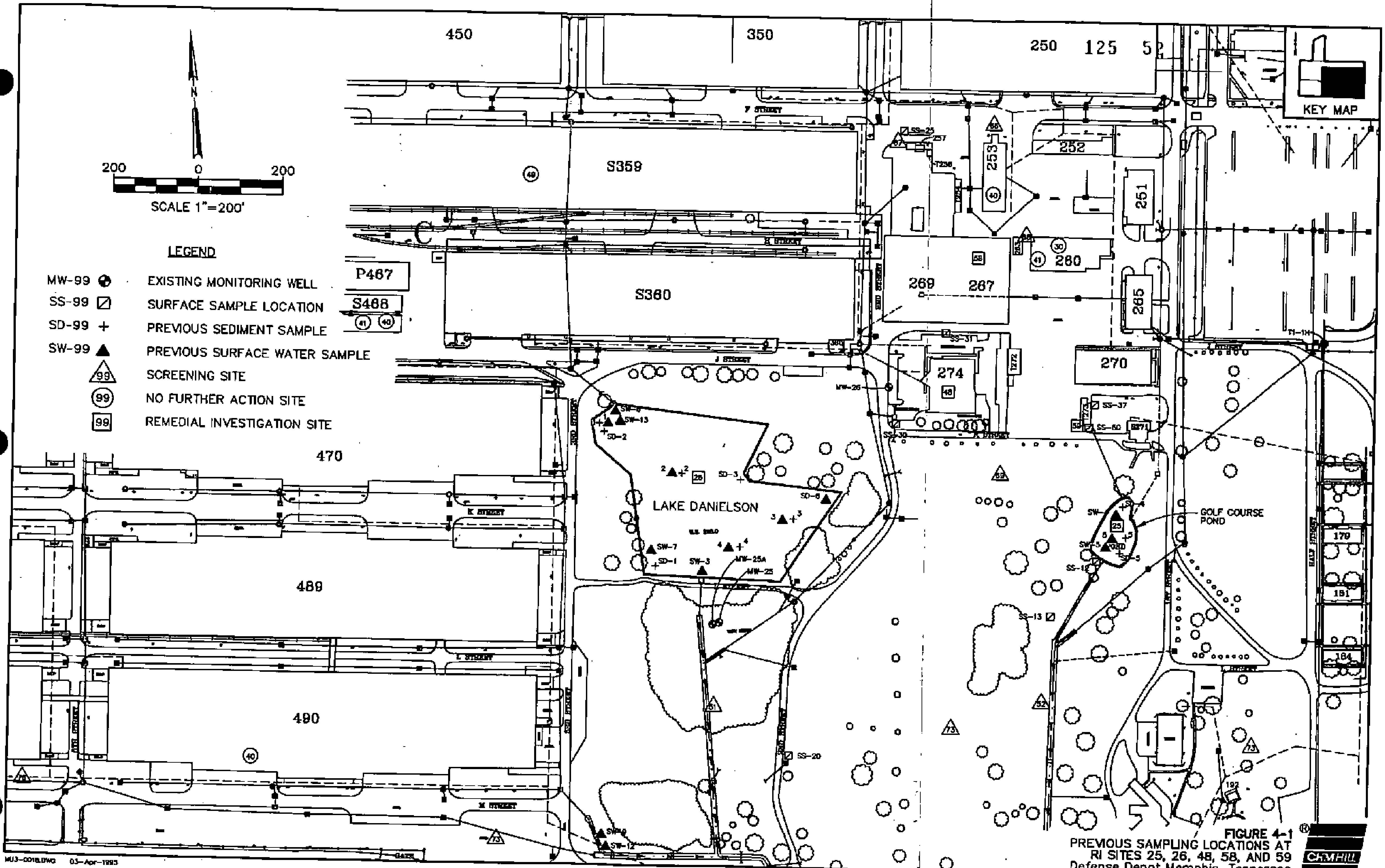

FIGURE 4-1
PREVIOUS SAMPLING LOCATIONS AT RI SITES 25, 26, 48, 58, AND 59
Defense Depot Memphis, Tennessee

CH2M HILL

of the water analysis from this study indicated that the pond water was generally free of the tested analytes (metals, semivolatiles, and pesticides) (Appendix B, ref. 2). Sediment analysis from the pond detected several metals and pesticides. However, since both the metals and pesticides were not detected in the accompanying surface water samples, this study concluded that the contaminants appeared to be accumulating in the sediments without being a water quality problem (ref. 2). Fish tissue samples from goldfish in the Golf Course Pond exhibited pesticide (dichlorodiphenyltrichloroethane [DDT] and its breakdown products) and PCB residues. Because of the levels of pesticides observed in the fish tissue analysis, the USAEHA study recommended that fish from the Golf Course Pond not be consumed (ref. 2). In addition, surface water, sediment, and surface soil samples were also collected during the 1990 RI activities (ref. 10). The results of this study were in agreement with the USAEHA study and the analytical results are provided in Appendix B. Figure 4-1 shows the previous sampling locations at the Golf Course Pond and in OU-3.

4.2.4 Potential Contaminants of Concern

Review of the site history and the previous sampling analytical results indicates that the potential contaminants of concern (COCs) are metals, pesticides, and PCBs.

4.2.5 Data Gaps and Site-specific Data Quality Objectives

Site 25
Data Gaps and DQOs
Defense Depot Memphis, Tennessee

Data Gaps	DQOs
Source of sediment contamination	Evaluate whether contamination is from the storm water collection system or area runoff by sampling surface water during rainfall events
	Collect at least one TCL/TAL sample to access whether other unknown contamination is present in storm water runoff

4.2.6 Soils Sampling and Analysis

Site 25 is proposed for FS as a result of known contamination. No soil sampling and analyses are currently proposed for this site.

4.2.7 Groundwater Sampling and Analysis

Groundwater contamination as a result of leaching from the sediment in the Golf Course Pond is not suspected. The COCs are pesticides, PCBs, and metals, which have low mobility in soils. If contamination has leached form the sediments, it would likely be bound in the soils beneath the pond. Furthermore, the bottom of the pond may be sealed, so no aqueous phase contaminants could be transported vertically to the groundwater. Therefore, sampling of monitoring wells is not proposed for this site.

4.2.8 Surface Water Sampling and Analysis

Surface water samples will be collected from the two storm water inlets and two other runoff sources to the Golf Course Pond to help assess if sediment contamination may have resulted from transport of contaminants through the storm water collection system.

Storm water samples will be collected at the closest manhole to where the storm water inlets discharge to the Golf Course Pond (2 inlets) during two separate storm events with more than 0.2 inches of rainfall. A total of eight grab samples will be collected (2 events x 4 locations). Both filtered (0.45-micrometer [μm] glass fiber filter) and unfiltered samples will be analyzed for Level 3 pesticides/PCBs and metals. This approach will allow an evaluation of whether detected contaminants are associated with the suspended particles or are in a dissolved phase. Each sample will be collected to coincide with the first flush of storm water from the collection system. This will provide the greatest likelihood of detecting the highest levels of contamination that may be transported to the pond by the collection system. Specific analyses are listed in Table 4-2.

Contaminants that have been found in Golf Course Pond sediments and fish tissue may have been the result of spillage from DDMT industrial areas that was then transported into the storm water sewer system (and eventually into the pond) by precipitation. Taking surface water samples after a rainfall event at the pond will help assess if there is still an active source for the contaminants of interest (pesticides, PCBs, metals) in the industrial areas. Presence of an active source will be indicated if surface water samples have concentrations above background concentrations and PRGs. If it is suspected that an active source may still be present, a more extensive monitoring plan will need to be initiated for the DDMT storm sewer system to evaluate the source(s) of contamination. This will be performed during a later phase of field investigation at DDMT.

4.2.9 Sediment Sampling and Analysis

No sediment sampling and analysis are proposed for Site 25. Site 25 may require FS sampling as part of a future effort.

4.3 Site 26: Lake Danielson

4.3.1 Site Description

Lake Danielson consists of an unlined, manmade pond approximately 4 acres in surface area and approximately 15 ft deep at the deepest point. The lake is located at the

Table 4-2
Collection and Analysis of Site 25 Samples (by Media)
Golf Course Pond
Defense Depot Memphis, Tennessee

Media	Description	Level 3			
		Pest./PCB[a]	Metals[b]	Misc.[c]	TCL/TAL[d]
Surface Soil	None				
QC					
Surface Water[e]	4 locations x 2 sampling events; (filtered/unfiltered)	14	14	8	2
QC	FB, FD	EB, MS/MSD	FB, FD, EB, MS/MSD	EB,FB,MS/MSD	
Sediment	None				
QC					

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).
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix).
PAH = Polynuclear aromatic hydrocarbon.
Pest./PCB = Pesticide/polychlorinated biphenyl.
QC = Quality control.
TB = Trip blank (1 per day per cooler containing VOCs.
TCL/TAL = Target compound list/target analyte list.
TOC = Total organic carbon.
TSS = Total suspended solids.
VOC = Volatile organic compound.

Notes:
[a] Pesticides/PCBs will be analyzed by a modified SW 846 Method 8080.
[b] 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). Groundwater samples will be analyzed for total metals only. Dissolved metal samples will not be collected.
[c] TSS will be analyzed by EPA Method 160.2. TOC will be analyzed by Method 415.1.
[d] TCL/TAL analysis will include the CLP methods for VOCs, SVOCs, pesticides/PCBs, and metals.
[e] Both filtered and unfiltered analyses are required for Pest./PCB and Metals.

northwest corner of the golf course, just east of Buildings 470 and 489 (Figure 4-1). The site is currently listed as an FS site; however, sampling will occur as part of the RI effort to identify source areas of contamination.

4.3.2 Site History

Lake Danielson receives storm water runoff from the central area (approximately 65 acres) of DDMT. Major facilities within this area include the majority of the 20 typical warehouse areas, Building 359 and 360, and part of Building 559. The ground cover in the catchment area is mostly impervious (i.e., paved or built up). Storm water from the catchment area enters Lake Danielson via a 48-inch-diameter pipe in the northwest corner of the lake. A smaller amount of storm water is contributed via overland flow from the area immediately surrounding Lake Danielson (ref. 5). Previous uses of Lake Danielson date back to the 1940s when the lake was used for fire tank truck testing and recreational purposes. Fire tank truck testing consisted of fire trucks withdrawing water from the reservoir, testing various equipment (pumps, hoses, instruments), and discharging the water back into Lake Danielson. Recreational use of Lake Danielson (fishing) was discontinued after the results of the 1986 USAEHA study were published (ref. 2). Overflow from this impoundment flows to an open, concrete-lined storm drain that eventually drains into Nonconnah Creek, a tributary of the Mississippi River.

4.3.3 Existing Data

Existing data from Lake Danielson consist primarily of surface water, sediment, and fish tissue (catfish) samples taken during the USAEHA study (ref. 2) and surface water and sediment samples (Figure 4-2) taken during the 1990 RI activities (ref. 10). The only parameter detected in the surface water during the USAEHA study was the pesticide DDT at USAEHA Sample Site 1 (located at the storm water influent to the lake). This sample was taken after a rainfall event. SW-13 was taken at the same location during RI activities and did not detect DDT (ref. 10). The sediment data from both studies indicated the presence of pesticides (DDT, chlordane) and metals. However, comparison of the contaminant data (metals and pesticide concentrations) in the surface water and sediments indicates that the metals and pesticides appear to be effectively bound up in the sediments and do not pose a water quality problem. Analytical results from previous sampling activities around Site 26 are provided in Appendix B. The water quality during rainstorms is largely unknown because influent flows may cause turbidity in lake sediments. Fish tissue (catfish) samples taken from Lake Danielson during the USAEHA study indicated the presence of pesticides (DDT and its breakdown products, chlordane, chlorpyrifos, and dieldrin) and PCBs, resulting in a recommendation to prohibit fish consumption (and fishing) from Lake Danielson.

Monitoring well MW-25 was installed near Lake Danielson during the RI activities to assess whether contaminants from the lake have affected groundwater. Analytical results of previous sampling indicate elevated levels of tetrachloroethene. After review of the

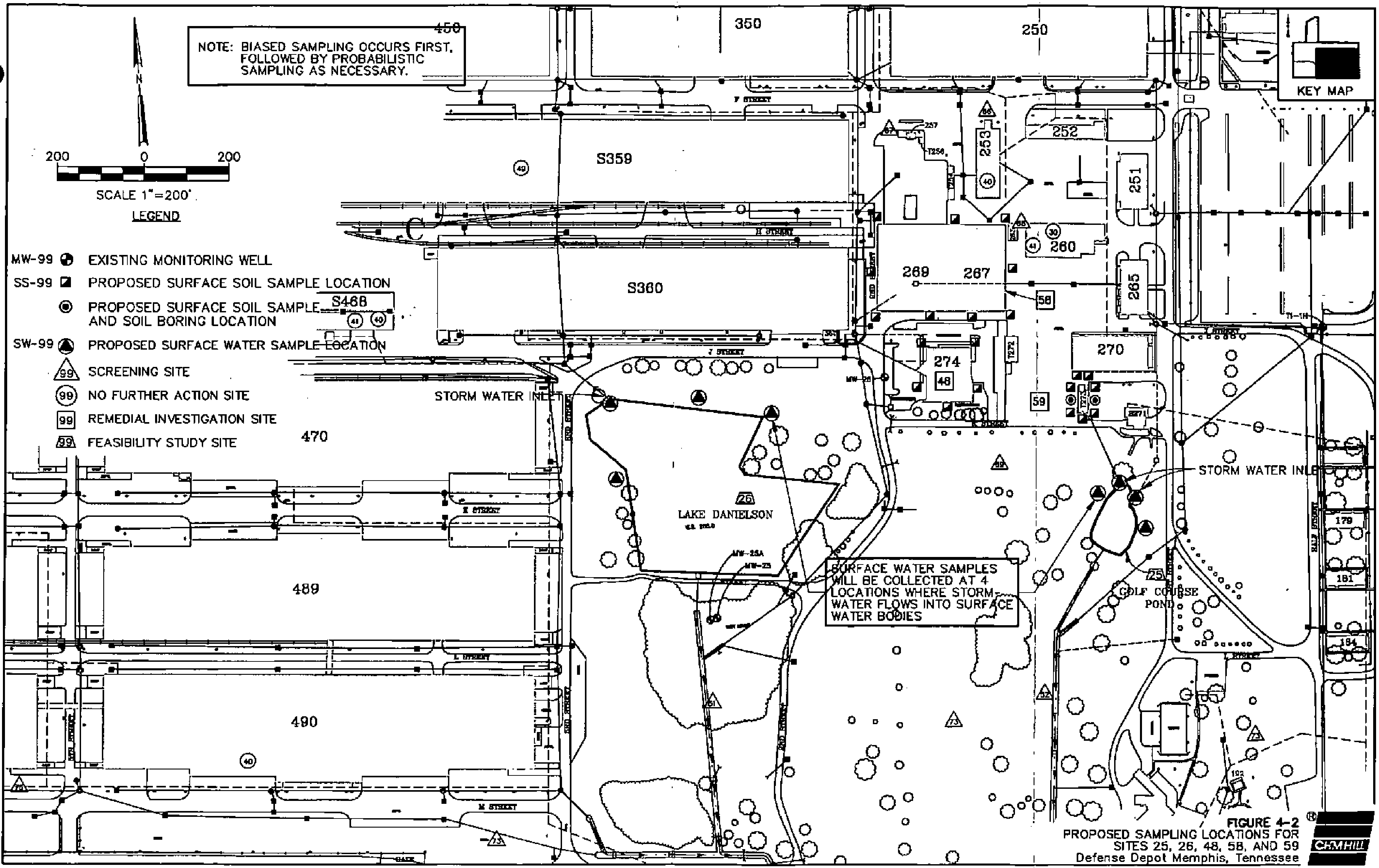

FIGURE 4-2
PROPOSED SAMPLING LOCATIONS FOR SITES 25, 26, 48, 58, AND 59
Defense Depot Memphis, Tennessee

MU3-0019.DWG 28-Sept-1995

November 1993 water table surface map (Figure 2-9), MW-25 was found to be cross-gradient of Lake Danielson. The VOC contamination may be from offsite sources.

4.3.4 Potential Contaminants of Concern

Review of the site history and previous sampling analytical results indicates that the potential COCs are metals, pesticides, and PCBs. VOCs were not included as a COC because the parameters detected in soil were methylene chloride and acetone, and detections were near or below quantitation limits. The compounds are common laboratory contaminants, and their detection was not likely representative of field conditions.

VOCs were detected in MW-25; an offsite source of VOCs is suspected. This will be investigated by installing Fluvial Aquifer monitoring wells (one upgradient of MW-25 and one upgradient of MW-26) along the DDMT facility boundary. The installation of these wells and the sampling that will be performed is addressed in the *OU-4 FSP* (ref. 15).

4.3.5 Data Gaps and Site-specific Data Quality Objectives

Site 26
Data Gaps and DQOs
Defense Depot Memphis, Tennessee

Data Gaps	DQOs
Source of sediment contamination	Evaluate whether contamination is from the storm water collection system or area runoff by sampling surface water during rainfall events
Offsite, upgradient groundwater quality	Collect groundwater data at DDMT facility boundary upgradient of the site (*OU-4 FSP*)
	Collect at least one TCL/TAL sample to assess whether other unknown contamination is present in storm water runoff

4.3.6 Soils Sampling and Analysis

Site 25 is proposed for FS as a result of known contamination. No soil sampling is currently proposed for this site.

4.3.7 Groundwater Sampling and Analysis

Monitoring well MW-25 was installed near Lake Danielson during the RI activities to assess whether contaminants from the lake have affected groundwater. Analytical results of previous sampling indicate elevated levels of tetrachloroethene. After review of the

November 1993 water table surface map (Figure 2-9), MW-25 was found to be cross-gradient of Lake Danielson. The VOC contamination may be from offsite sources.

Groundwater contamination as a result of leaching from the sediment in Lake Danielson is not suspected. The COCs are pesticides, PCBs, and metals, which have low mobility in soils. If contamination has leached from the sediments, it would likely be bound in the soils beneath the lake. Furthermore, the bottom of the lake may be sealed, so no aqueous phase contaminants could be transported vertically to the groundwater. Therefore, no groundwater sampling is proposed for the site.

4.3.8 Surface Water Sampling and Analysis

Surface water samples will be collected from the storm water inlet and three other potential source locations to Lake Danielson to evaluate whether contamination found in the sediments may have resulted from transport of contaminants from specific areas in OU-3.

Storm water samples will be collected at the closest manhole (or discharge point) to where the storm water discharges to Lake Danielson (1 inlet) during two separate storm events with more than 0.2 inches of rainfall. A total of eight grab samples will be collected (2 events x 4 locations). The location of the inlet to Lake Danielson is shown in Figure 4-2. Both filtered (0.45-μm glass fiber filter) and unfiltered samples will be analyzed for Level 3 pesticides/PCBs and metals. This approach will provide information on whether detected contaminants are associated with the suspended particles or are in a dissolved phase. Each sample will be collected to coincide with the first flush of storm water from the collection system. This will provide the greatest likelihood of detecting the highest levels of contamination that may be transported to the lake by the collection system. Specific analyses are listed in Table 4-3.

Contaminants found in Lake Danielson during previous studies indicate that the source of contaminants in the sediments and the fish tissue may have been the result of spillage from DDMT industrial areas that was then transported into the storm water sewer system (and eventually into the lake) by precipitation.

Taking surface water samples after a rainfall event at the lake inlet will help evaluate whether there is an active source for the contaminants of interest (pesticides, PCBs, metals) in the industrial areas. Presence of an active source will be indicated if surface water samples have concentrations above background concentrations and PRGs. If it is suspected that an active source may still be present, a more extensive monitoring plan will need to be initiated for the DDMT storm sewer system to evaluate the source(s) of contamination. This will be performed during a later phase of field investigation at DDMT.

Table 4-3
Collection and Analysis of Site 26 Samples (by Media)
Lake Danielson
Defense Depot Memphis, Tennessee

Media	Description	Level 3			
		Pest./PCB[a]	Metals[b]	Misc.[c]	TCL/TAL[d]
Groundwater	None				
QC					
Surface Soil	None				
QC					
Surface Water[e]	4 locations x 2 sampling events	14	14	8	2
QC		EB, MS/MSD	EB, MS/MSD	EB, FB, MS/MSD	EB, FB, MS/MSD
Sediment	None				
QC					

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).
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix).
Pest./PCB = Pesticide/polychlorinated biphenyl.
QC = Quality control.
SS = Split sample.
TB = Trip blank (1 per day per cooler containing VOCs).
TCL/TAL = Target compound list/target analyte list.
TOC = Total organic carbon.
TSS = Total suspended solids.

Notes:
[a] Pesticides/PCBs will be analyzed by a modified SW 846 Method 8080.
[b] 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). Surface water samples will be analyzed for total and dissolved metals.
[c] TSS will be analyzed by EPA Method 160.2; TOC will be analyzed by a modified EPA Method 415.1.
[d] TCL/TAL analysis will include the CLP methods for VOCs, SVOCs, pesticides/PCBs, and metals.
[e] Total and dissolved samples will be collected to assess nature of contamination.

4.3.9 Sediment Sampling and Analysis

No sediment sampling and analyses are proposed for Site 26. Sediment sampling may occur as part of future FS activities.

4.4 Site 48: Former PCB Transformer Storage Area

4.4.1 Site Description

This site is a former storage location of electrical transformers containing PCBs. The site is located west of Building T-272 (Figure 4-1). Building 274 is located on this site and was constructed after the transformer storage had ceased. The location of the site in OU-3 is shown in Figure 4-1.

4.4.2 Site History

This site has been reported as the former storage location of at least two electrical transformers. Testing of the fluid in the transformers indicated a concentration of less than 50 parts per million (ppm) of PCBs (refs. 16 and 17). These transformers were discovered during the Installation Assessment conducted in March 1981 (ref. 17). The site's date of initial operation is unknown but assumed to be 1981. Activities ceased in the mid-1980s because the new DDMT cafeteria was constructed at this site.

4.4.3 Existing Data

Two soil samples were taken next to the perimeter during the 1990 RI activities (ref. 10). These samples exhibited PAHs and pesticides (DDT plus breakdown products). All of the PAHs detected were below the reporting limits for the analysis. PCBs were not detected in surface soil samples or in the downgradient groundwater samples collected from MW-26 during the RI (ref. 10) and the November 1993 groundwater monitoring event (ref. 11). However, tetrachloroethane and carbon tetrachloride were detected in MW-26 samples at levels near or slightly above maximum contaminant levels (MCLs) during both the RI (ref. 10) and the November 1993 sampling event (ref. 11).

4.4.4 Potential Contaminants of Concern

Review of previous activities at the site and historical analytical results indicate that the potential COCs at this site are VOCs, pesticides, and PCBs. VOCs are included because elevated levels were detected during previous groundwater sampling in the vicinity of the site, and pesticides are included because elevated levels were previously detected in nearby soil samples. PCBs are included because of the storage of PCB-contaminated transformers. However, no PCBs have been detected during previous sampling.

4.4.5 Data Gaps and Site-specific Data Quality Objectives

Site 48 Data Gaps and DQOs Defense Depot Memphis, Tennessee	
Data Gaps	**DQOs**
Horizontal extent of potential soil contamination	Assess the horizontal extent of potential 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 to assess whether other unknown contamination is present

4.4.6 Soils Sampling and Analysis

Soil samples will be collected to assess the horizontal extent of potential soil contamination from past activities in the area of Site 48 (Building 274). The details of the sampling plan for Site 48 are shown in Table 4-4. Biased surface soil samples will be collected to evaluate contaminants and to make comparisons to background concentrations and PRGs. Field personnel will survey the area around the site for indicators of contamination (i.e., stained soil, distressed vegetation). Where areas of concern are found, a surface soil sample will be collected and analyzed by Level 2 methods for VOCs and pesticides/PCBs. Five surface locations will be sampled at a depth of 0 to 12 inches below land surface (bls). The samples will be collected beneath any gravel or pavement that may be present. Sampling locations are shown in Figure 4-2.

Optional surface soil samples and optional soil borings may be performed, if initial sampling indicates contamination, to further investigate the extent of contamination. These sample locations will be chosen through review of the analytical results obtained from the primary soil sampling locations. The optional borings will include additional samples from depths of 10 and 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.

Soil samples obtained from Site 48 will be analyzed for Level 2 VOCs and pesticides/PCBs. The soil sampling plan for Site 48 is detailed in Table 4-4. Duplicate soil samples will be collected at each sampling point to provide a sample for possible Level 3 (confirmational) analysis. A minimum of 10 percent of the Level 2 samples will have a duplicate sent for Level 3 confirmational analysis. Selection of the samples for Level 3 analysis will be determined by the field team leader or site hydrogeologist. The

Table 4-4
Collection and Analysis of Site 48 Samples (by Media)
Former PCB Transformer Storage Area
Defense Depot Memphis, Tennessee

Media	Description	Level 2		Level 3		
		Pest./PCB[a]	VOCs[b]	TCL/TAL[c]	Pest./PCB[a]	VOCs[b]
Groundwater	1 existing well (MW-26)			1		
QC	See Table 4-3			TB, FB, EB, MS/MSD, SS		
Surface Soil	5 locations	5	5	1		
QC		EB,FB, MS/MSD	TB,EB,FB, MS/MSD	TB, EB, FB, MS/MSD, SS		
Subsurface Soil	None					
QC						

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 =
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix).
PAH = Polynuclear aromatic hydrocarbon.
Pest./PCB = Pesticide/polychlorinated biphenyl.

QC = Quality control.
SS = Split sample.
TB = Trip blank (1 per day per cooler containing VOCs).
TCL/TAL = Target compound list/target analyte list.
VOC = Volatile organic compound.

Notes:
[a] Pesticides/PCBs will be analyzed by a modified SW 846 Method 8080.
[b] VOCs will be analyzed by SW 846 Method 8240.
[c] TCL/TAL analysis will include the CLP methods for VOCs, SVOCs, pesticides/PCBs, and metals. Groundwater samples will be analyzed for total metals only. Dissolved metals samples will not be collected and analyzed for groundwater.

determination will be based on field screening results. One surface soil location will be analyzed for TCL/TAL parameters to assess the presence of any contamination not previously found. Field screening results 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 the *QAPP* and are indicated in Table 4-4.

4.4.7 Groundwater Sampling and Analysis

Information on whether releases from the site have affected groundwater quality in the vicinity of Site 48 will be obtained by sampling the Fluvial Aquifer. Downgradient groundwater quality will be monitored by sampling MW-26. Analytical testing will include a full scan for TCL/TAL.

Groundwater from MW-26 will be sampled in accordance with standard groundwater sampling practices outlined in Section 5.1 of the *QAPP*. Each groundwater sample will be sent offsite for Level 3 TCL/TAL analysis as shown in Table 4-4.

4.5 Site 58: Pad 267 (Pesticides, Herbicides)

4.5.1 Site Description

Pad 267 refers to a concrete slab area approximately 150 ft by 200 ft that was formerly the site of Building T-267, the Pesticide Shop. The site is located north of Building 274 (Figure 4-1).

4.5.2 Site History

Past uses of Pad 267 include the storage and mixing of pesticides and herbicides that were applied to DDMT grounds by DDMT Entomology Division personnel. Dates of operation for the shop are unknown but are possibly from the 1940s to the mid-1980s. The Installation Assessment (ref. 17) documented that rinse water from pesticide and herbicide spraying operations was dumped on the ground near the facility up until late 1980. The specific location where rinse water was dumped is unknown. After that time, the rinse water was held for the mixing of later batches. Past pesticide and herbicide spray operations at DDMT generally included 2,4-D on grassy areas, Monuron on railroad track areas, pyrethrum in textile warehouses, Hy-Var-X in gravel areas, and phostoxin (aluminum phosphide) for stack and transit fumigation (ref. 17). The USAEHA Environmental Audit of DDMT (ref. 18) conducted in 1985 indicated that all pesticide operations at DDMT were transferred to Building 737 and that Building T-267 (Pesticide Shop) was demolished, thus resulting in Pad 267.

4.5.3 Existing Data

Previous investigations did not characterize potential soil contamination at this site. MW-26 was installed in the Fluvial Aquifer near this site during RI activities (ref. 10). Based on groundwater flow direction as shown on the November 1993 water table surface map (Figure 2-9), MW-26 is likely to be cross-gradient of Site 58. Analyses of groundwater samples from MW-26 detected VOCs and metals. Metals concentrations were close to levels found in other monitoring wells.

4.5.4 Potential Contaminants of Concern

Based on the activities that occurred at the site, the potential COCs are pesticides and herbicides. The history of Site 58 indicates that a variety of specific pesticides and herbicides was used. Other than 2,4-D, each of the listed chemicals either is not persistent in the environment (degrades quickly) or has no approved analytical methods available by which it could be detected. Analysis for pesticides and herbicides will include approved methods that cover chemicals that are persistent in the environment and present an environmental hazard. The analytical methods that will be used for pesticides and herbicides are indicated in Table 4-5.

The metals and VOCs detected in MW-26 are assumed to be from another source. None of the activities at Site 58 would have presented the possibility of release of VOCs or metals. Furthermore, the location of MW-26 is cross-gradient of the site, so contaminant levels in the groundwater at MW-26 would not necessarily represent groundwater quality at Site 58. VOCs detected in MW-26 may be from an offsite source. The quality of groundwater entering DDMT from offsite will be investigated through installation of a Fluvial Aquifer monitoring well upgradient of the RI sites in OU-3 along the DDMT facility boundary (ref. 15). The installation and sampling of this new upgradient well is addressed in the *OU-4 FSP*.

4.5.5 Data Gaps and Site-specific Data Quality Objectives

Site 58
Data Gaps and DQOs
Defense Depot Memphis, Tennessee

Data Gaps	DQOs
Presence of soil contamination	Assess presence 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
	Collect at least one TCL/TAL sample to assess whether other unknown contamination is present

Table 4-5
Collection and Analysis of Site 58 Samples (by Media)
Pad 267
Defense Depot Memphis, Tennessee

Media	Description	Level 2		Level 3		
		Pesticides[a]	Herbicides[b]	TCL/TAL[c]	Pesticides[a]	Herbicides[b]
Surface Soil	9 locations	9	9	1		
QC		EB,FB,MS/MSD	EB,FB,MS/MSD	TB, EB, FB, MS/MSD		
Subsurface Soil	None					
QC						

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
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix, if collected within 14 days).
QC = Quality control.
TB = Trip blank (1 per day per cooler containing VOCs).
TCL/TAL = Target compound list/target analyte list.

Notes:
[a] Pesticides will be analyzed by a modified SW 846 Method 8080.
[b] Herbicides will be analyzed by SW 846 Method 8150.
[c] TCL/TAL analysis will include the CLP methods for VOCs, SVOCs, pesticides/PCBs, and metals.

4.5.6 Soils Sampling and Analysis

To evaluate whether contamination exists at this site, surface soil samples will be collected. Nine surface soil samples will be collected from the systematic locations identified in Figure 4-2. Because the exact location of releases is not known, samples will be taken across the entire area of potential contamination. A significant amount of this area has been paved, so surface soil samples will be collected from unpaved areas nearest the locations indicated in Figure 4-2. The samples will be from the upper 12 inches of the soil beneath any gravel that may be present. These samples will be analyzed for Level 2 pesticides and herbicides. One duplicate surface soil sample will be analyzed for Level 3 TCL/TAL to assess whether any other contamination is present at the site.

Optional soil samples may be collected if the field screening results indicate that additional samples are required to evaluate the extent of contamination present at the site. Sample locations will be determined by review of the analytical results obtained from the primary sampling locations. Optional soil borings will include additional samples from depths of 10 and 20 ft bls.

Additional samples may also be collected from areas where there is visual evidence of contamination. Field personnel will survey the area for indicators of contamination such as stained soil or distressed vegetation. If an area of possible contamination is found, a surface soil sample will be collected and analyzed by Level 2 methods for pesticides and herbicides. The field team leader will use the results to decide whether additional surface soil samples or soil borings are needed.

The soil sampling plan for Site 58 is detailed in Table 4-5. Duplicate soil samples will be collected at each sampling point to provide a sample for possible Level 3 (confirmational) analysis. A minimum of 10 percent of the Level 2 samples will have a duplicate sent for Level 3 confirmational analysis. Selection of the samples for Level 3 analysis will be determined by the field team leader or site hydrogeologist. The determination will be based on field screening results. One surface soil location will be analyzed for TCL/TAL parameters to assess the presence of any contamination not previously found. Field screening results will be used to select a biased location so that the TCL/TAL analysis is performed near the area with the highest contaminant concentrations. All samples will be collected in accordance with the *QAPP*. QC samples that will be collected at Site 58 are indicated in Table 4-5.

4.5.7 Groundwater Sampling and Analysis

Groundwater contamination near Site 58 is not suspected because of the low mobility of pesticides and herbicides. Therefore, no monitoring wells or groundwater monitoring are proposed for the site.

4.6 Site 59: Building 273 (Pesticides, Cleaners)

4.6.1 Site Description

This site consists of a mixing area for golf course pesticides and herbicides, approximately 10 ft by 50 ft, located next to the DDMT Golf Course and practice putting green.

4.6.2 Site History

This site had reportedly served as a mixing area for golf course pesticide and herbicide spray operations (ref. 10). Further details concerning this operation are unknown. The dates of operation for the site are unknown but are assumed to be from the 1940s to the mid-1980s.

4.6.3 Existing Data

Two surface soil samples (0 to 12 inches in depth) were collected at this site during the 1990 RI activities (ref. 10) and detected VOCs, PAHs, and pesticides. Results and sampling locations are provided in Appendix B. The levels of VOCs detected were quite low. Most were below method quantitation limits and many of the VOCs were common laboratory or field contaminants that are not believed to be the result of environmental contamination. A number of PAHs were detected at elevated concentrations. The pesticide levels (especially DDT and its breakdown products) detected generally indicate that either minor spillage or disposal of pesticide rinse water may have occurred in this area.

4.6.4 Potential Contaminants of Concern

The history of activities at the site and results of the previous surface soil samples indicate that the potential COCs are PAHs, pesticides, and herbicides. As was discussed for Site 58, the pesticides and herbicides that will be monitored are those that persist in the environment and therefore present a hazard. The specific analytical methods are indicated in Table 4-6.

Table 4-6
Collection and Analysis of Site 59 Samples (by Media)
Building 273
Defense Depot Memphis, Tennessee

Media	Description	Level 2			Level 3			
		Pesticides[a]	Herbicides[b]	PAH[c]	TCL/TAL[d]	Pesticides[a]	Herbicides[b]	PAH[c]
Surface Soil	9 locations (2 borings, 7 ss)	9	9	9	1			
QC					TB, EB, FB, MS/MSD			
Subsurface Soil	2 locations, 2 depths at each	4	4	4		1	1	1
QC		FD	FD	FD		EB	EB	EB

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
MS/MSD = Matrix spike/matrix spike duplicate (5% per matrix, if collected within 14 days).
PAH = Polynuclear aromatic hydrocarbon.
QC = Quality control.
TB = Trip blank (1 per day per cooler containing VOCs).
TCL/TAL = Target compound list/target analyte list.

Notes:
[a] Pesticides will be analyzed by a modified SW 846 Method 8080.
[b] Herbicides will be analyzed by SW 846 Method 8150.
[c] PAHs will be analyzed by SW 846 Method 8100.
[d] TCL/TAL analysis will include the CLP methods for VOCs, SVOCs, pesticides/PCBs, and metals. Groundwater samples for metals will include total metals only. Dissolved-metals samples will not be collected and analyzed.

4.6.5 Data Gaps and Site-specific Data Quality Objectives

Site 59 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 to assess whether other unknown contamination is present

4.6.6 Soils Sampling and Analysis

This site is close to the Golf Course Pond and has previously documented levels of PAHs and pesticides in its surface soils. Surface and subsurface soil samples will be collected to assess the vertical and horizontal extent of contamination.

Surface soils will be sampled at nine locations (two borings and seven surface soil locations) around this site (Figure 4-2) and analyzed for Level 2 pesticides, herbicides, and PAHs. One surface soil sample will be analyzed for Level 3 TCL/TAL. All samples for Site 59 will be analyzed as indicated in Table 4-6.

Subsurface soil samples will be collected to assess the vertical extent of contamination. Two 10-ft-deep soil borings will be taken. The borings are located on each side of Building 273 as shown in Figure 4-2, and samples will be collected from the borings at depths of 5 and 10 ft bls. Each sample will be analyzed for Level 2 pesticides, herbicides, and PAHs.

Additional samples may also be collected from areas where there is visual evidence of contamination. Field personnel will survey the area for indicators of contamination such as stained soil or distressed vegetation. If an area of possible contamination is found, a surface soil sample will be collected and analyzed by Level 2 methods for pesticides and herbicides. The field team leader will use the results to decide whether additional surface soil samples or soil borings are needed.

The soil sampling plan for Site 59 is detailed in Table 4-6. Duplicate soil samples will be collected at each sampling point to provide a sample for possible Level 3 (confirmational) analysis. A minimum of 10 percent of the Level 2 samples will have a duplicate sent for Level 3 confirmational analysis. Selection of the samples for Level 3 analysis will be determined by the field team leader or site hydrogeologist. The determination will be based on field screening. For the surface soil analyzed for TCL/TAL, screening results (Level 2) will be used to select a biased location so that the analysis is performed near the area with the highest contaminant concentrations. All samples will be collected in accordance with the *QAPP*. QC samples that will be collected at Site 59 are indicated in Table 4-6.

One sample will be collected from one of the borings (at the 10-foot depth) at Site 59 for geotechnical analyses. The purpose of the analyses is to obtain initial geotechnical and fate and transport data on subsurface soils for OU-3. The hydrogeologist will select the sample for the analyses 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).

4.6.7 Groundwater Sampling and Analysis

Groundwater contamination beneath Site 59 is not suspected because of the low mobility of PAHs, pesticides, and herbicides. Therefore, no monitoring wells or groundwater sampling are proposed for the site.

TAB

Section 5-Additional Data Collection

5.0 Additional Data Collection

5.1 Investigation of Potential Contamination near MW-24

MW-24 is located in the southwest section of OU-3. No known RI sites are located in the immediate vicinity of this well. In November 1993, low levels (less than 0.01 parts per billion [ppb]) of PAHs were detected in MW-24, although none of the concentrations exceeded EPA Region III's risk-based concentrations for tap water. These compounds have not been detected in this well during previous sampling events. To assess the presence of contamination, MW-24 will be purged in accordance with the procedures outlined in Section 5.4.2.7 of the *QAPP* (ref. 1). The well will be sampled for PAHs by SW 846 Method 8100 at an FBL (Level 3 data quality) in accordance with the procedures outlined in Section 5.1 of the *QAPP*. If constituents are detected above established background concentrations or PRGs, whichever is higher, a plan will be developed for investigating sources near MW-24.

5.2 Fluvial Aquifer Characteristics

After well development, the hydraulic conductivity of the water-bearing zone in which each new monitoring well in OU-3 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-3 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 well bore under pressure, followed by an instantaneous release of pressure. The water level response in the well bore 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 (e.g., 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 data test, the project hydrogeologist will select a published, generally accepted analytical method (such as Bouwer, 1989) (ref. 19) that is appropriate for the hydrogeologic conditions at DDMT.

5.3 Preliminary Data Needs for Remedial Alternatives

After the RI field work has been completed, the data will be evaluated to assess the appropriate future disposition of a site (NFA, FS, or IRA). Sites that require a feasibility study to meet the objectives of the program may 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.

5.3.1 Initial Alternatives

A cursory review of the RI sites at OU-3 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 and sediment at each site are provided in Table 5-1 (alternatives listed are for soil and sediment 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-3 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.*

5.3.2 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

125 75

Table 5-1
Preliminary Screening of Remedial Alternatives for RI Sites
Operable Unit 3
Defense Depot Memphis, Tennessee

Page 1 of 2

Site Number[a]	Description	Media	Potential Contaminants to Be Remediated[b]	Potential Remedial Options[c]	Data Need for Initial Evaluation of Alternatives[d]
48	Former PCB transformer storage area	Soil	VOCs, PAHs, pesticides/PCBs	Land disposal	TCLP, hazardous characteristics
				Incineration	Total metals, Btu, ash content
				Cover	Soil boring blow counts
				Bioremediation	Moisture content, porosity, pH, temperature, TOC, microbial poulation, dissolved oxygen (soil and groundwater)
58	PAD 267 (pesticides, herbicides)	Soil	Pesticides	Land disposal	TCLP, hazardous characteristics
				Incineration	Total metals, Btu ash content
				Cover	Soil boring blow counts

Table 5-1
Preliminary Screening of Remedial Alternatives for RI Sites
Operable Unit 3
Defense Depot Memphis, Tennessee

Site Number[a]	Description	Media	Potential Contaminants to Be Remediated[b]	Potential Remedial Options[c]	Data Need for Initial Evaluation of Alternatives[d]
59	Building 273 (pesticides, cleaners)	Soil	Pesticides	Land disposal	TCLP, hazardous characteristics
				Incineration	Total metals, Btu, ash content
				Cover	Soil boring blow counts

[a] Only remedial investigation (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: that is, incineration would generally also represent thermal desorption, cement kilns, incinerators, pyrolysis, or wet air oxidation as similar technologies.
[d] This table is a generalized list of potential data needs for the RI field activities. It is not intended to collect data for all potential remedial alternatives to be evaluated.

125 76

- 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, and the project manager. 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.

5.4 Water Level Measurements

The flow direction of the Fluvial Aquifer in OU-3 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-3. These data will provide valuable information on groundwater flow direction in OU-3.

5.5 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 decision-making 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 of 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 for high-quality 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; two will be collected during the OU-3 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 4-6).

TAB

Appendix A - References

Appendix A
References

Appendix A
References

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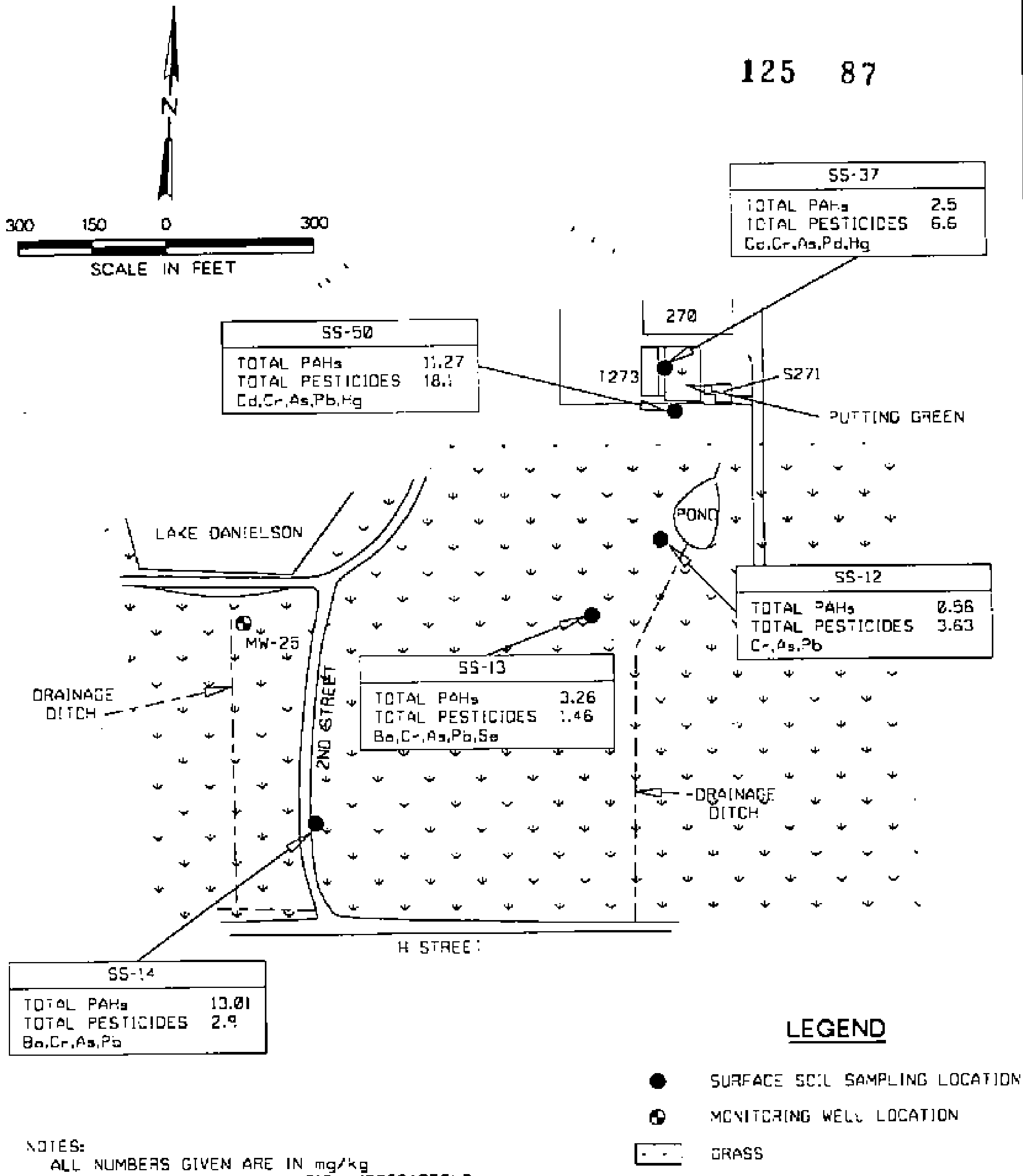
TAB

Appendix B - Exisiting Sampling Data

Appendix B
Existing Sampling Data

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

Remedial Investigation/Feasibility Study
Law Environmental
August 1990

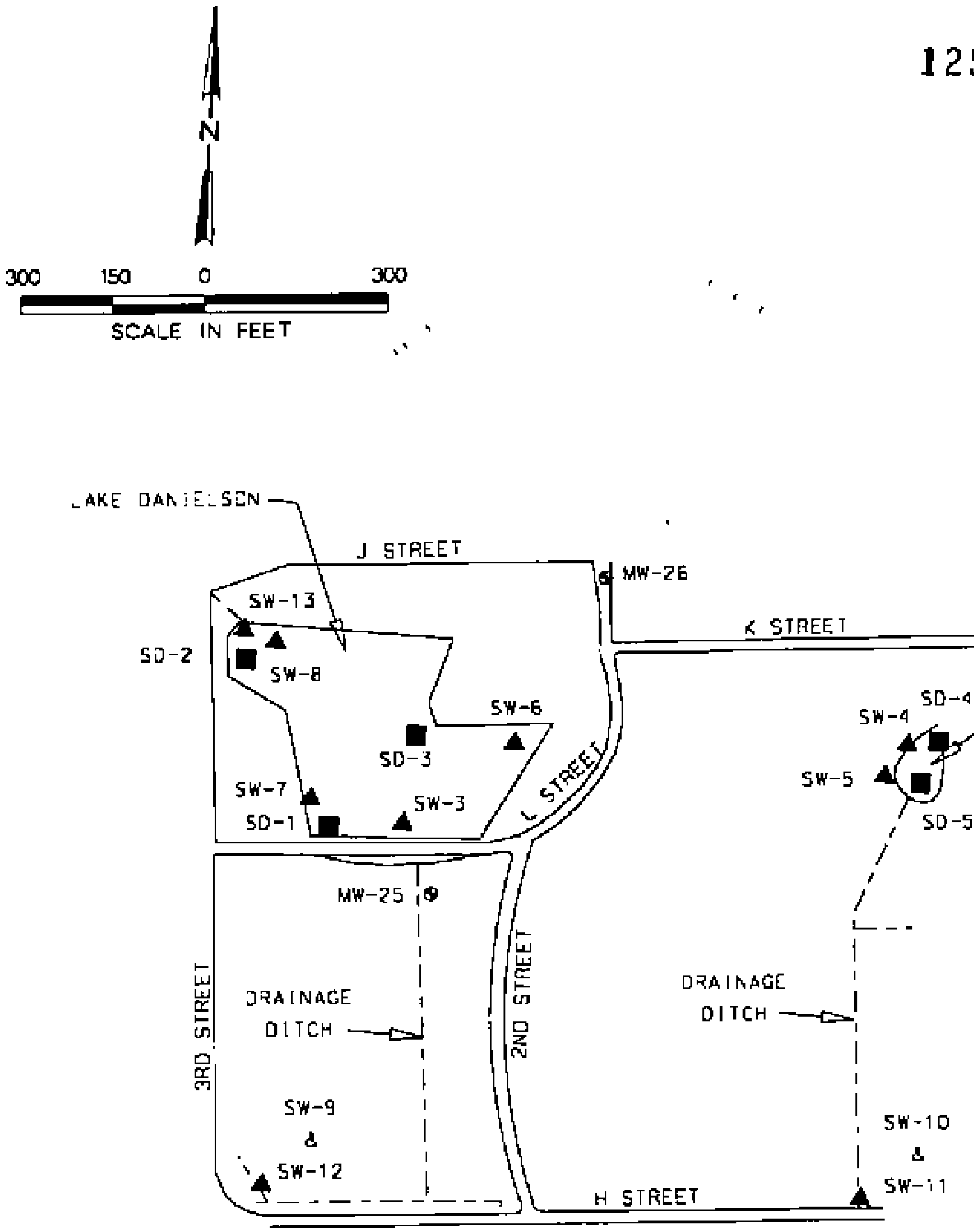


NOTES:
ALL NUMBERS GIVEN ARE IN mg/kg
PAHs = POLYNUCLEAR AROMATIC HYDROCARBONS
TCE = TRICHLOROETHENE
METALS LISTED ARE THOSE THAT EXCEED STATE OF TN SOIL GUIDELINES

FIGURE B-1
SURFACE SOILS WITH POSITIVE RESULTS COLLECTED FROM GOLF COURSE
Defense Depot Memphis, Tennessee

Source: RI Report, 1990

mu3-0016.dgn 31-MAR-1995



NOTES:
POSITIVE RESULTS FOR SURFACE WATER ARE GIVEN IN TABLE
POSITIVE RESULTS FOR SEDIMENTS ARE GIVEN IN TABLE

LEGEND

▲ SURFACE WATER SAMPLE LOCATION

■ SEDIMENT SAMPLE LOCATION

⊕ MONITORING WELL LOCATION

FIGURE B-2
SURFACE WATER AND SEDIMENT SAMPLES
COLLECTED IN THE LAKE DANIELSON/GOLF COURSE POND
Defense Depot Memphis, Tennessee

Source: RI Report, 1990

mu3-0015.dgn 31-MAR-1995

Table B-1
Positive Results in Sediments
Defense Depot Memphis, Tennessee

	PHASE I									
	LAKE DANIELSON						GOLF COURSE POND			
PARAMETER	SD-1-SS	SD-1-9	SD-2-SS	SD-2-9	SD-3-SS	SD-3-9	SD-4-SS	SD-4-9	SD-5-SS	SD-5-9
HALOGENATED VOLATILES ug/kg										
Methylene chloride	42B	38B	22B	22B	28B	22B	27B	29B	14B	25B
NONHALOGENATED VOLATILES ug/kg										
Acetone	71B	75B	46B	51B	43B	36B	170	140	21	24
2-Butanone	--	30J	18J	--	--	--	6J	5J	--	--
Toluene	--	--	--	--	--	--	--	--	--	2J
HALOGENATED SEMIVOLATILES ug/kg										
Pentachlorophenol	--	--	--	--	--	--	--	--	270J	--
NONHALOGENATED SEMIVOLATILES ug/kg										
bis(2-Ethylhexyl) phthalate	550	570	580J	530J	760J	640J	710J	630J	710J	710J
Benzoic acid	460J	490J	300J	590J	160J	470J	680J	450J	1200J	970J
N-Nitrosodiphenylamine	100BJ	--	170BJ	--	270BJ	100BJ	190BJ	--	280BJ	190BJ

Source: RI Report, 1990

Table B-1
Positive Results in Sediments
Defense Depot Memphis, Tennessee

PARAMETER	PHASE I									
	LAKE DANIELSON						GOLF COURSE POND			
	SD-1-SS	SD-1-9	SD-2-SS	SD-2-9	SD-3-SS	SD-3-9	SD-4-SS	SD-4-9	SD-5-SS	SD-5-9
Polynuclear Aromatic Hydrocarbons (PAHs)										
Acenaphthene	--	--	--	--	--	--	--	--	110J	140J
Anthracene	--	--	--	--	--	--	--	--	200J	200J
Benzo(a)anthracene	--	--	--	--	230J	--	--	--	1100	680J
Benzo(a)pyrene	--	--	--	--	230J	--	--	--	1300	500J
Benzo(b)fluoranthene	--	--	--	--	380J	--	--	--	1800	690J
Benzo(g,h,i)perylene	--	--	--	--	200J	--	--	--	940	390J
Benzo(k)fluoranthene	--	--	--	--	290J	--	--	--	1600	690J
Chrysene	--	--	--	--	300J	--	--	--	1400	750J
Dibenzo(a,h)anthracene	--	--	--	--	--	--	--	--	330J	140J
Fluoranthene	74J	71J	100J	--	700J	--	130J	--	3000	1700
Fluorene	--	--	--	--	--	--	--	--	120J	150J
Indeno(1,2,3-cd)pyrene	--	--	--	--	210J	--	--	--	900J	350J
Phenanthrene	--	--	--	--	330J	--	100J	--	1300	1200
Pyrene	--	--	--	--	610J	--	100J	--	2400	1400
Total PAHs	74	71	100	--	3,480	--	330	--	16,500	8,980

PESTICIDES ug/kg

4,4'-DDD	47	--	--	--	45	--	190D	280D	3000D	960D
4,4'-DDE	36	--	--	--	110D	--	68D	64D	460Z	--
4,4'-DDT	--	--	--	--	--	--	--	--	2900D	620D
Endosulfan-I	--	--	--	--	--	--	--	--	200Z	--

Source: RI Report, 1990

125 90

Table B-1

Positive Results in Sediments

Defense Depot Memphis, Tennessee

	PHASE I									
	LAKE DANIELSON						GOLF COURSE POND			
PARAMETER	SD-1-SS	SD-1-9	SD-2-SS	SD-2-9	SD-3-SS	SD-3-9	SD-4-SS	SD-4-9	SD-5-SS	SD-5-9
METALS mg/kg										
Lead	--	--	--	--	--	--	5	6	91	55
Mercury	0.04	0.05	0.05	0.05	--	--	0.05	0.04	0.06	0.04
Barium	76	88.4	122	110	89.7	99	96	95.2	101	104
Cadmium	0.7B	--	--	--	--	--	--	--	0.9B	--
Chromium **	13	13	12	10	12	9	13	11	28	21
Copper	20	23	18	17	15	16	15	16	28	26
Nickel	11	14	14	12	14	13	13	13	14	14
Zinc	44.5N	47.8N	50.9N	47.6N	48.8N	45.4N	44.7N	43.2N	80.9N	66.8N

B (Inorganic) = Value less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).

B (Organic) = Found in method blank.

D = Identified in an analysis at a secondary dilution factor.

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

N = Spiked sample recovery not within control limits.

Z = Matrix interference; compound not positively identifiable.

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

-- = Not detected.

Source: RI Report, 1990

Table B-2
Positive Results in Surface Water
Operable Unit 3
Defense Depot Memphis, Tennessee

	Ambient Water Quality Criteria Aquatic Life		LAKE DANIELSON							GOLF COURSE POND				DRAINAGE DITCHES	
			LAKE WATER				LAKE INLET	LAKE DRAINAGE		POND WATER		POND DRAINAGE			
PARAMETER	Acute	Chronic	SW3	SW6	SW7	SW8	SW13	SW9	SW12	SW4	SW5	SW10	SW11	SW2	SW14
HALOGENATED VOLATILES (ug/l)															
Methylene chloride	11,000	NA	1BJ	--	2BJ	1BJ	--	1BJ	--	--	--	--	--	1BJ	--
NONHALOGENATED VOLATILES (ug/l)															
2-Butanone			--	--	--	--	--	--	--	--	--	--	--	--	4J
Acetone	NA	NA	3BJ	--	2BJ	2BJ	--	18B	4J	2BJ	2BJ	1BJ	4J	5BJ	110
Total xylenes	NA	NA	--	--	--	--	--	--	--	--	--	--	1J	--	--
NONHALOGENATED SEMIVOLATILES (ug/l)															
Benzoic acid	NA	NA	--	--	--	--	5BJ	--	6BJ	--	--	--	--	--	3BJ
bis(2-Ethylhexyl) phthalate	940	3	3BJ	--	2BJ	3BJ	6BJ	12BJ	3BJ	3BJ	5BJ	7BJ	3J	--	3BJ
Butyl benzyl phthalate	940	3	--	--	--	--	--	--	--	--	--	--	3J	--	--
Di-n-butyl phthalate	940	3	--	--	--	--	--	--	--	--	--	3J	--	--	--
Di-n-octyl phthalate	940	3	--	--	--	--	--	--	--	--	--	3BJ	--	--	--
Fluoranthene	NA	NA	--	--	--	--	--	--	--	--	--	--	2J	--	--
N-Nitrosodiphenylamine	NA	NA	--	--	3J	--	--	--	7BJ	--	3J	2J	--	--	--
Pyrene	NA	NA	--	--	--	--	--	--	--	--	--	3J	3J	--	--
PESTICIDES (ug/l)															
4,4'-DDE	1050	NA	--	.21	--	--	--	--	.65D	--	--	.14	.88D	--	--
4,4'-DDT	1.1	0.001	--	--	--	--	--	.16	2.2D	--	--	.27	1.9D	--	--
Endosulfan-I			--	--	--	--	--	--	--	--	--	--	--	.16Z	--

Source: RI Report, 1990

Table B-2
Positive Results in Surface Water
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	Ambient Water Quality Criteria Aquatic Life		LAKE DANIELSON							GOLF COURSE POND				DRAINAGE DITCHES	
			LAKE WATER				LAKE INLET	LAKE DRAINAGE		POND WATER		POND DRAINAGE			
	Acute	Chronic	SW3	SW6	SW7	SW8	SW13	SW9	SW12	SW4	SW5	SW10	SW11	SW2	SW14
METALS (ug/l)															
Arsenic	360	190	--	48	41	37	--	47	30	--	--	--	--	--	--
Lead	82	3.2	--	--	--	--	--	295	100	--	--	--	50	--	--
Barium	NA	NA	15B	17B	15B	15B	60	60B	98	14B	14B	26B	55	76B	42
Cadmium			--	--	--	--	--	5	19	--	--	--	--	--	--
Chromium			--	--	--	--	--	--	20	--	--	--	--	20	10
Copper	18	12	27	24B	20B	19B	--	68	20	46	30	25	30	23B	--
Silver			--	--	--	--	--	13	--	--	--	--	--	--	--
Zinc	120	110	68	41	32	37	54	400	150	22	22	81	110	29	36

NA - Not Available

B (Inorganic) = Value less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).

B (Organic) = Found in method blank.

D = Identified in an analysis at a secondary dilution factor.

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

Z = Matrix interference; compound not positively identifiable.

-- = Not detected.

Source: RI Report, 1990

125 94

Table B-3
Positive Results in Groundwater
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER (UG/L)	DATE	MCL	MW24	MW25	MW26
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		--	--	--
Tetrachlorethene	PHASE I	5	--	8	10
	PHASE II		--	7	5
Trichloroethene	PHASE I	5	--	--	3J
	PHASE II		--	--	3J
NONHALOGENATED VOLATILES (ug/l)					
Acetone	PHASE I	--	3J	2BJ	4J
	PHASE II		--	--	--
NONHALOGENATED SEMIVOLATILES (ug/l)					
Di-n-butyl phthalate	PHASE I	--	--	--	--
	PHASE II		--	--	--
Di-n-octyl phthalate	PHASE I	--	--	--	3J
N-Nitrosodiphenylamine	PHASE I	--	2J	5J	--
Phenol	PHASE II	--	--	--	--
bis(2-Ethylhexyl) phthalate	PHASE I	--	5J	--	9J
	PHASE II		--	--	--
METALS (ug/l)					
Arsenic	PHASE I	50	--	--	--
	PHASE II		--	--	50
Lead	PHASE I	50/15 (e)	152*	128	--
	PHASE II		--	70	50
Mercury	PHASE I	2	.4N	1.7	.4N
	PHASE II		--	--	--
Antimony	PHASE I	6	--	--	--
	PHASE II		--	60	50
Barium	PHASE I	2000	167	1960	908
	PHASE II		81	410	380

Source: RI Report, 1990

Table B-3
Positive Results in Groundwater
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER (UG/L)	DATE	MCL	MW24	MW25	MW26
Cadmium	PHASE I	5	18N*	--	--
	PHASE II		--	--	--
Chromium (d)	PHASE I	100	31	337	150
	PHASE II		--	40	30
Copper	PHASE I	1300 (f)	88	209	268
	PHASE II		50	20	40
Nickel	PHASE I	100	26	125	58
	PHASE II		--	--	--
Zinc	PHASE I	5000 (h)	193	408	400
	PHASE II		170	120	120

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.

Source: RI Report, 1990

Table B-4
Positive Results in Surface Soils
Old Transformer Storage Yard
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	PHASE I	
	SS30	SS31
HALOGENATED VOLATILES (ug/kg)		
Methylene chloride	3J	7B
NONHALOGENATED VOLATILES (ug/kg)		
Acetone	4J	7JB
Toluene	3J	–
NONHALOGENATED SEMIVOLATILES (ug/kg)		
bis(2-Ethylhexyl) phthalate	350BJ	460B
Polynuclear Aromatic Hydrocarbons (PAHs)		
Benzo(a)anthracene	240J	–
Benzo(a)pyrene	190J	–
Benzo(b)fluoranthene	320J	–
Benzo(g,h,i)perylene	230J	–
Chrysene	230J	–
Fluoranthene	390J	–
Indeno(1,2,3-cd)pyrene	180J	–
Phenanthrene	210J	–
Pyrene	340J	–
Total PAHs	2330	–
PESTICIDES (ug/kg)		
4,4'-DDE	78D	18
4,4'-DDT	1000D	190D
METALS (mg/kg)		
Arsenic	19	12
Lead	81	5
Mercury	0.04	0.02
Antimony	4	–

Source: RI Report, 1990

Table B-4
Positive Results in Surface Soils
Old Transformer Storage Yard
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	PHASE I	
	SS30	SS31
Barium	78.1	21.9
Cadmium	1	--
Chromium **	14	10
Copper	22	6
Nickel	13	3
Silver	0.6	--
Zinc	69	11

B (Organic) = Found in method blank.
D = Identified in an analysis at a secondary dilution factor.
J = Estimated value less than the sample quantitation limit, but greater than zero.
-- = Not detected.
** = No distinction beween Chromium (III) and Chromium (VI).

Source: RI Report, 1990

Table B-5
Positive Results in Surface Soils
Golf Course
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	PHASE I SS12	PHASE I SS13	PHASE I SS14	PHASE I SS37	PHASE II SS50
HALOGENATED VOLATILES ug/kg					
Chloroform	--	--	2J	--	--
Methylene chloride	14B	21B	15B	13B	16B
Tetrachlorethene	--	--	--	2J	--
Trichloroethene	--	--	--	4J	--
NONHALOGENATED VOLATILES ug/kg					
Acetone	9J	38	24	15	22
Toluene	17	9J	6J	3J	--
Total xylenes	--	--	--	8J	--
NONHALOGENATED SEMIVOLATILES ug/kg					
bis(2-Ethylhexyl) phthalate	1500BJ	2200BJ	2700B	710BJ	1700B
N-Nitrosodiphenylamine	260J	280J	340J	--	--
Polynuclear Aromatic Hydrocarbons (PAHs)					
Acenaphthene	--	--	--	--	200J
Anthracene	--	--	280J	--	330J
Benzo(a)anthracene	--	270J	920J	--	810J
Benzo(a)pyrene	--	340J	930J	--	610J
Benzo(b)fluoranthene	--	420J	1100J	620J	1100J
Benzo(g,h,i)perylene	--	--	780J	--	--
Benzo(k)fluoranthene	--	340J	1100J	--	--
Chrysene	--	390J	1200J	--	990J
Fluoranthene	330J	630J	2700	780J	2200
Fluorene	--	--	--	--	160J
Indeno(1,2,3-cd)pyrene	--	--	700J	--	370J
Phenanthrene	--	310J	1600J	520J	2000
Pyrene	230J	560J	1700J	580J	2500
Total PAHs	560	3,260	13,010	2,500	11,270

Source: RI Report, 1990

125 99

Table B-5
Positive Results in Surface Soils
Golf Course
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	PHASE I SS12	PHASE I SS13	PHASE I SS14	PHASE I SS37	PHASE II SS50
PESTICIDES ug/kg					
4,4'-DDE	2000D	340D	--	1200D	4300D
4,4'-DDT	870	290	--	4000D	3000DJ
Dieldrin	760D	830D	2900D	1400D	3800D
Heptachlor	--	--	--	--	1100Z
Heptachlor epoxide	--	--	--	--	340Z
beta-BHC	--	--	--	--	2500
METALS mg/kg					
Arsenic	33	22	41	42	12
Lead	80G*	50G*	80G*	71	157
Mercury	0.15N	0.1N	0.8N	0.32	0.5
Antimony	--	--	5.0B	5.0	--
Barium	95.8	118	117	76.9	78.4
Cadmium	--	--	--	2.0	1.9
Chromium **	20G	13G	16G	13	17
Copper	34*	21*	26*	18	15
Nickel	13*	12*	12*	11	8
Zinc	81.2G	89.3G	82.3G	80.4	290

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 limits.
Z = Matrix interference; compound not positively identifiable.
* = Duplicate analysis not within control limits.
** = No distinction between Chromium (III) and Chromium (VI)
-- = Not detected.

Source: RI Report, 1990

Water Quality Biological Study
Number 32-24-0733-86
United States Army Environmental Hygiene Agency (USAEHA)
March 1986

Table B-6
Positive Results in Surface Water
Operable Unit 3
Defense Depot Memphis, Tennessee

125 101

PARAMETER	DETECTION LIMIT	SAMPLE DATES	LAKE DANIELSON SAMPLE SITE				GOLF COURSE POND SAMPLE SITE
			1	2	3	4	5
METALS (mg / l)							
ANTIMONY	1.00	11&12 MARCH 86	–	–	–	–	–
ARSENIC	0.01	11&12 MARCH 86	–	–	–	–	–
BERYLLIUM	0.05	11&12 MARCH 86	–	–	–	–	–
CADMIUM	0.025	11&12 MARCH 86	–	–	–	–	–
CHROMIUM	0.05	11&12 MARCH 86	–	–	–	–	–
COPPER	0.05	11&12 MARCH 86	–	–	–	–	–
LEAD	0.05	11&12 MARCH 86	–	–	–	–	–
MERCURY	0.002	11&12 MARCH 86	–	–	–	–	–
NICKEL	0.05	11&12 MARCH 86	–	–	–	–	–
SELENIUM	0.01	11&12 MARCH 86	–	–	–	–	–
THALLIUM	0.01	11&12 MARCH 86	–	–	–	–	–
ZINC	0.05	11&12 MARCH 86	–	–	–	–	–
BASE NEUTRALS (ug / l)							
BENZIDENE 4-CHLORO-3-METHYLPHENOL	10	11&12 MARCH 86	–	–	–	–	–
3-3'-DICHLOROBENZIDENE	10	11&12 MARCH 86	–	–	–	–	–
BIS(2-CHLOROETHYL) ETHER	10	11&12 MARCH 86	–	–	–	–	–
BIS(2-CHLOROETHOXY) METHANE	10	11&12 MARCH 86	–	–	–	–	–
BIS(2-CHLOROISOPROPYL) ETHER	10	11&12 MARCH 86	–	–	–	–	–
4-BROMOPHENYL PHENYL ETHER	10	11&12 MARCH 86	–	–	–	–	–
4-CHLOROPHENYL PHENYL ETHER	10	11&12 MARCH 86	–	–	–	–	–
ISOPHORONE	10	11&12 MARCH 86	–	–	–	–	–
NITROBENZENE	10	11&12 MARCH 86	–	–	–	–	–
2,4-DINITROTOLUENE	10	11&12 MARCH 86	–	–	–	–	–
2,6-DINITROTOLUENE	10	11&12 MARCH 86	–	–	–	–	–
N-NITROSDIMETHYLAMINE	10	11&12 MARCH 86	–	–	–	–	–
N-NITROSDIPHENYLAMINE	10	11&12 MARCH 86	–	–	–	–	–
N-NITROSODI-N-PROPYLAMINE	10	11&12 MARCH 86	–	–	–	–	–
BENZYL BUTYL PHTHALATE	10	11&12 MARCH 86	–	–	–	–	–
BIS(2-ETHYLHEXYL) PHTHALATE	10	11&12 MARCH 86	–	–	–	–	21
DI-N-BUTYL PHTHALATE	10	11&12 MARCH 86	–	–	–	–	–
DI-N-OCTYL PHTHALATE	10	11&12 MARCH 86	–	–	–	–	9
DIETHYL PHTHALATE	10	11&12 MARCH 86	–	–	–	–	–
ACENAPTHENE	10	11&12 MARCH 86	–	–	–	–	–
ACENAPHTHYLENE	10	11&12 MARCH 86	–	–	–	–	–
ANTHRACENE	10	11&12 MARCH 86	–	–	–	–	–
BENZO(A)ANTHRACENE	10	11&12 MARCH 86	–	–	–	–	–
BENZO(A)PYRENE	10	11&12 MARCH 86	–	–	–	–	–
BENZO(B)FLUORANTHENE	10	11&12 MARCH 86	–	–	–	–	–

Source: USAEHA, 1986

Table B-6
Positive Results in Surface Water
Operable Unit 3
Defense Depot Memphis, Tennessee

125 102

PARAMETER	DETECTION LIMIT	SAMPLE DATES	LAKE DANIELSON SAMPLE SITE 1	2	3	4	GOLF COURSE POND SAMPLE SITE 5
BENZO(K)FLUORANTHENE	10	11&12 MARCH 86	–	–	–	–	–
CHRYSENE	10	11&12 MARCH 86	–	–	–	–	–
FLUORANTHENE	10	11&12 MARCH 86	–	–	–	–	–
NAPTHALENE	10	11&12 MARCH 86	–	–	–	–	–
PHENANTHRENE	10	11&12 MARCH 86	–	–	–	–	–
PYRENE	10	11&12 MARCH 86	–	–	–	–	–
HEXACHLOROCYCLOPENTADIENE	10	11&12 MARCH 86	–	–	–	–	–
HEXACHLOROBENZENE	10	11&12 MARCH 86	–	–	–	–	–
HEXACHLOROBUTADIENE	10	11&12 MARCH 86	–	–	–	–	–
HEXACHLOROETHANE	10	11&12 MARCH 86	–	–	–	–	–
1,2-DICHLOROBENZENE	10	11&12 MARCH 86	–	–	–	–	–
1,2,4-TRICHLOROBENZENE	10	11&12 MARCH 86	–	–	–	–	–
1,3-DICHLOROBENZENE	10	11&12 MARCH 86	–	–	–	–	–
1,4-DICHLOROBENZENE	10	11&12 MARCH 86	–	–	–	–	–
2-CHLORONAPTHALENE	10	11&12 MARCH 86	–	–	–	–	–
BENZO(G,H,I)PYRENE	25	11&12 MARCH 86	–	–	–	–	–
DIBENZO(A,H)ANTHRACENE	25	11&12 MARCH 86	–	–	–	–	–
IDENO(1,2,3-C,D)PYRENE	25	11&12 MARCH 86	–	–	–	–	–

ACID EXTRACTABLES (ug / l)

PARAMETER	DETECTION LIMIT	SAMPLE DATES	1	2	3	4	5
2-CHLOROPHENOL	25	11&12 MARCH 86	–	–	–	–	–
2,4-DICHLOROPHENOL	25	11&12 MARCH 86	–	–	–	–	–
2,4-DIMETHYLPHENOL	25	11&12 MARCH 86	–	–	–	–	–
2-NITROPHENOL	25	11&12 MARCH 86	–	–	–	–	–
4-NITROPHENOL	25	11&12 MARCH 86	–	–	–	–	–
PENTACHLOROPHENOL	25	11&12 MARCH 86	–	–	–	–	–
PHENOL	25	11&12 MARCH 86	–	–	–	–	–
2,4,6-TRICHLOROPHENOL	250	11&12 MARCH 86	–	–	–	–	–
2,4-DINITROPHENOL	250	11&12 MARCH 86	–	–	–	–	–
2-METHYL-4,6-DINITROPHENOL	250	11&12 MARCH 86	–	–	–	–	–

PESTICIDES / PCB'S (ug / l)

PARAMETER	DETECTION LIMIT	SAMPLE DATES	1	2	3	4	5
ALDRIN	0.16	11&12 MARCH 86	–	–	–	–	–
ALPHA BHC	0.20	11&12 MARCH 86	–	–	–	–	–
BETA BHC	0.20	11&12 MARCH 86	–	–	–	–	–
CHLORDANE (TECH)	1.20	11&12 MARCH 86	–	–	–	–	–
CHLORDANE - CIS	0.16	11&12 MARCH 86	–	–	–	–	–
CHLORDANE - TRANS	0.16	11&12 MARCH 86	–	–	–	–	–
CHLORPYRIFOS	0.24	11&12 MARCH 86	–	–	–	–	–
2,4-D (ACID EQUIV)	3.80	11&12 MARCH 86	–	–	–	–	–
O,P' - DDD	0.40	11&12 MARCH 86	BDL	–	–	–	–

Source: USAEHA, 1986

Table B-6
Positive Results in Surface Water
Operable Unit 3
Defense Depot Memphis, Tennessee

125 103

PARAMETER	DETECTION LIMIT	SAMPLE DATES	LAKE DANIELSON SAMPLE SITE 1	2	3	4	GOLF COURSE POND SAMPLE SITE 5
P,P' - DDD	0.40	11&12 MARCH 86	BDL	–	–	–	–
O,P' - DDE	0.40	11&12 MARCH 86	BDL	–	–	–	–
P,P' - DDE	0.40	11&12 MARCH 86	BDL	–	–	–	–
O,P' - DDT	0.60	11&12 MARCH 86	BDL	–	–	–	–
P,P' - DDT	0.60	11&12 MARCH 86	0.85	–	–	–	–
DIAZINON	1.00	11&12 MARCH 86	–	–	–	–	–
DIELDRIN	0.24	11&12 MARCH 86	–	–	–	–	–
ENDRIN	0.04	11&12 MARCH 86	–	–	–	–	–
HCB	0.80	11&12 MARCH 86	–	–	–	–	–
HEPTACHLOR	0.06	11&12 MARCH 86	–	–	–	–	–
HEPTACHLOR EPOXIDE	0.16	11&12 MARCH 86	–	–	–	–	–
LINDANE	0.08	11&12 MARCH 86	–	–	–	–	–
MALATHION	1.60	11&12 MARCH 86	–	–	–	–	–
METHOXYCHLOR	1.60	11&12 MARCH 86	–	–	–	–	–
METHYL PARATHION	0.60	11&12 MARCH 86	–	–	–	–	–
MIREX	0.04	11&12 MARCH 86	–	–	–	–	–
OXYCHLORDANE	0.16	11&12 MARCH 86	–	–	–	–	–
PARATHION	0.40	11&12 MARCH 86	–	–	–	–	–
PCB (AROCHLOR 1242, 1248, 1254, AND 1260)	0.80	11&12 MARCH 86	–	–	–	–	–
RONNEL	0.20	11&12 MARCH 86	–	–	–	–	–
SILVEX (ACID EQUIV)	0.50	11&12 MARCH 86	–	–	–	–	–
2,4,5-T (ACID EQUIV)	0.50	11&12 MARCH 86	–	–	–	–	–
TOXAPHENE	1.60	11&12 MARCH 86	–	–	–	–	–

– = NOT DETECTED

BDL = BELOW DETECTION LIMITS

Source: USAEHA, 1986

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Table B-7
Positive Results in Sediments
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	DETECTION LIMIT	SAMPLE DATES	LAKE DANIELSON SAMPLE SITE 1	2	3	4	GOLF COURSE POND SAMPLE SITE 5
METALS - SEDIMENT SUPERNATANT (mg / l)							
ANTIMONY	1.00	11&12 MARCH 86	–	–	–	–	–
ARSENIC	0.01	11&12 MARCH 86	–	–	–	–	–
BERYLLIUM	0.05	11&12 MARCH 86	–	–	–	–	–
CADMIUM	0.025	11&12 MARCH 86	–	–	–	–	–
CHROMIUM	0.05	11&12 MARCH 86	–	–	–	–	–
COPPER	0.05	11&12 MARCH 86	–	–	–	–	–
LEAD	0.05	11&12 MARCH 86	–	–	–	–	–
MERCURY	0.002	11&12 MARCH 86	0.02	0.15	0.04	0.04	0.04
NICKEL	0.05	11&12 MARCH 86	–	–	–	–	–
SELENIUM	0.01	11&12 MARCH 86	–	–	–	–	–
THALLIUM	0.01	11&12 MARCH 86	–	–	–	–	–
ZINC	0.05	11&12 MARCH 86	–	–	–	–	–
METALS - SEDIMENT (DRY) (mg / kg)							
ANTIMONY	0.30	11&12 MARCH 86	–	–	–	–	–
ARSENIC	NA	11&12 MARCH 86	16.9	17.7	13.5	20.8	23.1
BERYLLIUM	1.30	11&12 MARCH 86	–	–	–	–	–
CADMIUM	NA	11&12 MARCH 86	4.3	4.9	6.2	4.9	1.8
CHROMIUM	NA	11&12 MARCH 86	166	50	74	52	11
COPPER	NA	11&12 MARCH 86	68.6	84.4	70.5	81.0	39.8
LEAD	NA	11&12 MARCH 86	560	280	240	250	79
MERCURY	NA	11&12 MARCH 86	0.24	0.4	0.42	0.27	0.36
NICKEL	NA	11&12 MARCH 86	21.7	21.7	22.5	21.7	16.3
SELENIUM	0.25	11&12 MARCH 86	–	–	–	–	–
THALLIUM	0.25	11&12 MARCH 86	–	–	–	–	–
ZINC	NA	11&12 MARCH 86	801	768	643	768	195
PESTICIDES / PCB'S (mg / kg)							
ALDRIN	0.050	11&12 MARCH 86	–	–	–	–	–
ALPHA BHC	0.020	11&12 MARCH 86	–	–	–	–	–
BETA BHC	0.020	11&12 MARCH 86	–	–	–	–	–
DELTA BHC	0.060	11&12 MARCH 86					
CHLORDANE	0.400	11&12 MARCH 86	–	–	–	–	–
CHLORDANE (METAB)*	0.400	11&12 MARCH 86	1.11	2.52	1.64	2.09	–
O,P' - DDD	0.120	11&12 MARCH 86	0.95	1.34	0.77	0.97	–
P,P' - DDD	0.100	11&12 MARCH 86	3.45	3.75	2.32	3.93	0.21
O,P' - DDE	0.120	11&12 MARCH 86	–	–	–	–	–
P,P' - DDE	0.100	11&12 MARCH 86	2.71	5.31	4.22	4.75	0.22
O,P' - DDT	0.120	11&12 MARCH 86	0.18	0.24	0.18	0.21	–

Source: USAEHA, 1986

Table B-7
Positive Results in Sediments
Operable Unit 3
Defense Depot Memphis, Tennessee

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PARAMETER	DETECTION LIMIT	SAMPLE DATES	LAKE DANIELSON SAMPLE SITE 1	2	3	4	GOLF COURSE POND SAMPLE SITE 5
P,P - DDT	0.150	11&12 MARCH 86	0.77	0.81	0.59	0.75	0.15
DIAZINON	0.052	11&12 MARCH 86	–	–	–	–	–
DIELDRIN	0.070	11&12 MARCH 86	–	–	–	–	–
ENDRIN	0.130	11&12 MARCH 86	–	–	–	–	–
HCB	0.020	11&12 MARCH 86	–	–	–	–	–
HEPTACHLOR EPOXIDE	0.050	11&12 MARCH 86	–	–	–	–	–
LINDANE	0.024	11&12 MARCH 86	–	–	–	–	–
MALATHION	0.010	11&12 MARCH 86	–	–	–	–	–
METHOXYCHLOR	0.500	11&12 MARCH 86	–	–	–	–	–
METHYL PARATHION	0.030	11&12 MARCH 86	–	–	–	–	–
MIREX	0.120	11&12 MARCH 86	–	–	–	–	–
OXYCHLORDANE	0.050	11&12 MARCH 86	–	–	–	–	–
PARATHION	0.020	11&12 MARCH 86	–	–	–	–	–
PCB (AROCHLOR 1242, 1248, 1254, AND 1260)	0.100	11&12 MARCH 86	–	–	–	–	–
TOXAPHENE	4.000	11&12 MARCH 86	–	–	–	–	–

* = Metabolized/total constituents chlordane that includes cis and trans chlordane

-- = NOT DETECTED

BDL = BELOW DETECTION LIMITS

Source: USAEHA, 1986

Table B-8
Positive Results in Fish Tissue
Operable Unit 3
Defense Depot Memphis, Tennessee

PARAMETER	LAKE DANIELSON				GOLF COURSE POND	
	CATFISH				GOLDFISH	
	A	B	C	D	A	B
METALS (mg / kg)						
ANTIMONY	<0.992	<0.954	<1.05	<1.00	<0.992	<0.978
ARSENIC	<0.992	<0.954	<1.05	<1.00	<0.992	<0.978
BERYLLIUM	<0.198	<0.191	<0.209	<0.200	<0.198	<0.196
CADMIUM	<0.099	<0.095	<0.105	<0.100	<0.099	<0.098
CHROMIUM	< 2.98	< 2.86	< 3.14	< 3.00	< 2.98	< 2.94
COPPER	< 3.97	50.8	< 4.18	< 4.00	< 3.97	< 3.91
LEAD	0.794	1.15	0.628	< 0.200	0.397	< 0.196
MERCURY	< 0.039	< 0.038	< 0.042	< 0.040	0.238	0.333
NICKEL	< 9.82	< 9.54	< 10.5	< 10.0	< 9.92	< 9.78
SELENIUM	< 0.198	< 0.191	< 0.209	< 0.200	< 0.198	< 0.196
THALLIUM	< 0.198	< 0.191	< 0.209	< 0.200	< 0.198	< 0.196
ZINC	3.57	19.8	3.97	3.8	15.9	10.8
PESTICIDES / PCB'S (mg / kg)						
ALDRIN	—	—	—	—	—	—
ALPHA BHC	—	—	—	—	—	—
BETA BHC	—	—	—	—	—	—
DELTA BHC	—	—	—	—	—	—
CHLORDANE	—	—	—	—	—	—
CHLORDANE (METAB)*	2.13	2.13	2.01	1.82	0.14	0.60
CHLORPYRIFOS	0.012	0.008	0.023	0.006	—	—
O,P' - DDD	0.51	0.57	0.550	0.430	0.02	0.07
P,P' - DDD	4.06	4.76	3.66	3.68	0.18	1.02
O,P' - DDE	+	+	+	+	+	+
P,P' - DDE	15.55	15.65	8.44	11.82	1.25	3.61
O,P' - DDT	0.59	0.63	0.29	0.47	—	—
P,P' - DDT	2.16	2.03	1.38	1.66	—	—
DIAZINON	—	—	—	—	—	—
DIELDRIN	0.31	0.19	0.15	0.16	0.03	0.17
ENDRIN	—	—	—	—	—	—
HCB	—	—	—	—	—	—
HEPTACHLOR	—	—	—	—	—	—
HEPTACHLOR EPOXIDE	+	+	+	+	+	+
LINDANE	—	—	—	—	—	—
MALATHION	—	—	—	—	—	—
METHOXYCHLOR	—	—	—	—	—	—
METHYL PARATHION	—	—	—	—	—	—
MIREX	—	—	—	—	—	—
OXYCHLORDANE	+	+	+	+	+	+
PARATHION	—	—	—	—	—	—
PCB (AROCHLOR 1242)	—	—	—	—	—	—
PCB (AROCHLOR 1248 & 1254)	—	—	—	—	—	—
PCB (AROCHLOR 1260)	0.45	0.48	0.34	0.44	1.13	2.84
TOXAPHENE	—	—	—	—	—	—

\+ = Unable to separate
— = NOT DETECTED
* = Metabolized/total constituents chlordane that includes cis and trans chlordane

Source: USAEHA, 1986

Groundwater Monitoring Results Report for DDMT
Environmental Science & Engineering, Inc.
January 1994

Table B-9
Positive Results (Above Detection Limits) of
November 1993 Groundwater Monitoring
Operable Unit 3
Defense Depot Memphis, Tennessee

ID			MW24	MW25	MW26
COLLECTION DATE			11/14/93	11/13/93	11/09/93
COLLECTION TIME			17:00	08:20	19:30
PARAMETER LIST			CDDMTW.1	CDDMTW.1	CDDMTW.1
STORET*METHOD	PARAMETER NAME	UNITS			
32101*8010-G	BROMODICHLOROMETHANE	UG/L			
32102*8010-G	CARBON TETRACHLORIDE	UG/L			3.16
34301*8010-G	CHLOROBENZENE	UG/L			
32106*8010-G	CHLOROFORM	UG/L			
34496*8010-G	1,1-DICHLOROETHANE	UG/L			
34531*8010-G	1,2-DICHLOROETHANE	UG/L			
34501*8010-G	1,1-DICHLOROETHYLENE	UG/L			
34546*8010-G	TRANS-1,2-DICHLORO ETHENE	UG/L			
34423*8010-G	METHYLENE CHLORIDE	UG/L			
34516*8010-G	1,1,2,2-TETRACHLORO ETHANE	UG/L			
34475*8010-G	TETRACHLOROETHENE	UG/L		11.2	6.50
34506*8010-G	1,1,1-TRICHL'ETHANE	UG/L			
34511*8010-G	1,1,2-TRICHL'ETHANE	UG/L			
39180*8010-G	TRICHLOROETHENE	UG/L			1.29
34010*8020-G	TOLUENE	UG/L			
39100*8270/3520-G	BIS (2-ETHYLHEXYL) PHTHALATE	UG/L	9.6	4.0	5.8
39110*8270/3520-G	DI-N-BUTYLPHTHALATE	UG/L			
34376*8270/3520-G	FLUORANTHENE	UG/L			
34694*8270/3520-G	PHENOL	UG/L			
34205*8310/3520-G	ACENAPHTHENE	UG/L			
34220*8310/3520-G	ANTHRACENE	UG/L			
34526*8310/3520-G	BENZO(A)ANTHRACENE	UG/L	0.009		
34247*8310/3520-G	BENZO(A)PYRENE	UG/L	0.004		
34230*8310/3520-G	BENZO(B)FLUORANTHENE	UG/L	0.005		0.002
34521*8310/3520-G	BENZO(GHI)PERYLENE	UG/L			
34242*8310/3520-G	BENZO(K)FLUORANTHENE	UG/L	0.002		
34320*8310/3520-G	CHRYSENE	UG/L			
34556*8310/3520-G	DIBEN(A,H)ANTH'CENE	UG/L			
34376*8310/3520-G	FLUORANTHENE	UG/L	0.009		0.007
34403*8310/3520-G	INDENO(1,2,3-CD) PYRENE	UG/L			
34696*8310/3520-G	NAPHTHALENE	UG/L			
34461*8310/3520-G	PHENANTHRENE	UG/L			
34469*8310/3520-G	PYRENE	UG/L			
39330*8080/3520-G	ALDRIN	UG/L			
39310*8080/3520-G	DDD,PP'	UG/L			
39320*8080/3520-G	DDE,PP'	UG/L			
39300*8080/3520-G	DDT,PP'	UG/L			
39380*8080/3520-G	DIELDRIN	UG/L			
39420*8080/3520-G	HEPTACHLOR EPOXIDE	UG/L			
1105*6010-G	ALUMINUM,TOTAL	UG/L	89900	33400	23400
1002*7060-G	ARSENIC,TOTAL	UG/L			
1007*6010-G	BARIUM,TOTAL	UG/L	358	599	360
1027*6010-G	CADMIUM,TOTAL	UG/L			
1034*6010-G	CHROMIUM,TOTAL	UG/L	118	109	49.3
1037*6010-G	COBALT,TOTAL	UG/L	156	103	31.1
1042*6010-G	COPPER,TOTAL	UG/L	71.6	90.1	97.3
1051*7421-G	LEAD,TOTAL	UG/L	24.4	21.8	17.5
71900*7470-G	MERCURY,TOTAL	UG/L	0.31	0.26	0.28
1092*6010-G	ZINC,TOTAL	UG/L	268	148	107
70300*160.1-G	RESIDUE,DISS (TDS)	MG/L	181	373	260
1106*6010-G	ALUMINUM,DISS	UG/L			494
1005*6010-G	BARIUM,DISS	UG/L	38.8	44.9	171
1040*6010-G	COPPER,DISS	UG/L			
1049*7421-G	LEAD,DISS	UG/L			
1090*6010-G	ZINC,DISS	UG/L			

Source: Environmental Science and Engineering, Inc., 1994

TAB

Appendix C - Sample Collection
Procedures for Surface Water & Sediments

Appendix C
Sample Collection Procedures for Surface Water and Sediments

Surface Water Sampling

At each of the four sampling locations out in the water body, surface water will be collected from two sampling depths. One sample will be collected within the top 24 inches down from the water surface and one at approximately 1 ft above the bottom. Water at these discrete depths will be collected using a 1.2-liter Kemmerer sampler. This sampler is a messenger-activated device constructed of Teflon® and plastic. The sample comes into contact only with Teflon®

The device will be cocked open to allow free flow of water as it is lowered by rope to the sample depth. The sample will be contained using a line messenger to trip the closing mechanism. After retrieval, collected water will be dispensed directly into the sample containers. This process will be repeated until all sample bottles are filled. Surface water will be sampled before sediment sampling or other activities that may suspend sediments or disturb the water column. The top surface sample will be collected first. Before being used, all sampling equipment will be decontaminated in accordance with the *QAPP* (ref. 1).

Sediment and Soil Sampling within Surface Water Bodies

Where the vertical distribution of sediment and soil contamination is being investigated in a surface water body, samples will be collected at two depths. One sample will be collected from the top few inches of sediment on the basin bottom, and a second sample will be collected from the soil below the sediment layer. The underlying soil sample will be collected at a depth of approximately 6 to 18 inches beneath the sediments. At the Golf Course Pond (Site 25) and Lake Danielson (Site 26), four locations in each water body will be sampled to evaluate the vertical distribution of contamination in the sediments and soils.

The upper layer of sediment will be collected using a Petite Ponar dredge or similar sampling device. The Petite Ponar is a clamshell-type scoop activated by a counter lever system which will sample 232 square centimeters (cm^2) of sediment up to several centimeters deep. To collect a sediment sample, the sampler will be carefully lowered onto the sediments to minimize disturbance and to allow the device to settle upright. Once the rope is relaxed, the counter lever will function and the device will grab sediment as it is pulled up. After retrieval, the sampler will be opened over a decontaminated stainless steel tray. The collected sediment will be removed with a stainless steel spoon and placed in sample jars. All sampling equipment will be decontaminated in accordance with the *QAPP* (ref. 1).

The soil below the sediment will be sampled using a Kajak-Brinkhurst (KB) gravity corer. This is a hand-held corer composed of a stainless steel tube with a removable tapered nosepiece at the bottom and a check valve on the top. The check valve allows water to pass through the corer on descent but prevents washout during recovery. A clear, hard plastic sleeve is placed inside the corer to contain the sample and provide for clean removal. The top of the KB corer is connected to sections of galvanized pipe that provide for precise lowering of the device and enable the corer to be pushed by hand into the sediment and underlying soils. The purpose of using the KB corer is to sample beyond the deposited sediment layer and into the underlying soil. When the corer is filled and returned to the sampling platform, the nose piece is unscrewed and the plastic sleeve is carefully removed. Over a stainless steel tray, the soil sample will be extruded from the end containing the desired sample. Care will be taken to prevent mixing of the soil and sediment layers contained within the tube. Samples of soil will be collected either directly from the plastic sleeve or from the stainless steel tray using a stainless steel spoon. All sampling equipment will be decontaminated before use in accordance with the *QAPP* (ref. 1).

If the sediment layer is found to be extremely thick (greater than 12 inches), thus preventing effective sampling of the underlying soil using the KB corer, an attempt will be made to collect the sample using PVC pipe as a deeper penetrating corer. This will be accomplished by using a 1- to 2-inch PVC pipe of appropriate length; the pipe will be forced into the sediment layers by hand or hammered to an appropriate depth to recover samples of the deeper soil. The upper end of the pipe will be capped before the sample is brought to the surface to prevent the soil from being flushed from the corer. The sample will be collected by shaking or cutting the PVC corer or by any other means needed to retrieve a sample as intact as possible without cross contamination. After the sample is placed in a decontaminated stainless steel tray, the soil will be removed with a stainless steel spoon and placed into the sample jars. All sample collection equipment will be decontaminated in accordance with the *QAPP* (ref. 1).

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