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SITE INVESTIGATION REPORT

**FORT McCLELLAN, ALABAMA
TASK ORDER 001
Contract Number DAAA15-91-D-0017**

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Prepared for:

**U.S. Army Environmental Center
Installation Restoration Division
Aberdeen Proving Ground,
Maryland 21010-5401**

August 31, 1993

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13. ABSTRACT (Maximum 200 words) This report documents the findings of environmental investigations at 17 sites indentified by USAEC at Fort McClellan, Alabama. The investigated sites included 12 former chemical warfare agent (CWA) training areas, 2 possible chemical munitions disposal areas, and 3 former landfills. Twelve of the sites are located on the Main Post of Fort McClellan and 5 sites are located on the adjacent Pelham Range. Environmental investigations at the sites included field screening of soil for HD, GB, and VX chemical warfare agents using MINICAMS and laboratory analysis for agent breakdown products. Screening for CWA at the sites indicated below TWA concentrations at sites where readings were obtained. Agent breakdown products were not detected in soil samples submitted for laboratory analysis. Qualitative and quantitative geophysical surveying was conducted at several sites including metal detection, EM-31 electromagnetics surveys, and magnetometry. Eight monitoring wells were installed at two of the former landfill sites. Samples obtained from the eight SI monitoring wells and from five existing monitoring wells detected low levels of organic chemicals and metals in the groundwater. HRS scoring for former landfill #3 produced a 16.08 score based on limited sampling.				
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FOR
FORT McCLELLAN, ALABAMA**

FINAL

Submitted to:

**U.S. Army Environmental Center
Installation Restoration Division
SFIM-AEC-IRB
Aberdeen Proving Ground, Maryland 21010-5401**

Submitted by:

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McLean, Virginia 22102**

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LIST OF ACRONYMS AND ABBREVIATIONS

ADEM	Alabama Department of Environmental Management
APC	Armored Personnel Carrier
ASTM	American Society of Testing and Materials
BEQ	Bachelor Enlisted Quarters
BG	Bacillus globigii
BLS	Below Land Surface
BOQ	Bachelor Officer Quarters
bpf	Blows per foot
CBR	Chemical, Biological, and Radiological
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COD	Chemical Oxygen Demand
CE	U.S. Army Corps of Engineers
CNB	Chloracepto-phenone
CRL	Certified Reporting Limit
CUCV	Commercial Utility Cargo Vehicles
CWA	Chemical Warfare Agent
DES ₂	bis(2-diisopropylaminoethyl) disulfide
DESMF	S-(diisopropylaminoethyl) methylphosphonothioate
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
DS-2	Decontamination Solution 2
DVS	Divinyl sulfide
EIS	Environmental Impact Statement
EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
GB	Sarin (Isopropyl methyl phosphonofluoridate)
gpd	Gallons per day
GPR	Ground Penetrating Radar
GPS	Global Positioning Survey
HD	Distilled Mustard
HO	Mustard Sulfoxide
HRS	Hazard Ranking System
I.D.	Inside Diameter
IMPA	Isopropyl methylphosphonic acid
IRDMIS	Installation Restoration Data Management Information System
LEL	Lower Explosive Limit
MCL	Maximum Contaminant Level
mph	Miles Per Hour
MP	Military Police
MSL	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NWI	National Wetlands Inventory

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

O.D.	Outside Diameter
OVA	Organic Vapor Analyzer
OWS	Oil/Water Separator
PA	Preliminary Assessment
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PID	Photoionization Detector
POW	Prisoner of War
PREscore	Preliminary Risk Evaluation Score
PSI	Pounds per Square Inch
PVC	Polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
SAIC	Science Applications International Corporation
SAP	Sampling Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SARM	Standard Analytical Reference Material
SI	Site Investigation
SM	Serratia mercesans
SOP	Standard Operating Procedure
STB	Supertropical Bleach
SPT	Standard Penetration Test
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TRADOC	U.S. Army Training and Doctrine Command
TWA	Time Weighted Average
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USAMCLS	U.S. Army Chemical School
USAMPS	U.S. Army Military Police School
USATEU	U.S. Army Technical Escort Unit
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
UTES	Unit Training Equipment Site
UXO	Unexploded Ordnance
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
VX	O-ethyl-S-(diisopropylaminoethyl)-methylphosphonothiolate (nerve agent)

EXECUTIVE SUMMARY

This Site Investigation (SI) report summarizes work performed by Science Applications International Corporation (SAIC) between June 1991 to July 1993 at 17 identified sites within Fort McClellan, Alabama for the U.S. Army Environmental Center (USAEC) at Aberdeen Proving Ground, Maryland. The SI was conducted to investigate the potential for environmental contamination by chemical warfare agents, biological simulants, and chemical warfare agent breakdown products at 12 former training areas (Areas T-4, T-5, T-6, T-24A, T-31, and T-38; Old Toxic Training Area; Ranges I, J, and K; Detection and Identification Area, and Former HD Spill/Burial Sites) identified at Fort McClellan, Alabama. Two additional areas (Range L and the Old Water Hole) also were investigated as potential former chemical weapons and munitions disposal areas. Nine of the former training sites are located on the Main Post at Fort McClellan and five of the sites are located on the Pelham Range, located west of Fort McClellan. Activities at the training sites were completed with assistance from the U.S. Army Technical Escort Unit (USATEU) from Aberdeen Proving Ground, Maryland. Three former municipal landfill sites (Former Landfills #1, #2, and #3) were investigated for potential groundwater and surface water contamination.

Field screening (using MINICAMS) for chemical warfare agents (GB, HD, and VX) in soil, sediment, and water samples did not detect agent in concentrations exceeding established TWA values for these compounds. Laboratory analysis of the screened samples for agent breakdown products yielded nondetect results. However, organic compounds and metals were detected in groundwater samples taken at Former Landfill #3. In addition, geophysical surveys indicated the presence of near surface metallic debris or shallow soil disturbance at Landfill #1, Range L, Old Water Hole, Area T-24A, and Area T-38. Metallic surface debris was visually observed at Landfill #2.

The former training areas were investigated by the USATEU using portable drilling equipment to sample shallow soil, surface water, and sediments for laboratory analysis. Field screening of collected samples for the chemical agents distilled mustard (HD), sarin (GB), and O-ethyl-S(diisopropylaminoethyl) Methylphosphonothiolate (VX) was conducted by the USATEU

using MINICAMS analyzers provided by the U.S. Army Chemical School at Fort McClellan. Screened samples were analyzed in the laboratory for chemical agent breakdown products. Environmental sampling activities at the training sites were conducted under SAIC oversight. Qualitative metal detection surveys were conducted by the USATEU at several sites that potentially contained buried ordnance, including Range L and the Old Water Hole. SAIC conducted quantitative electromagnetic (EM) surveys at Area T-24A, Area T-38, Range J, and Range K.

Three former municipal landfill sites were investigated by SAIC using surface geophysics and environmental sampling of groundwater, surface water, and sediment at the sites. Former Landfill #1 was investigated by obtaining quantitative magnetometer measurements at discrete, equally spaced locations along seven transects arranged in a grid pattern at the site. Former Landfill #2 was investigated with three borings completed as monitoring wells, and Former Landfill #3 was investigated with five borings completed as monitoring wells. All of the monitoring wells at these sites (including five existing wells at Former Landfill #3) were sampled during the SI. Chemical analyses for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides/PCBs, explosives, and chemical agent breakdown products were completed for groundwater, surface water, and sediment samples collected at Former Landfills #2 and #3.

The results of environmental analyses at the locations sampled in the training areas did not detect the presence of chemical warfare agents or agent breakdown products in samples collected from high-probability locations within the identified site areas. Qualitative geophysical (metal detection) surveys by the USATEU indicate the presence of substantial metallic objects buried at Range L and the Old Water Hole. Quantitative EM surveys at Area T-38 suggest the presence of subsurface disturbance at the approximate location of a former disposal sump. These areas warrant additional investigative activities, including quantitative geophysics, drilling, and monitoring well installation. Two of the sites (Old Toxic Training Area, HD Spill/Burial Sites) will not require additional investigation and warrant removal from SI program consideration. Range K will require additional site reconnaissance and soil sampling to investigate identified HD and GB canisters and ordnance within the site boundaries.

Quantitative magnetometer surveys at Former Landfill #1 detected the presence of scattered near-surface metallic debris. Broad anomalous areas were delineated in the southwestern portion of the site that warrant additional, multiple-technique geophysical surveying and potentially monitoring well installation.

Environmental analyses at Former Landfill #2 do not indicate the presence of groundwater contamination at the site. A second round of groundwater analyses, including a downstream surface water/sediment sample, are recommended at the site to confirm the initial sample results. In addition, the known boundaries of the former landfill indicate that the site may be smaller than initially indicated; however, the site boundaries have not been fully established.

Groundwater contamination by organic compounds and metals was detected at Former Landfill #3. Concentrations of organics (trichloroethylene, 1,1-dichloroethene, benzene, methyl isobutyl ketone, and 1,1,2,2-trichloroethane) were generally detected below or slightly exceeding regulatory maximum contaminant levels (MCLs). Metals concentrations, including chromium, nickel, lead, and beryllium, exceeded MCLs at wells OLF-2 and OLF-3. Explosive-related compounds 1,3,5-trinitrobenzene and 2,4-dinitrotoluene were detected in well OLF-10. Additional investigative activities are warranted for this site, including a second groundwater sampling round, more detailed characterization of groundwater flow conditions and water quality in the landfill area, and photogrammetric, or geophysical investigation of the landfill geometry. The Former Landfill #3 groundwater and surface water pathways produced a Hazard Ranking System (HRS) score of 16.08.

Additional geologic and hydrogeologic characterization is warranted at Former Landfills #1, #2, and #3, Range L, and the Old Water Hole, since these areas indicate a potential for release of contaminants to the environment or represent an environmental hazard. Additional characterization at these sites should include combinations of quantitative geophysics, drilling and monitoring well installations, soil sampling and analysis, water level measurements, and slug testing.

1. INTRODUCTION

1.1 PURPOSE AND SCOPE

Science Applications International Corporation (SAIC) conducted a Site Investigation (SI) at Fort McClellan, Alabama to determine the presence and nature of potential environmental contamination at 17 sites identified by the U.S. Army Environmental Center (USAEC). The 17 sites were identified for initial investigation as a result of the findings of a 1989 report submitted by Fort McClellan to the U.S. Environmental Protection Agency (EPA) Region IV. The sites that were investigated under the SI program are summarized in Table 1-1. The work at Fort McClellan was conducted at the request of USAEC pursuant to Contract DAAA15-91-D-0017, Task Order 1.

1.2 SITE INVESTIGATION OVERVIEW

SI activities followed site-specific project plans that included field sampling and laboratory chemical analyses using specific quality assurance/quality control (QA/QC) and health and safety protocols. Specific objectives of the SI included identification of the presence and magnitude of environmental contamination at the 17 identified sites at Fort McClellan. The scope of work did not include delineation of the areal extent of detected contamination or detailed geologic/hydrogeologic site characterization.

1.3 REPORT ORGANIZATION

The outline of this SI report follows guidance presented in the EPA document, *Information and Data Requirements for Site Investigations, Federal Agencies* (EPA 1990). Section 1 presents background information for the Fort McClellan area and the 17 individual sites investigated under the SI program. Section 2 describes the investigation activities conducted at Fort McClellan, including geotechnical analyses, field screening and sampling protocols, waste management, test drilling, well installation, waste management, and laboratory investigations. Section 3 discusses the site geology as observed from monitoring well drilling in addition to a data quality assessment of the laboratory analytical results and a summary of the results of investigations and analyses at each of the SI sites. Section 4 contains a preliminary

**Table 1-1. Sites Investigated Under SI Program
Fort McClellan, Alabama**

Site Number and Name	Location
1 Area T-4 Biological Simulant Test Area	Main Post
2 Area T-5 Toxic Hazards Detection and Decontamination Training Area	Main Post
3 Area T-6 Agent Decontamination Training Area	Main Post
4 Area T-24A Chemical Munitions Disposal Training Area	Main Post
5 Area T-31 Technical Escort Reaction Area	Main Post
6 Area T-38 Technical Escort Reaction Area	Main Post
7 Old Toxic Training Area	Main Post
8 Range K Agent Training Area	Pelham Range
9 Range I Agent Shell Tapping Area	Pelham Range
10 Range J Agent Training Area	Pelham Range
11 Range L (Lima Pond) Chemical Munitions Disposal Area	Pelham Range
12 Detection and Identification Area	Main Post
13 Former Landfill #1	Main Post
14 Former Landfill #2	Main Post
15 Former Landfill #3	Main Post
16 HD Spill/Burial Sites	Main Post/Pelham Range
17 Old Water Hole	Pelham Range

risk evaluation consisting of Hazard Ranking System (HRS) scoring for the site determined during the investigation to be the most contaminated. Section 5 summarizes SAIC's conclusions and recommendations based on the results of the SI investigation. Section 6 lists the references used in preparing this SI report. Appendices A through J contain data tabulations and summary field records.

1.4 FACILITY BACKGROUND

Background information pertinent to the Fort McClellan SI was obtained from USATHAMA (1977, 1990) and includes details of the facilities present on Post, site descriptions, regulatory history, and prior environmental activities.

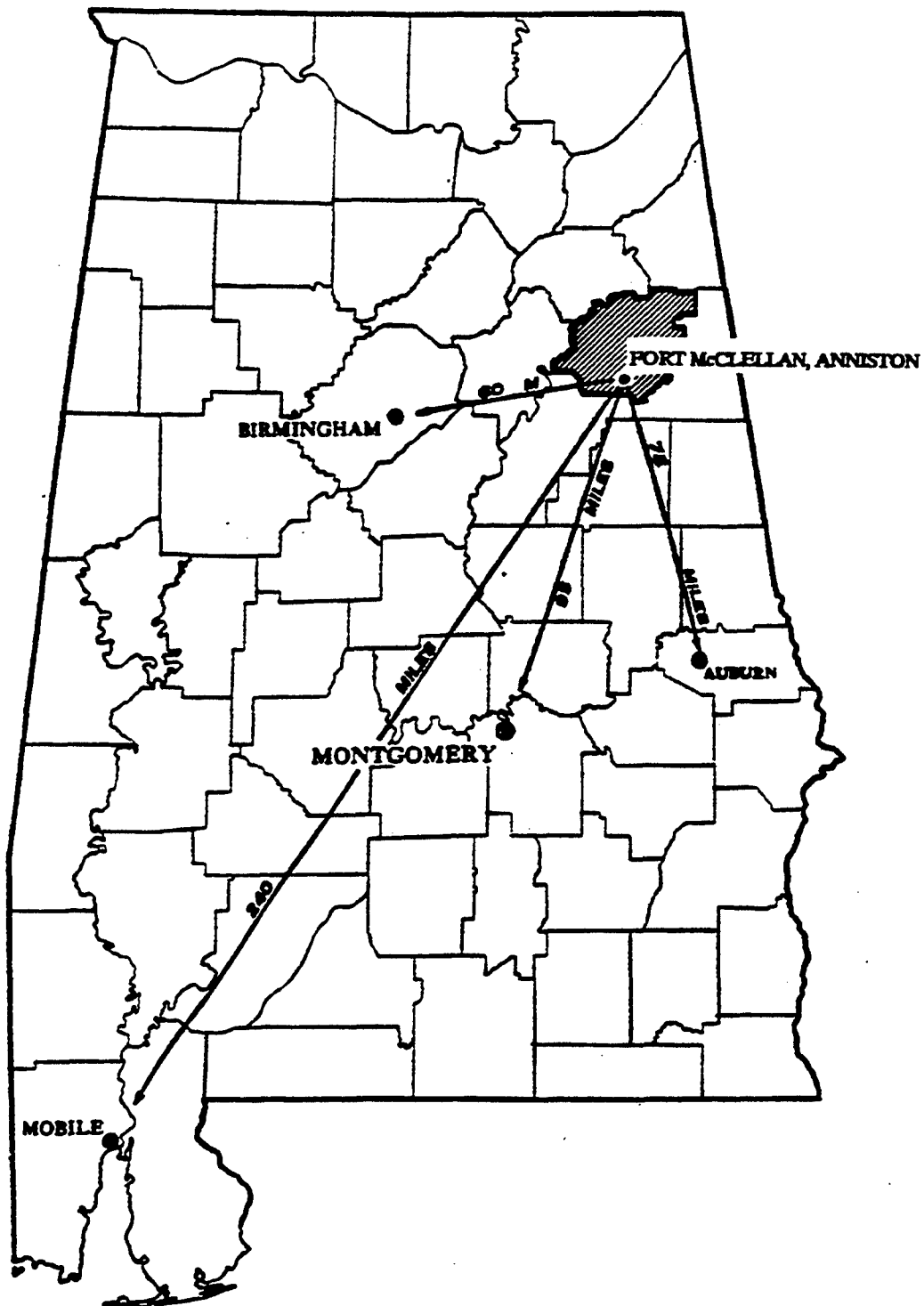
1.4.1 Post Description and History

Fort McClellan is located in northeastern Alabama in Calhoun County, as shown in Figure 1-1. The Post is approximately 60 miles northeast of Birmingham and approximately 75 miles northwest of Auburn, Alabama. The town of Anniston adjoins the main installation on the south and east, and the town of Gadsden lies 28 miles to the north. The Morrisville Maneuver Area, or Pelham Range, is located approximately 5 miles due west of the main installation, and adjoins the Anniston Army Depot. Pelham Range is bordered on the east by U.S. Highway 431.

The Post consists of 45,679 acres of Government-owned and leased land situated in the foothills of the Appalachian mountains of northwest Alabama. The size of each main parcel is as follows:

Main Installation	18,946 acres
Pelham Range	22,245 acres
Choccolocco Corridor (leased)	<u>4,488</u> acres
	45,679 acres

The Main Post includes administrative, mission, housing, and commercial buildings. Pelham Range is used for artillery firing, smoke operations training, and field training exercises.



LOCATION OF FORT McCLELLAN/
ANNISTON, ALABAMA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 1-1

Adjoining the Main Post to the east is the Choccolocco Corridor, which is leased to the Federal Government by the Alabama State Legislature to provide an access corridor from the Main Post to the Talladega National Park.

Fort McClellan reports directly to the U.S. Army Training and Doctrine Command (TRADOC) and is under their operational control. The installation houses three major organizations -- U.S. Army Military Police School (USAMPS), U.S. Army Chemical School (USAMCLS), and Training Center (under the direction of the Training Brigade) -- in addition to other support units and tenants.

1.4.1.1 Ownership and Operational History

In 1917, the Federal Government purchased 18,946 acres of land near Anniston for use as an artillery range. Camp McClellan was used to train troops for World War I and served in that capacity until the armistice. The area was then designated as a demobilization center. Between 1919 and 1929, Camp McClellan served as a training area for active army units and other civilian elements. Camp McClellan was redesignated as Fort McClellan in July 1929 and continued to serve as a training area.

In October 1940, the Federal Government acquired an additional 22,245 acres west of Fort McClellan. This tract of land was named Pelham Range in honor of Major John Pelham. In 1941, the Alabama Legislature leased approximately 4,488 acres to the Federal Government to provide an access corridor from the Main Post to Talladega National Forest. From August 1945 until August 1946, Fort McClellan served as a separation point. After a 3-month closing period, it was activated as a Recruit Training Center until May 1947 and subsequently was placed in an inactive status until 1951.

The Army reactivated Fort McClellan on January 4, 1951 for operation of the Chemical Corps School and as a replacement center for the Chemical Corps. The Chemical Corps School offered advance training in all phases of chemical, biological, and radiological warfare to students from all branches of the military service until the school was deactivated in 1973. The

Army Combat Development Command Chemical/Biological Radiological Agency moved to Fort McClellan in 1962 and performed its mission until it also was deactivated in 1973.

The mission of the installation was changed in 1966 and Fort McClellan was renamed the U.S. Army School/Training Center and Fort McClellan. An Advanced Individual Training Infantry Brigade was activated in 1966 to meet requirements for the Vietnam War. Because of continued force reductions in Vietnam, the Brigade was deactivated in 1970 after training more than 30,000 men. The 3rd Army NCO Academy also was stationed at Fort McClellan from 1967 to 1972.

On July 11, 1975, the U.S. Army Military Police School was moved from Fort Gordon, Georgia to Fort McClellan. In December 1979, the U.S. Army Chemical School was relocated to Fort McClellan from Aberdeen Proving Ground, Maryland.

1.4.1.2 Regulatory History

The following information is provided in accordance with *Information and Data Requirements for Site Investigations, Federal Agencies* (EPA 1990) and is taken from USATHAMA (1990).

Resource Conservation and Recovery Act Facilities — The Main Post (EPA ID No. AL4 210 020 562) contained an interim status storage area and several hazardous waste generation points. Fort McClellan has closed the interim status container storage area under the Resource Conservation and Recovery Act (RCRA), and as referenced in a letter (3 November 1988) to the Alabama Department of Environmental Management (ADEM), the facility will store and handle hazardous waste under a generator status at the Main Post. Pelham Range is used for the open demolition of unexploded ordnance (UXO). A RCRA Part B Subpart X permit application for the Open Burn Area was submitted on 13 December 1988. Unless otherwise noted, the permits mentioned below have been issued by the State of Alabama.

National Pollutant Discharge Elimination System (NPDES) Permits — Wastewater generated at the Post is treated in the Fort McClellan Wastewater Treatment Plant (4.5 million

gallons per day [gpd] capacity), which has been leased by the Army to the city of Anniston since 1974. The NPDES permit (No. AL0024520) is maintained by the Water Works and Sewer Board of the city of Anniston. Concern over degradation of nearby Cane Creek due to the age (constructed in 1941) and capacity of the treatment plant and violation of the permit conditions led the ADEM to enter into a Consent Order (No. 90-039-WP) with the Water Works and Sewer Board of the city of Anniston. Various solutions to the current wastewater treatment system overload have been considered. However, since Fort McClellan's activities account for approximately 90 percent of the influent to the wastewater treatment plant. Fort McClellan has recently completed the design for the upgrade of the wastewater treatment plant and is expected to start construction of the plant in early 1993.

Point source discharges were covered by NPDES Permit No. AL003803, April 1976, including 6 vehicle wash racks, blowdown from 10 cooling towers, blowdown from 2 boiler plants, and filter backwash from 4 swimming pools.

The Army currently maintains two NPDES permits for Fort McClellan and Pelham Range. Permit No. AL0055999 covers storm water runoff via oil/water separators (OWSs) from petroleum storage and handling areas that discharge to Cane Creek and South Branch. This permit also includes the OWSs at the fog oil drum storage areas located at Ranges 4A and 24A. Permit No. AL0057665 covers discharge from the Unit Training Equipment Site (UTES) #1 at Pelham Range via a sedimentation basin equipped with a float block and an oil skimming device and discharges the water to an unnamed tributary of Cane Creek.

Air Permits — Air permits maintained for Fort McClellan and Pelham Range are covered under Permit Approval Data Sheet - Facility Number 301-0017 and include:

- Boiler Plant 1, Building 3176, Main Post. Four gas/oil-fired boilers (one 9.279-MM Btu/hr and three 28.0-MM Btu/hr). Permit No. 301-0017-008.
- Boiler Plant 2. Two gas/oil-fired boilers (51,500,000 Btu/hr). Permit No. 301-0017-002.
- Boiler Plant 3. Three gas/oil-fired boilers (40,626,000 Btu/hr). Permit No. 301-0017-001.

- Boiler Plant 4, Building 1876. Grandfathered.
- Five gasoline storage tanks (12,000 gallons each), Facility T-265. Permit No. 301-0017-003.
- Two JP-4 storage tanks (12,000 gallons each), Facility T-263. Permit No. 301-0017-004.
- Five propane storage tanks (30,000 gallons each), Facility 3217. Permit No. 301-0017-005.
- Chemical Decontamination Training Facility Incinerator with wet scrubber. Permit No. 301-0017-007.
- Noble Army Hospital infectious waste incinerator (30 pounds per week).

Solid Waste Permits — Solid waste (i.e., household refuse and commercial waste) generated at the Post is landfilled at a permitted on-Post facility. The landfill is regulated under Permit No. 08-02R for Military Reservation Fort McClellan. The permitted landfill location is described as South half of the North half, Section 10, township 15 South, Range SE, located in Calhoun County, Alabama. Waste approved for disposal under Permit No. 80-02R includes household garbage and rubbish, and commercial solid waste (i.e., wooden pallets, paper, and demolition waste). The permit was issued 1 May 1987 and expired 30 April 1992. An extension of the presently expired permit has been given to Fort McClellan by the Alabama Department of Environmental Management (ADEM) until October 9, 1993.

Water Supply Permits — Water supply permits maintained for Fort McClellan and Pelham Range include:

- Facility location — Anniston, Alabama, Permit No. 86-860; water system consists of two storage tanks combined capacity of 2,500,000 gallons; 15,350 customers, approximately 93 miles of water main.
- Facility location — Range 57, Permit No. 87-742; consists of a 70-gpm well with hypochlorinator and a 100-gallon pressurized tank.
- Facility location — Range 44, Permit No. 87-743; consists of a 5-gpm well with hypochlorinator and a 15,000-gallon elevated storage tank.
- Facility location — Rideout Hall, Building 8801, Permit No. 84-744; consists of a 5-gpm well with hypochlorinator and a 500-gallon pressurized tank.

1.4.1.3 Process and Waste Disposal History

Historical information regarding the activities conducted at the sites investigated under the SI program was obtained from USATHAMA (1990) and Environmental Science and Engineering (1984). This information is summarized in Table 1-2.

The chemical and biological agent training sites under investigation during the SI were used for the controlled training of personnel in various facets of chemical and biological warfare decontamination, detection, and munitions/agent disposal. Training at these sites occurred at various times between the early 1950's and 1973, with operations involving various agents, some of which may have been used on the individual sites. Limited, controlled usage of fixed quantities of chemical warfare agent was typical during the training exercises. Usage included establishment of identification stations where agent samples were set up for field identification, in addition to contaminating field equipment with limited quantities of agent for identification and decontamination training. Evidence of widespread dispersal or usage of training materials at the sites of concern was not identified by SAIC based on review of records at the U.S. Army Chemical Museum at Fort McClellan and discussions with site personnel who were present during the training exercises. The chemical agents included mustard (HD), the nerve agents O-ethyl-S(diisopropylaminoethyl)-methylphosphonothiolate (VX) and Sarin (GB), and the biological simulants *Bacillus globigii* (BG) and *Serratia mercesans* (SM). HD is the predominant agent thought to have been used at Fort McClellan. HD readily undergoes hydrolysis to form thiodiglycol, a relatively nontoxic compound. The HD also may polymerize on its surface in aqueous situations to form a protective insoluble coat, thus inhibiting further hydrolysis.

The potential persistence of subsurface contamination in soils and groundwater for the agents, agent degradation byproducts, decontaminant DS-2 (70 percent diethylenetriamine, 2 percent sodium hydroxide, and 28 percent ethylene glycol monomethyl ether) and supertropical bleach (STB) constituents, and byproducts from the reactions of agent with decontaminants has been evaluated (Small 1983). Based on the solubility, volatility, toxicity, and formation potential of the compounds evaluated, it was concluded that the only toxic compounds likely to persist in the subsurface soils at Fort McClellan are HD and bis(2-diisopropylaminoethyl) disulfide (DES)₂.

**Table 1-2. Summary of Process and Waste Disposal Activity
Site Investigation Sites, Fort McClellan, Alabama**

Range	Range Size	Probable Date Opened	Last Used	Agents Used	Process and Waste Disposal History
T-4	0.3 acres	1965	1971	BG, SM, HD**, VX**	Testing biologic simulants BG, SM.
T-5	11.4 acres	1961	1973	HD, GB, VX, BG, SM	Training for detection and decontamination of HD, GB, VX agents and simulants BG, SM. 110-gallon HD spill.
T-6	7.3 acres	Unknown	1973	HD	Training for decontamination of chemical agents, including HD.
T-24 Alpha	1.5 acres	Unknown	1973	HD, GB*	Chemical munitions disposal training for CG, BZ, HD, GB agents. Two square (256 sq ft) decontamination burn pits, depth possibly 6 feet. Possible HD spill (unconfirmed).
T-31	3.4 acres	1957	1969	HD, GB	Training with HD, GB agents. Onsite chemical storage. Possible spills.
T-38	6.0 acres	1961	1972	HD, GB, VX	Training in elimination of toxic hazards for chemical munitions and storage of HD, GB, VX agents. STB, DANC, DS-2 decontaminants used.
Old Toxic Training Area	484 sq ft	early 1950s	Unknown	HD	Training exercises for identification and detection of HD agent. Other agents possible. Agent placed directly on ground surface.
Pelham Range K	2.0 acres	Unknown	Unknown	HD**	Chemical/biological agent (GB, HD) training; shell tapping area for GB, CG rounds.
Pelham Range I	0.5 acres	Possibly 1963/1964	Possibly 1963/1964	HD**, GB	Chemical agent shell tapping — HD, GB agents.
Pelham Range J	0.1 acres	Unknown	1963	HD**	Training and chemical/biological agent disposal, possibly HD. Possible HD spill disposal area.
Detection and Identification	1.1 acres	Early 1950s	1973	HD, GB*	Testing and training with chemical/biological agents HD, GB, CK, GC, CX, AC. Training aids burned in pit onsite.
HD Spill/Burial Sites	Varied	Unknown	Unknown	HD	HD spill/burial sites.
Pelham Range L	0.5 acres	Unknown	Unknown	HD**	Disposal of captured WWII munitions, including chemical munitions (Lima Pond).
Former Landfill 1	2 acres	1945	1947	None	Sanitary landfill disposal.
Former Landfill 2	4 acres	1947	Unknown	None	Waste disposal during deactivation of installation
Former Landfill 3	22 acres	1946	1967	None	Sanitary landfill disposal.
Old Water Hole	2,975 sq ft	Unknown	Unknown	Unknown	Disposal site (possible sinkhole), chemical agents, munitions.

* Other simulants also used
 ** Assumed HD or VX used
 BG Bacillus Gobi
 SM Serratia Marcescens

Reference: Solid Waste Study No. 99-056-73/76, Fort McClellan, AL, Jul 73-Aug 75

The latter compound is the principal byproduct formed from the decontamination of VX with DS-2. The limited quantities of VX used on these sites essentially eliminates the potential for sufficiently large quantities of DES₂ to be of significance as an environmental contaminant in the soil.

Based on similar considerations, it was concluded that the only toxic compounds with the potential to persist in groundwater are divinyl sulfide (DVS), mustard sulfoxide (HO), DES₂, and S-(diisopropylaminoethyl) methylphosphonothioate (DESMP). DVS is formed from the alkaline hydrolysis of HD with DS-2, and HO is formed from the oxidation of HD with STB. DESMP is formed from the hydrolysis of VX. Although the potential exists for these compounds to be present in groundwater, it is unlikely they will be detected due to the limited quantities of agents used and decontaminated during training exercises.

1.4.1.4 Previous Environmental Studies at Fort McClellan

Several environmental studies have been published on Fort McClellan and Pelham Range. Nine facility-wide studies are available and some are discussed below.

The U.S. Army Environmental Hygiene Agency (USAEHA 1975) documented a 2-year investigation into the status and historical use of chemical, biological, and radiological (CBR) training areas. Based upon a limited records review and interviews, USAEHA (1975) identified 12 areas at Fort McClellan and Pelham Range that were investigated and cleared for surface contamination by the U.S. Army, but that were possibly contaminated in the subsurface. Restricted access and inclusion in future land restoration and recovery programs were recommended for these areas.

A second investigation consisting of records reviews, personnel interviews, and field inspections was conducted in 1977 (USATHAMA 1977). During this investigation, burial grounds and training areas were identified within the facility in which chemical or radiological contamination existed or was suspected. In addition, records indicated that UXO may be present in several training areas. This study also concluded that CBR contamination has not been

detected in surface water at the site and that a potential may exist for groundwater contamination from documented landfill operations.

Based upon a literature review of fate and transport of chemical agents, decontaminants, agent decontaminant byproducts, and past onsite CBR training practices, a 1983 study identified the most probable groundwater and soil contaminants that could still be present at Fort McClellan and Pelham Range. A second review of facility operations and their effects on the environment also was published in 1983. This study was compiled for the facility's Installation Planning Board.

A 1977 records search conducted by USATHAMA was re-evaluated and integrated with subsequent data in 1984. This study was limited to chemical agents and restricted compounds and resulted in 21 site-specific contamination assessments.

The USAEHA conducted an investigation at Fort McClellan in 1986 to identify all solid waste management units (SWMUs) on Post. USAEHA (1986) formally identified 41 SWMUs on Fort McClellan and Pelham Range. Each SWMU was located, described, and evaluated to the extent possible. Five monitoring wells were installed by the Agency at Former Landfill #3 as part of the investigation.

An enhanced Preliminary Assessment (PA) was conducted by Roy F. Weston, Inc. in 1990 (USATHAMA 1990) to evaluate the status of active non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and inactive CERCLA sites potentially impacting the U.S. Army's planned closure of Fort McClellan. The PA identified 67 active and inactive sites on the Main Post and Pelham Range.

1.4.1.5 Previous Remedial/Removal Actions

Historical information regarding previous activities conducted at the SI sites to mitigate environmental contamination was obtained from USATHAMA (1990). Table 1-3 summarizes the available information for the 17 SI sites.

**Table 1-3. Summary of Previous Remedial/Removal Actions
Site Investigation Sites, Fort McClellan, Alabama**

Range	Range Size	Probable Date Opened	Last Used	Agents Used	Process and Waste Disposal History
T-4	0.3 acres	1965	1971	BG, SM, HD**, VX**	Decontamination of agents and surface soils using STB and DS-2. Surface soil sampling and analysis.
T-5	11.4 acres	1961	1973	HD, GB, VX, BG, SM	Training sites decontaminated and tested at end of each exercise, using STB and/or DS-2. Contaminated soil possibly removed and disposed of at Range J. Surface soil sampling and analysis.
T-6	7.3 acres	Unknown	1973	HD	Decontaminants STB and DS-2 used during exercises. Random surface soil sampling and analysis.
T-24 Alpha	1.5 acres	Unknown	1973	HD, GB*	Pits filled with soil. Decontamination of agents on soils using STB and DS-2. Surface soil sampling and analysis.
T-31	3.4 acres	1957	1969	HD, GB	Training aids moved to Site T-38. Soil possibly decontaminated using STB and DS-2.
T-38	6.0 acres	1961	1972	HD, GB, VX	Extensive decontamination for reported spills and contaminated training aids. Surface soil sampling and analysis.
Old Toxic Training Area	484 sq ft	early 1950s	Unknown	HD	Surface soil decontaminated using STB and DS-2.
Pelham Range K	2.0 acres	Unknown	Unknown	HD**	Site was physically rearranged (bulldozed). Surface monitoring conducted.
Pelham Range I	0.5 acres	Possibly 1963/1964	Possibly 1963/1964	HD**, GB	Area physically rearranged with upper 2 feet of soil removed to unknown location.
Pelham Range J	0.1 acres	Unknown	1963	HD**	Limited onsite monitoring.
Detection and Identification	1.1 acres	Early 1950s	1973	HD, GB*	Decontaminants STB and DS-2 used on surface soils. Training aids burned in open, onsite pit and subsequently buried.
HD Spill/Burial Sites	Varied	Unknown	Unknown	HD	Some areas may have been paved.
Pelham Range L	0.5 acres	Unknown	Unknown	HD**	Sampled and analyzed surface water and soil samples (Lima Pond).
Former Landfill 1	2 acres	1945	1947	None	Visual inspection.
Former Landfill 2	4 acres	1947	Unknown	None	Visual inspection.
Former Landfill 3	22 acres	1946	1967	None	Installed 5 groundwater monitoring wells. Sampled and analyzed groundwater samples.
Old Water Hole	2,975 sq ft	Unknown	Unknown	Unknown	Visual inspection.

* Other simulants also used
 ** Assumed HD or VX used
 BG Bacillus Gobi
 SM Serratia Marcescens
 STB Supertropical Bleach

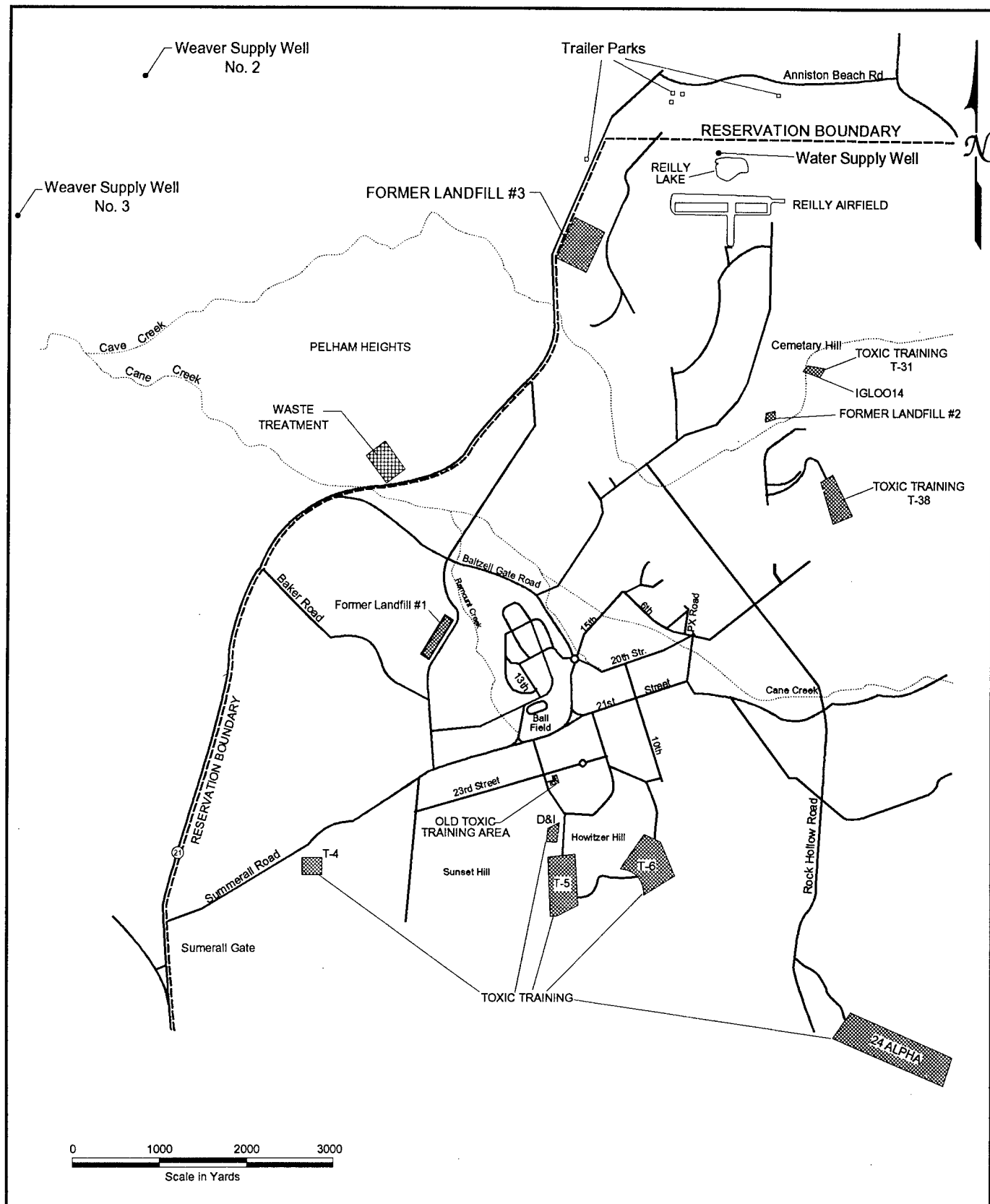
Reference: Solid Waste Study No. 99-056-73/76, Fort McClellan, AL, Jul 73-Aug 75

1.4.2 Site Descriptions

The 17 sites investigated under the Fort McClellan SI are summarized below. Information pertinent to the sites was obtained from USATHAMA (1990), Environmental Science and Engineering (1984), USAEHA (1986), and site visits conducted by SAIC in 1991 and 1992. These sites are shown collectively in Figures 1-2 and 1-3. SAIC's original scope of work for the SI program included 17 sites identified by USAEC, as described in the SI Sampling and Analysis Plan (SAIC 1992). Prior to the initiation of field work in April 1992, USAEC and SAIC conducted site visits to the various locations in October 1991 and April 1992. During the October 1991 visit, it was concluded that further sampling activities would not be conducted at Site 1 (Area T-4) and Site 12 (HD Spill/Disposal Sites) because the sites could not be adequately located and in some instances the appropriate locations were underneath developed areas. Biological simulants reportedly used at Area T-4 are not environmentally persistent and were used in minimal quantities.

1.4.2.1 Site 1 - Area T-4

Site 1 - Area T-4 was reportedly a Biological Simulant Test Area located on the Main Post (Figure 1-2). Records indicate that a 0.25-acre site was used between 1965 and 1971 for biological simulant (BG and SM) training. Decontamination of the simulants on the surface soils was performed by adding STB and DS-2. Contamination from HD was not detected in surface soil samples collected by the Army in April and July 1973; however, subsurface soil samples were not collected at that time. The use of the area was limited to surface activity in the unlikely event that some HD may have been used at the site, and because subsurface sampling had not been conducted at the site. The identified area of the former site had been extensively re-worked and no evidence of a former site was observed at the location identified by the Base during the October 1991 site visit by USATHAMA and SAIC. Based on the inability to locate the former site and the fact that biological simulants are not persistent in the environment, additional investigative activities were not conducted at Area T-4 during the SI. SAIC recommends that additional efforts be made to locate Site 1 and that sampling be conducted before the site is eliminated from further study.

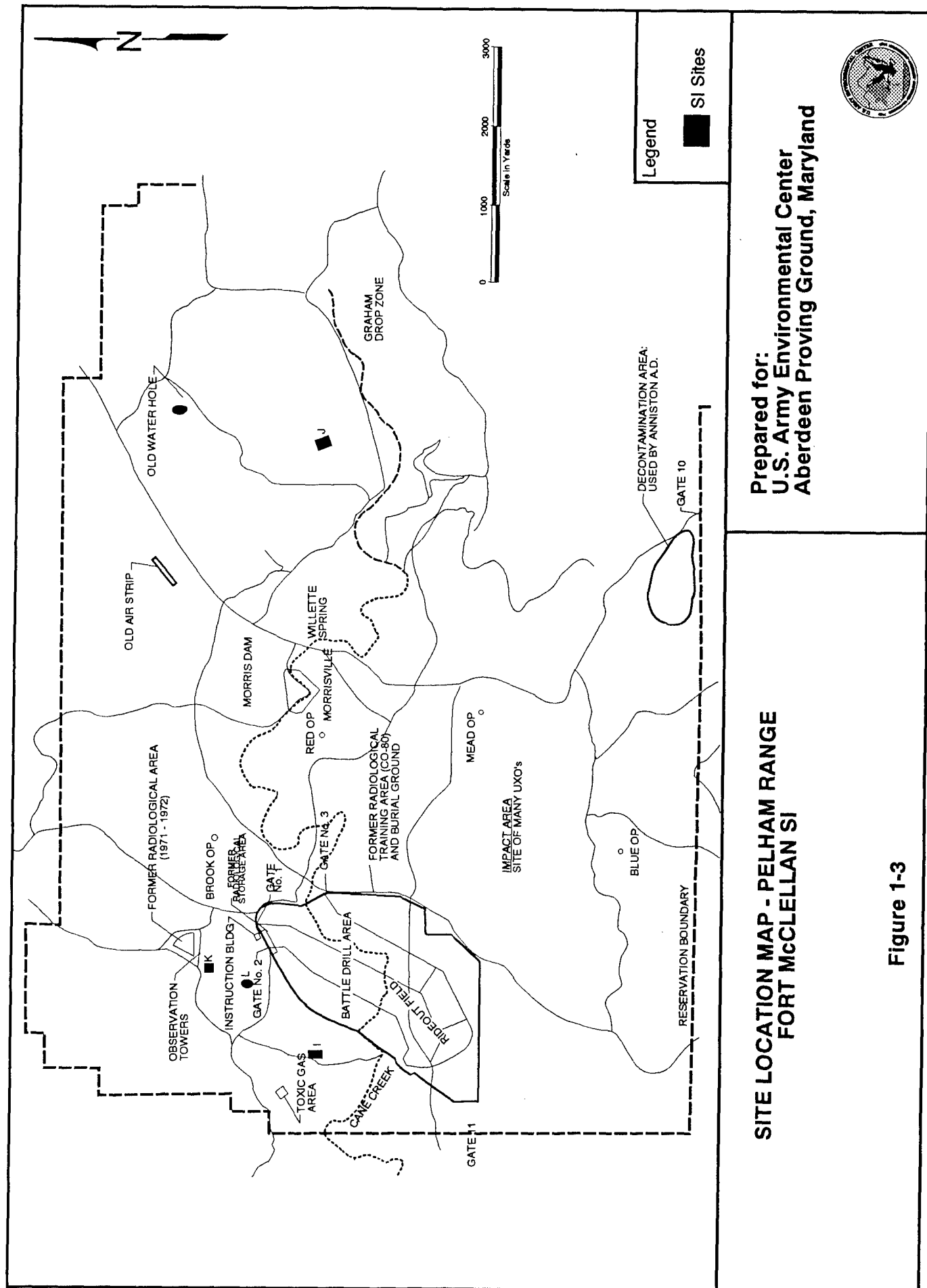


**SITE LOCATION MAP - MAIN POST
FORT McCLELLAN, ALABAMA**

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Aberdeen Proving Ground, Maryland



Figure 1-2

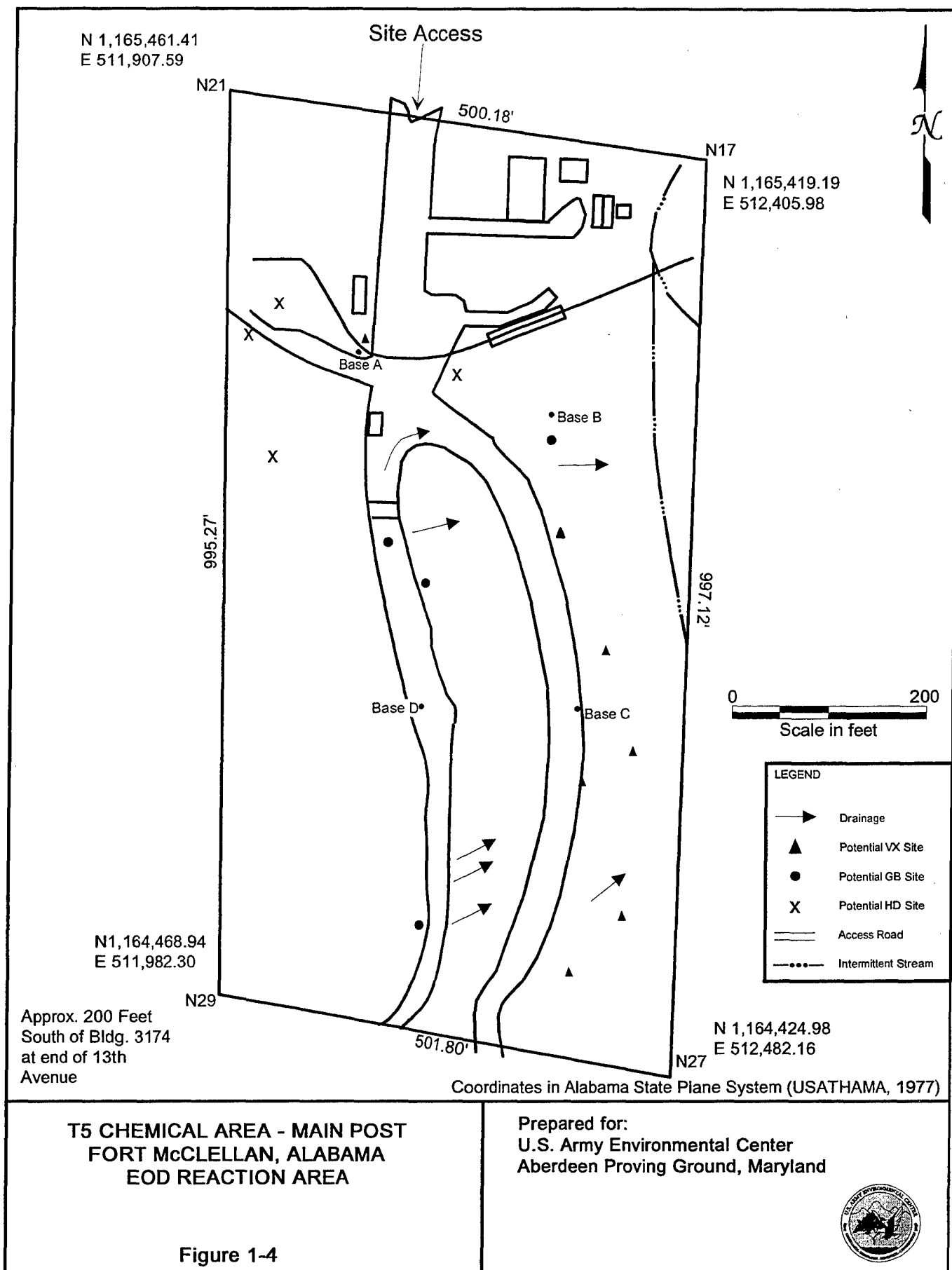


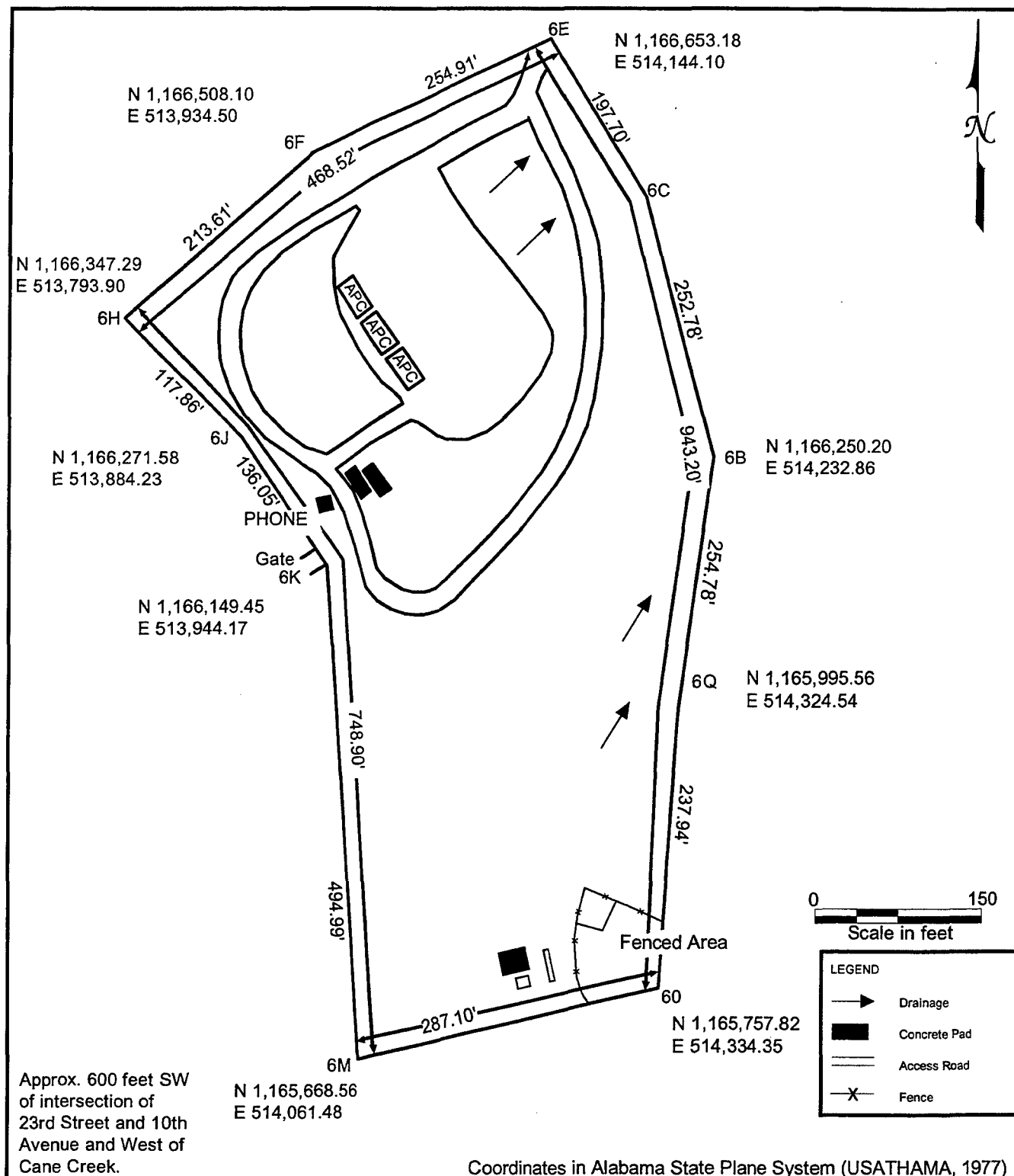
1.4.2.2 Site 2 - Area T-5

Site 2 - Area T-5 is the Toxic Hazards Detection and Decontamination Training Area located between Sunset Hill and Howitzer Hill. The locations of suspected or potential chemical warfare agent training sites are shown in Figure 1-4. The 11.4-acre wooded site was used between 1961 and 1973 to train students in the methods of detecting and decontaminating toxic agents, including HD, GB, and VX. The quantities of agent used for training purposes ranged from 20 to 40 milliliters per exercise. The training sites were decontaminated and checked at the end of each exercise. Decontamination of the agents on residual soils was performed by adding STB and/or DS-2. In addition to HD, GB, and VX used during training, Site 2 may have been the location of a 110-gallon HD spill. Available evidence indicates that the contaminated soil was chemically decontaminated, removed, and ultimately disposed of at Range J (Pelham Range). The Army collected surficial soil samples in December 1972, April 1973, and July 1973 and analyzed the samples for the chemical agents HD, GB, and VX. Chemical warfare agents were not detected in these samples. The area was permitted for surface use because subsurface sampling had not been conducted. Survey monuments "C" and "D" were located in the field during the October 1991 site visit. Additional building foundations and an asphalt pad also were observed at this time. A projectile casing was observed in the eastern portion of the site during the site visit.

1.4.2.3 Site 3 - Area T-6

Site 3 - Area T-6 was an Agent Decontamination Training Area (also referred to as Naylor Field) located near the base of the eastern slope of Howitzer Hill (Figure 1-5). The 7.5-acre site was used until 1973 for training in techniques of decontaminating chemical agents, including HD. The area contained eight training sites that consisted of concrete pads on which equipment was parked. The equipment was contaminated with not more than 40 milliliters of HD during each exercise. The decontaminants STB and DS-2 were used during the exercises. Random surface soil samples collected by the Army in March 1973 revealed no agent contamination, and the area was cleared for surface activity. Several concrete pad structures and a small metal hut were located on the heavily wooded site during the October 1991 site visit.





**T6 CHEMICAL AREA (HOWITZER HILL)
FORT McCLELLAN, ALABAMA
AGENT DECONTAMINATION AREA**

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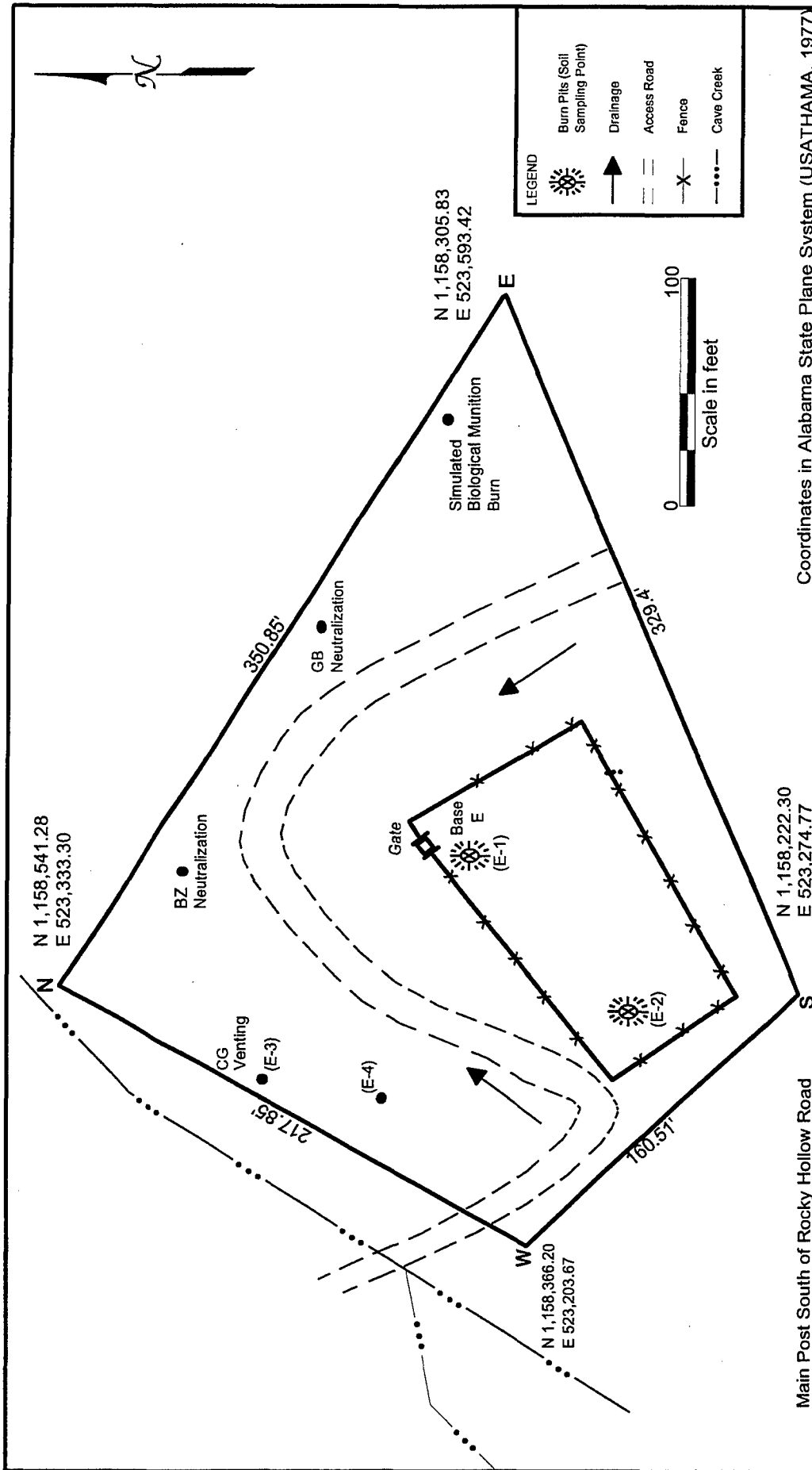
Figure 1-5

1.4.2.4 Site 4 - Area T-24A

Site 4 - Area T-24A was a Chemical Munitions Disposal Training Area located on the Main Post south of Holloway Hill (Figure 1-6). The 1.5-acre site was used until 1973 for chemical munitions disposal training with CG, BZ, GB, and HD. During each training exercise, approximately 4.46 kilograms of HD were reportedly used; however, first hand observers reported that as much as 2 gallons of HD was poured on six howitzers and later on APCs during training exercises. In addition, 40 milliliters of CG, one M-6 canister of BZ, and 740 grams of GB were used per exercise. Two square burning pits, each 16 feet on a side, were used for training exercises and were enclosed by a fenced area measuring 40 by 80 meters. The depths of the pits are unknown; however, standard operating procedures (SOPs) recommended a depth of 6 feet. At closure, the pits reportedly were filled with soil, although some depressions were observed in 1988. Decontamination of agents on residual soils was performed with STB and DS-2. A large HD spill may have occurred at this site, but has not been confirmed. The agents HD, CG, BZ, and GB were not detected in the surface samples collected by the Army in April and July 1973 in the proximity of the pits. Sample depths ranged from 3 to 10 centimeters, and may not represent the depths at which agents were used in the training pits. An unauthorized dump was identified in 1990 at the western end of the fenced area. The enclosed site area was heavily overgrown during SAIC's October 1991 site visit. A survey marker was located within the enclosure showing the location of a former burn pit. Two 81-mm mortar shells also were discovered at the site in October 1991. Portions of Area T-24A are located within the target area (fan) of two currently operating firing ranges.

1.4.2.5 Site 5 - Area T-31

Site 5 - Area T-31 (Technical Escort Reaction Area) was a toxic hazard training area located on the Main Post (Figure 1-7) near Range 31. The 3.4-acre site was used between 1957 and 1969 for training with GB and HD in quantities of 20 to 40 milliliters. Six different locations within Area T-31 were used for training exercises. Training aids used at the site were moved to Area T-38. Area T-31 was used to store undetermined types and quantities of chemical agents. Several spills reportedly occurred onsite from these stored materials. Information regarding the quantities of materials spilled is unavailable. The types and quantities of decontaminants used to treat residual soils contaminated with agents are unknown, but are



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**RANGE T24A - MAIN POST
FORT MCCLELLAN, ALABAMA
EOD DISPOSAL AREA**

Figure 1-6

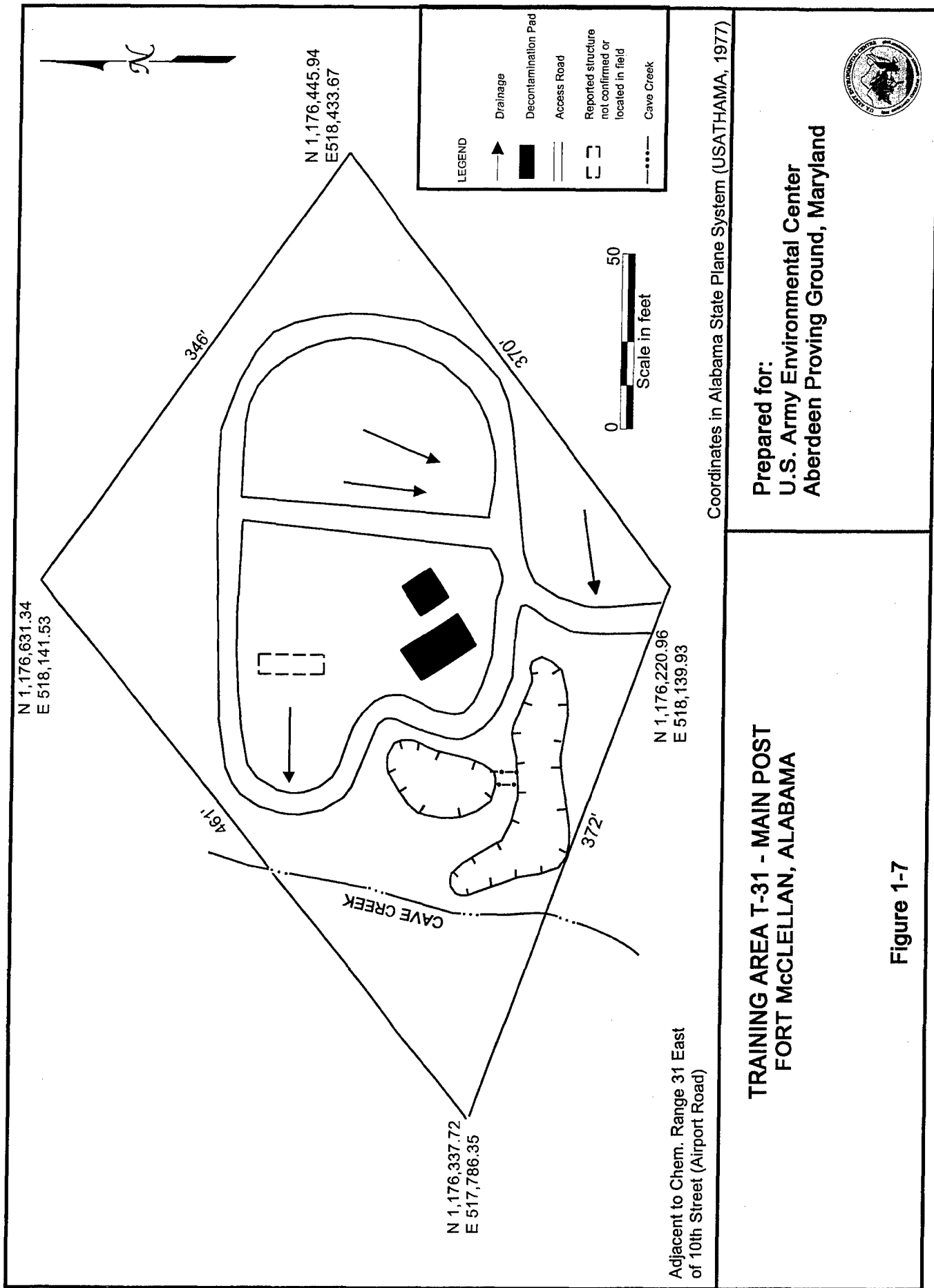


Figure 1-7

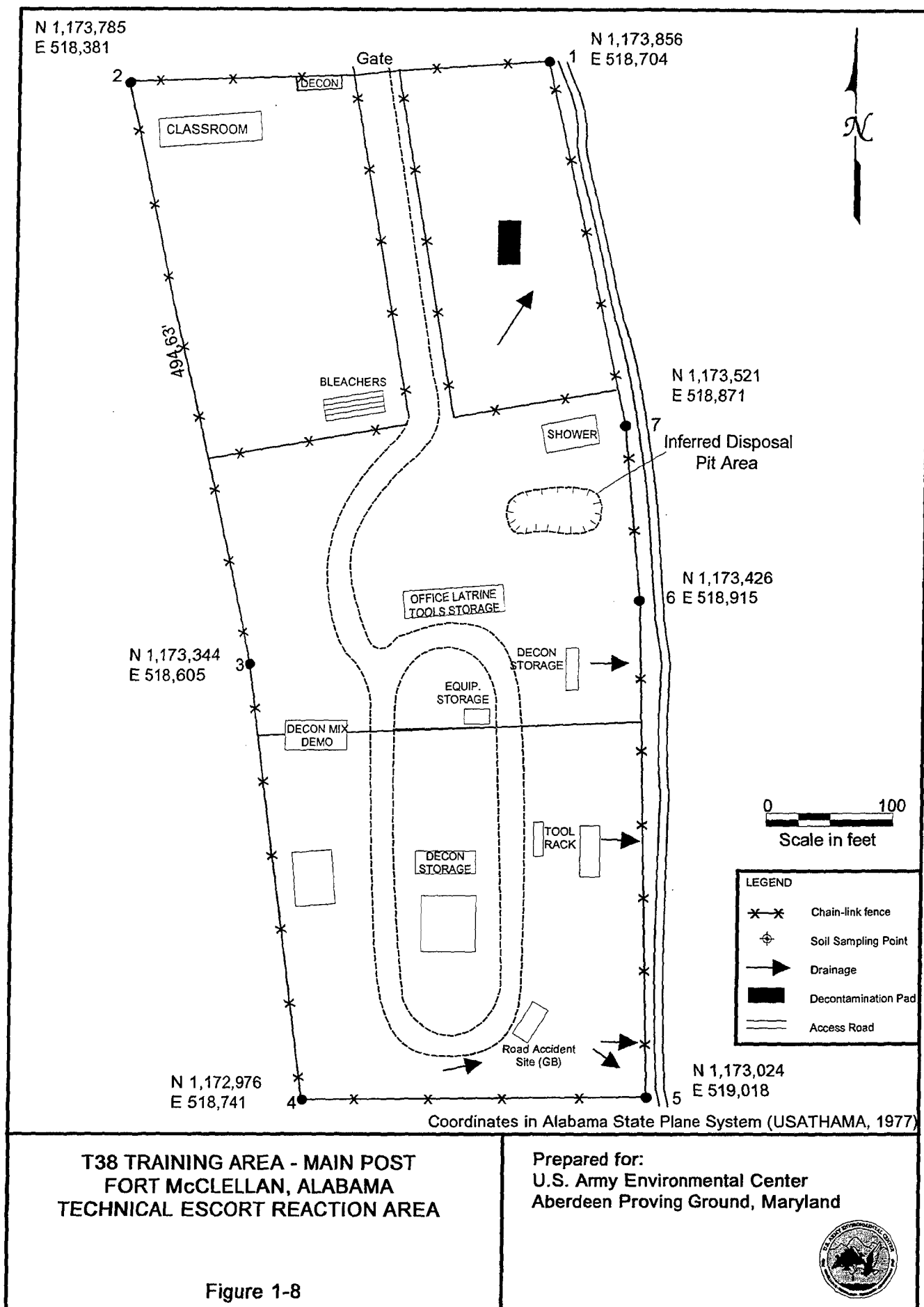
believed to have included STB and DS-2. The site area was heavily overgrown during the October 1991 site visit. Several concrete pads and structures were located at that time.

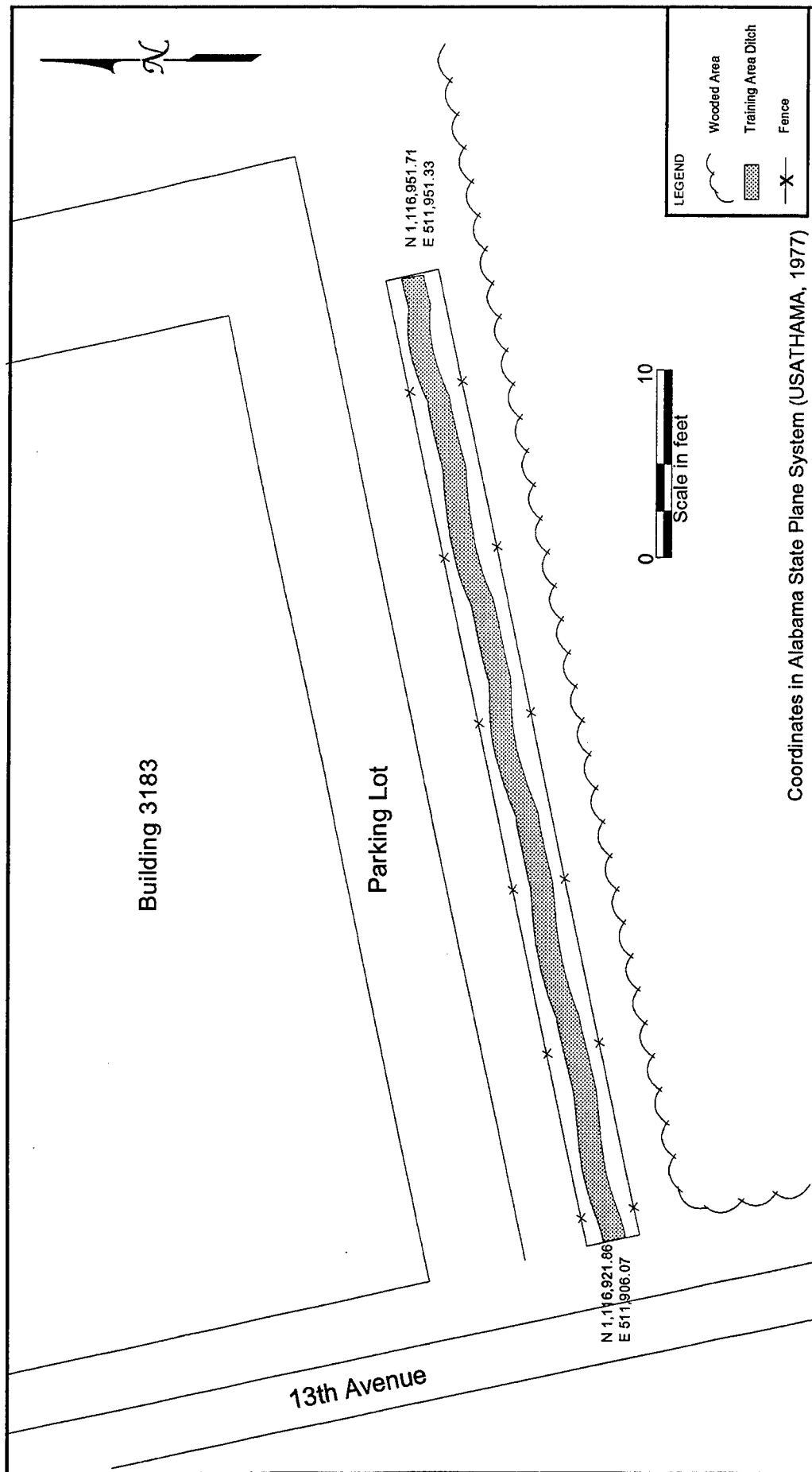
1.4.2.6 Site 6 - Area T-38

Site 6 - Area T-38 (Technical Escort Reaction Area) is located on the Main Post west of Reservoir Hill (Figure 1-8). The 6-acre site was used between 1961 and 1972 for training escort personnel in techniques of eliminating toxic hazards caused by mishaps to chemical munitions during transport. The area also was used to store toxic agents and munitions, including GB, VX, and HD. Storage included four 1-ton HD containers. In addition, unspecified decontaminants (likely STB and DS-2) were stored on at least two sites and were used for demonstration purposes. Extensive decontamination was conducted on this site for reported spills and contaminated training aids. Residual surface contamination with HD was reported in January 1973. Subsequent sampling in March 1973 indicated that the surface soil at Area T-38 was uncontaminated. A concrete decontamination pad was located in the field during the October 1991 site visit. In addition, there is an unconfirmed report of the burial of a drum of chemical agent (mustard) in the southern portion of the site; however, efforts to determine the precise location of the drum were unsuccessful. A former disposal pit (sump) area approximately 10 by 20 by 10 feet was reportedly used to dispose of decontaminants and other hazardous wastes at the site and was approximately located in the field during the April 1992 site visit (G. Harvey, written communication, October 7, 1992).

1.4.2.7 Site 7 - Old Toxic Training Area

Site 7 - Old Toxic Training Area is located within a fenced area on the Main Post behind Building 3183 (Figure 1-9). The 10,000 square foot ditch area was used during the 1950's for training exercises to identify and detect HD. The quantities of agent used during training are not documented. According to facility personnel, the chemicals were placed on the ground surface. Decontaminants such as STB and DS-2 were likely used on surficial soils.





**OLD TOXIC TRAINING AREA - MAIN POST
FORT MCCLELLAN, ALABAMA**

**Prepared for:
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Aberdeen Proving Ground, Maryland**



Figure 1-9

1.4.2.8 Site 8 - Range K

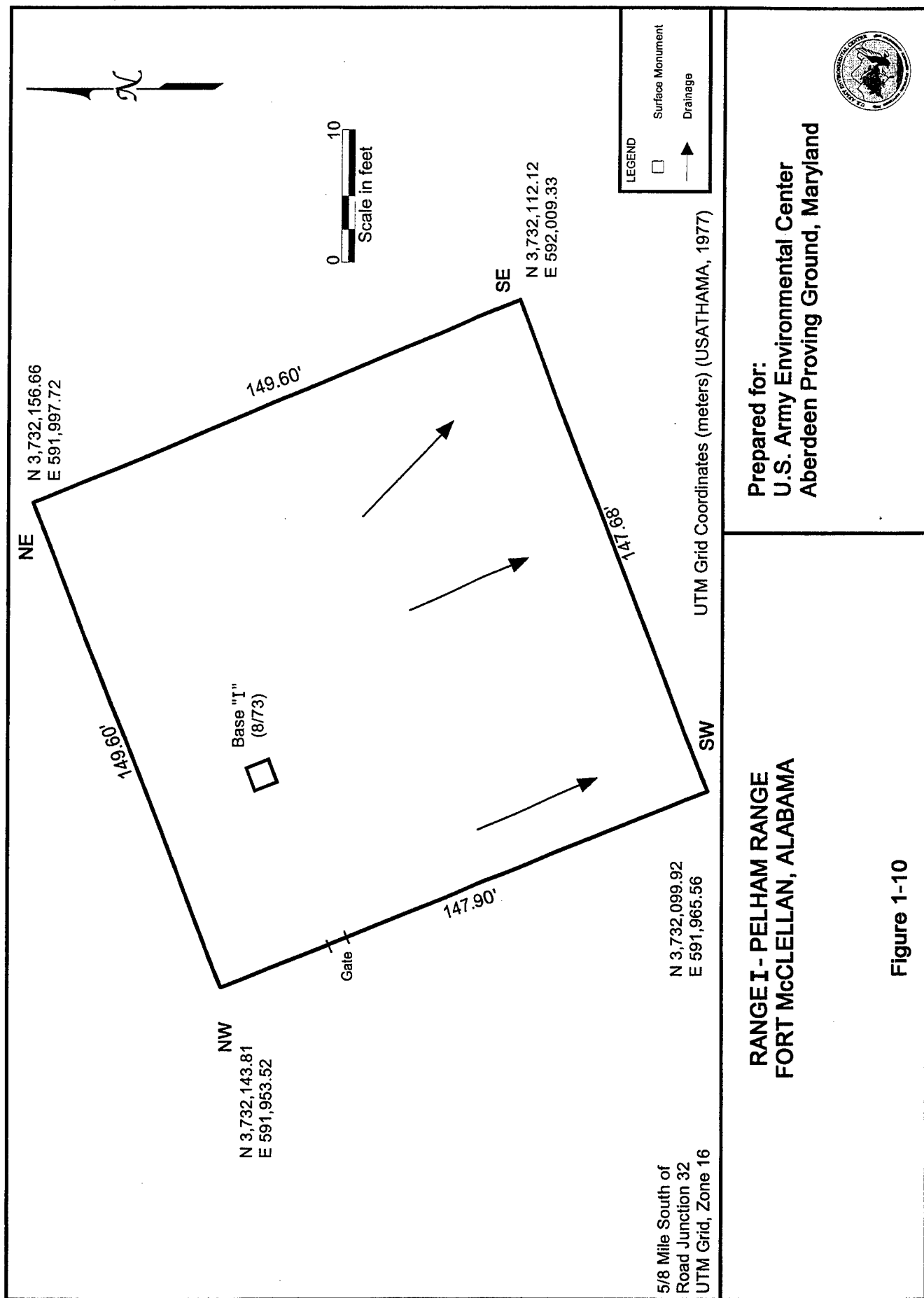
Site 8 - Range K was a 2-acre Agent Training Area located on Pelham Range (Figure 1-3). Limited information on the site is available, including time of operation and agents used. A reported shell tapping area where rounds were opened and decontaminated was operated in Range K prior to 1961 through the summer of 1963. During training exercises breaking open of one 55-mm round of HD, one 105-mm GB, and one 4.2-mortar round of CG was standard practice (G. Harvey, written communication, October 7, 1992). The identified site has been physically rearranged (bulldozed) and records indicate that the area was cleared for surface usage in 1967. The Army conducted surface monitoring in 1980, and no surface contamination was detected. Evidence of a former training area at this site was not observed during SAIC's October 1991 site visit. An approximately 5-foot diameter area of ponded drainage was noted in the site area. In addition, evidence of site usage as a bivouac area was observed.

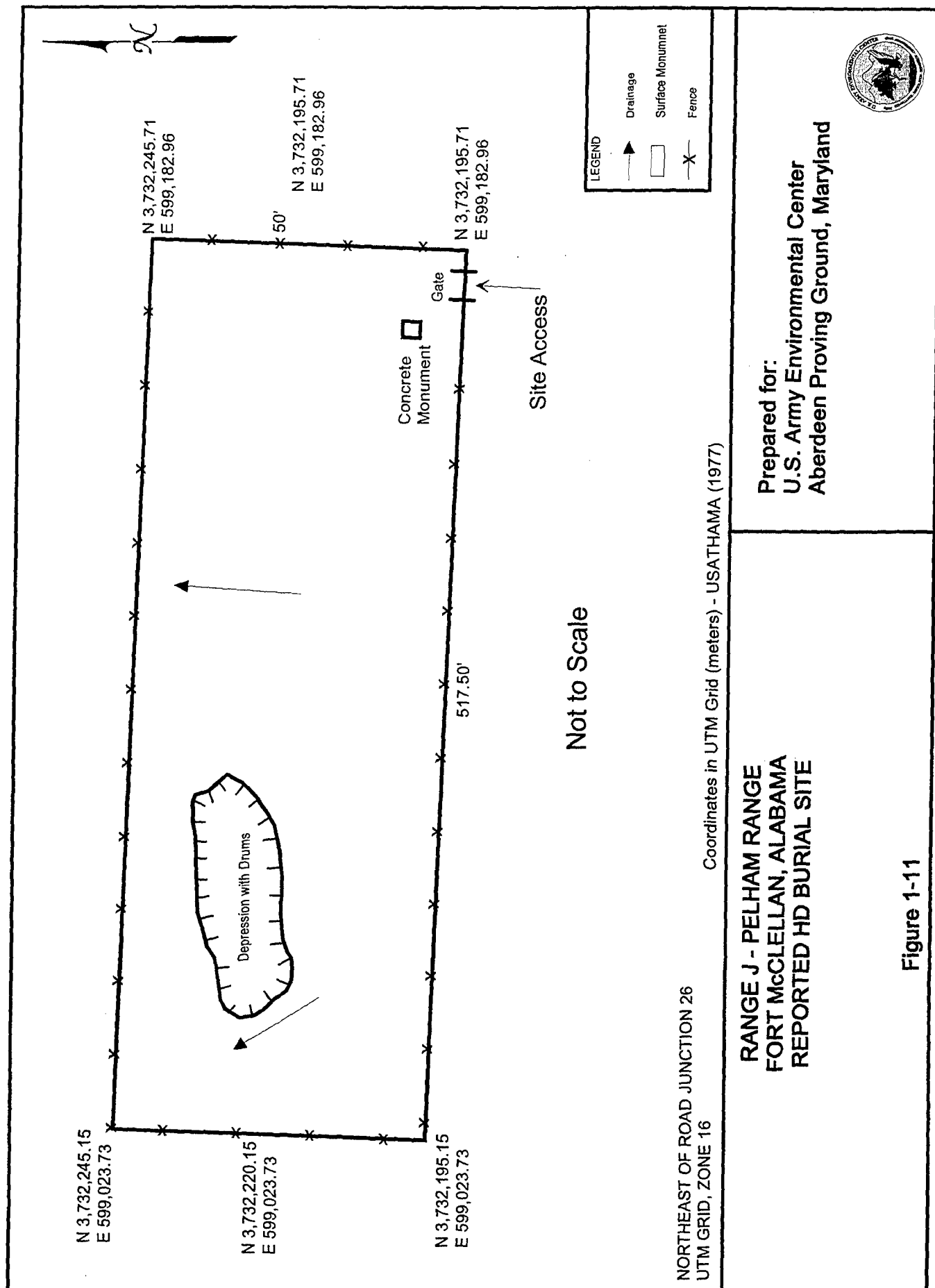
1.4.2.9 Site 9 - Range I

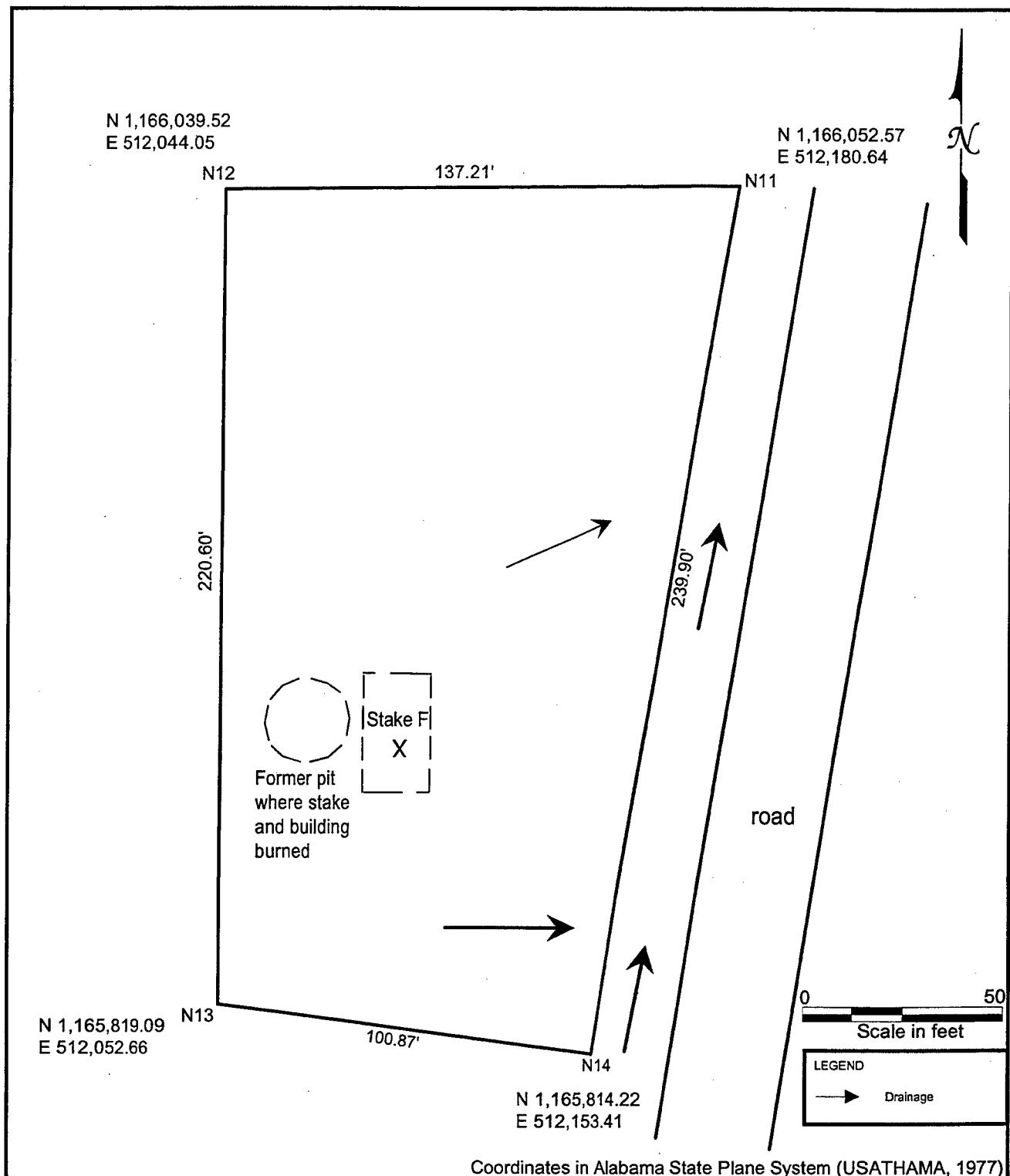
Site 9 - Range I was an Agent Shell Tapping Area located on Pelham Range (Figure 1-10). The 0.5- to 1-acre site was used between 1963 and 1964 for chemical agent shell tapping purposes. The agent used onsite is assumed to have been HD. The area has been physically rearranged, with the top 2 feet of soil having been moved to an unknown location. Army field tests showed no evidence of surface contamination. A concrete marker was located at the site during the October 1991 site visit.

1.4.2.10 Site 10 - Range J

Site 10 - Range J was an Agent Training Area located on Pelham Range (Figure 1-11). The 139- by 50-foot fenced area was used until 1963 for training and agent disposal. The agents used at the site are unknown, but are believed to be HD. The site also was reportedly used for disposal of a 110-gallon HD spill that occurred on the Main Post in 1955. Evidence of drummed soil disposed of in a surface pit at the site was observed during the October 1991 and April 1992 site walkovers. The depth at which this material was buried is unknown. Limited monitoring has been conducted onsite by the Army. Available data indicate that surface







**DETECTION AND IDENTIFICATION AREA
- MAIN POST
FORT McCLELLAN, ALABAMA**

Figure 1-12

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contamination is not present at the site. A survey monument dated August 1973 was located within the fenced area during the October 1991 walkover.

1.4.2.11 Site 12 - Detection and Identification Area

Site 12 - Detection and Identification (D and I) Area is located on the Main Post (Figure 1-12). The 1.1-acre site was used from the 1950's to 1972 for GB training. The Navy may have used HD at the site in the late 1950's for training purposes. Training routinely consisted of application of test kits to detect and identify of agents contained in 40-milliliter vials. Agents often were mixed as a 10 percent solution with water. The agent simulants CK, GC, CX, and AC also were reportedly used in the training area. All training aids from this site and a building from Area T-4 were burned twice in a dug pit and buried. The remains are reportedly still located in the pit. The pit containing the burned materials is identified by stake F which was located during the October, 1991 walkover. The decontaminants STB and DS-2 were used on surface soils and the area was cleared for surface use. The D and I Area is heavily wooded.

1.4.2.12 Site 16 - HD Spill/Burial Sites

A number of HD spills (Figure 1-2) and burial sites have been reported on both the Main Post and Pelham Range, although these activities have not been documented. Areas cited as possible spill locations include:

- Near 6th Street and PX Road
- Along the western side of 10th Avenue on either side of 21st Street
- Along the eastern side of 13th Avenue
- Southeast of the intersection of 13th Avenue and 23rd Street
- Toxic gas area near the western property line of Pelham Range, north of Cane Creek.

Most of these areas have been paved or otherwise developed. Assuming that the decontamination SOP was followed carefully for each spill, the sites would have been decontaminated and cleared for surface usage. Based on the inability to locate the possible sites

and the developed nature of the approximate locations, additional investigative activities were not conducted at these sites.

1.4.2.13 Site 11 - Range L (Lima Pond)

Site 11 - Range L was a Chemical Munitions Disposal Area located on Pelham Range (Figure 1-3). The 0.5-acre site reportedly was used to dispose of captured World War II munitions, including chemical munitions. According to Post personnel, a shallow man-made pond (Lima Pond) was used as a dump site for the munitions. The pond is within a bermed area that is approximately 15 feet higher topographically than the surrounding wooded terrain. The pond is estimated to be approximately 30 feet deep, although the actual depth of potential burials below the pit bed is unknown. The USATEU collected three water samples from Lima Pond in 1982 and analyzed the samples for HD, GB, and VX. All analytical results were below detection limits for HD (i.e., 2 mg/L), GB (i.e., 0.5 mg/L), and VX (i.e., 1.14 mg/L). Surface soil sampling at Range L did not detect contaminants above detection limits. The depth of water in the pond was low (<2 feet) during the October 1991 site visit. Although empty ammunition crates were observed along the pond walls, no quantitative determination has been made on the presence or nature of buried munitions at this site.

1.4.2.14 Site 13 - Former Landfill #1

Site 13 - Former Landfill #1 reportedly operated as the Post sanitary landfill between 1945 and 1947. The assumed site covers approximately 2 densely wooded acres and is located between 16th Avenue and Avery Drive adjacent to the floodplain of an unnamed intermittent stream draining into Remount Creek (Figure 1-13). The site slopes to the southeast toward 16th Avenue. No information exists concerning the operation or content of the landfill.

Known or suspected releases have not been documented and evidence of releases (leachate seeps) was not observed during the site PA (USATHAMA 1990) or the October 1991 site visit. Aerial photographs of the site dated 1944 suggest that portions of the area may have been cleared, although the purpose for the clearing is unknown. A site walkover in October 1991 showed no evidence of previous landfilling at this location.

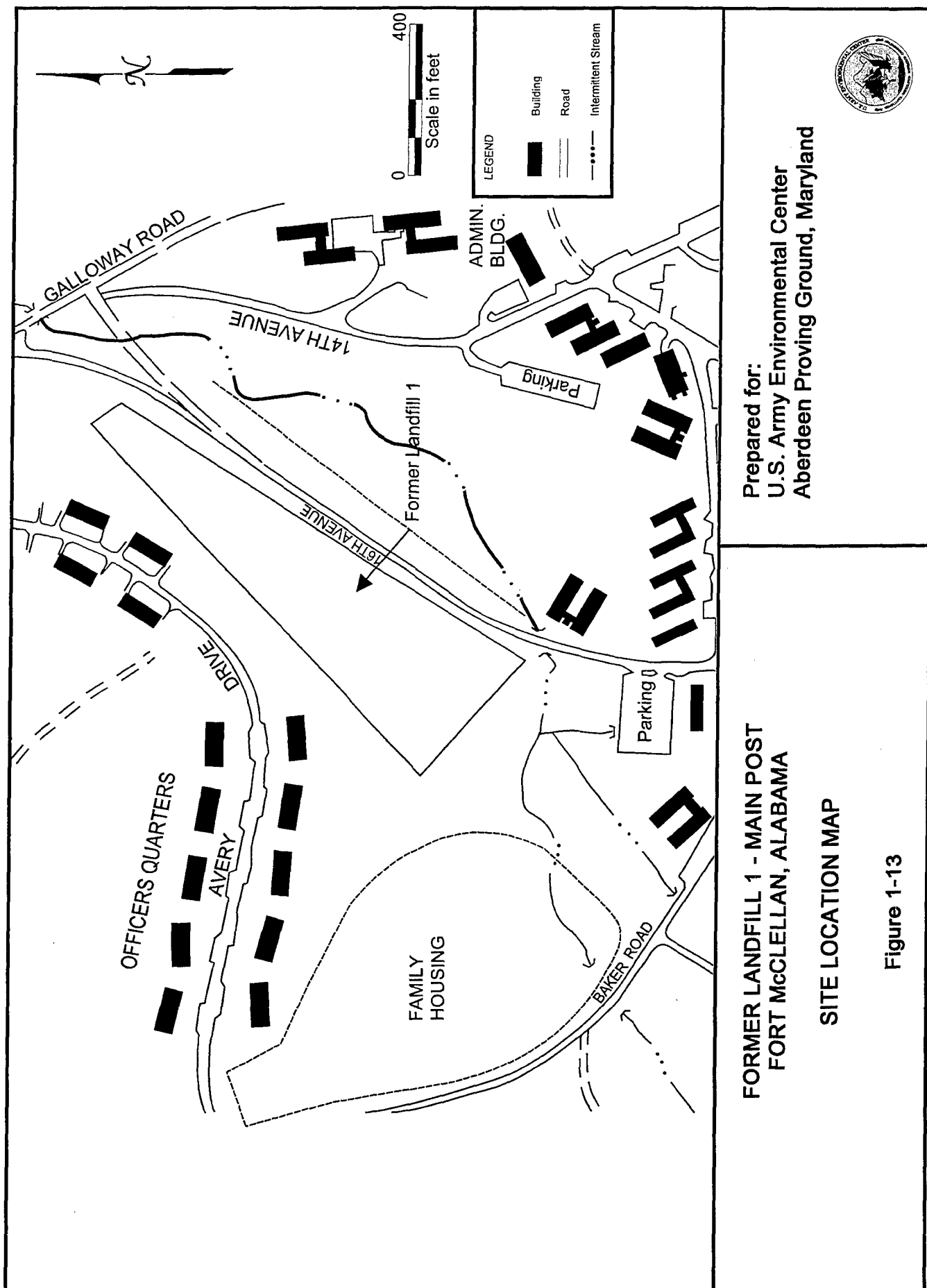


Figure 1-13

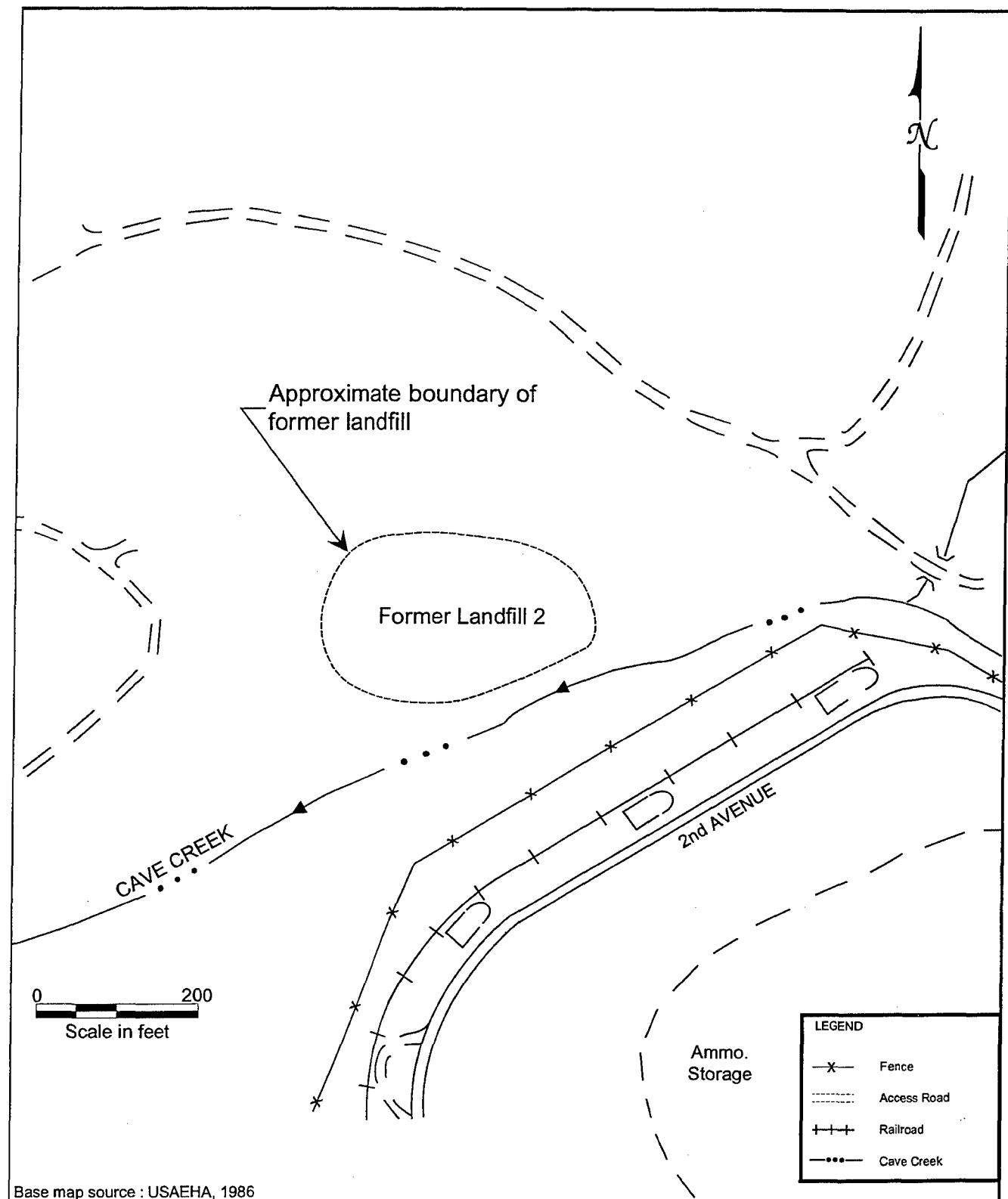
1.4.2.15 Site 14 - Former Landfill #2

Site 14 - Former Landfill #2 reportedly was used as the Post sanitary landfill after the closure of Former Landfill #1 and was active from 1947 to an unknown date. The landfill covers approximately 4 acres and is located west of the southern tip of Cemetery Hill, between 2nd Avenue and 10th Street. This site is heavily wooded and is located in the floodplain of Cave Creek, which is an intermittent stream flowing south-southeast of the landfill (Figure 1-14). Shallow weathered bedrock was observed in the creek bed. The landfill reportedly was used to dispose of waste during deactivation of the installation. Rusted drums, metal, small containers (5-gallon cans and bottles), assorted building materials, and machinery parts were observed at the site in October 1991. Known or suspected releases have not been documented and evidence of releases (leachate seeps) was not observed during SAIC's October 1991 site visit.

1.4.2.16 Site 15 - Former Landfill #3

Site 15 - Former Landfill #3 was the Post sanitary landfill in operation between 1946 and 1967. The landfill was operated using the trench and fill method, with trenches trending northwest to southeast. Traces of the trenches due to settling over the old landfill cells has been noted in the past, and were observed during the SI field work. The linear depressions probably result in the ponding of water and accelerate leachate generation. The landfill covers approximately 22 wooded acres and is located east of State Route 21 and north of Cane Creek. This location is northwest of and adjacent to active Sanitary Landfill #4 (Figure 1-15). Access to the landfill area is obtained along unpaved perimeter roads.

USAEHA (1986) installed five monitoring wells (OLF-1 to OLF-5) within or adjacent to Former Landfill #3 in 1986. Water levels measured at that time indicate northwestwardly groundwater flow exiting Fort McClellan toward State Route 21. Groundwater sampling of these wells was initiated in 1986 by USAEHA. Groundwater samples were collected and analyzed for pesticides and polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), metals, and standard inorganic and water quality parameters (chloride, sulfate, nitrate/nitrite, total dissolved solids [TDS], specific conductivity [umhos/cm], chemical oxygen demand [COD], phenols, and pH). The initial (1986)



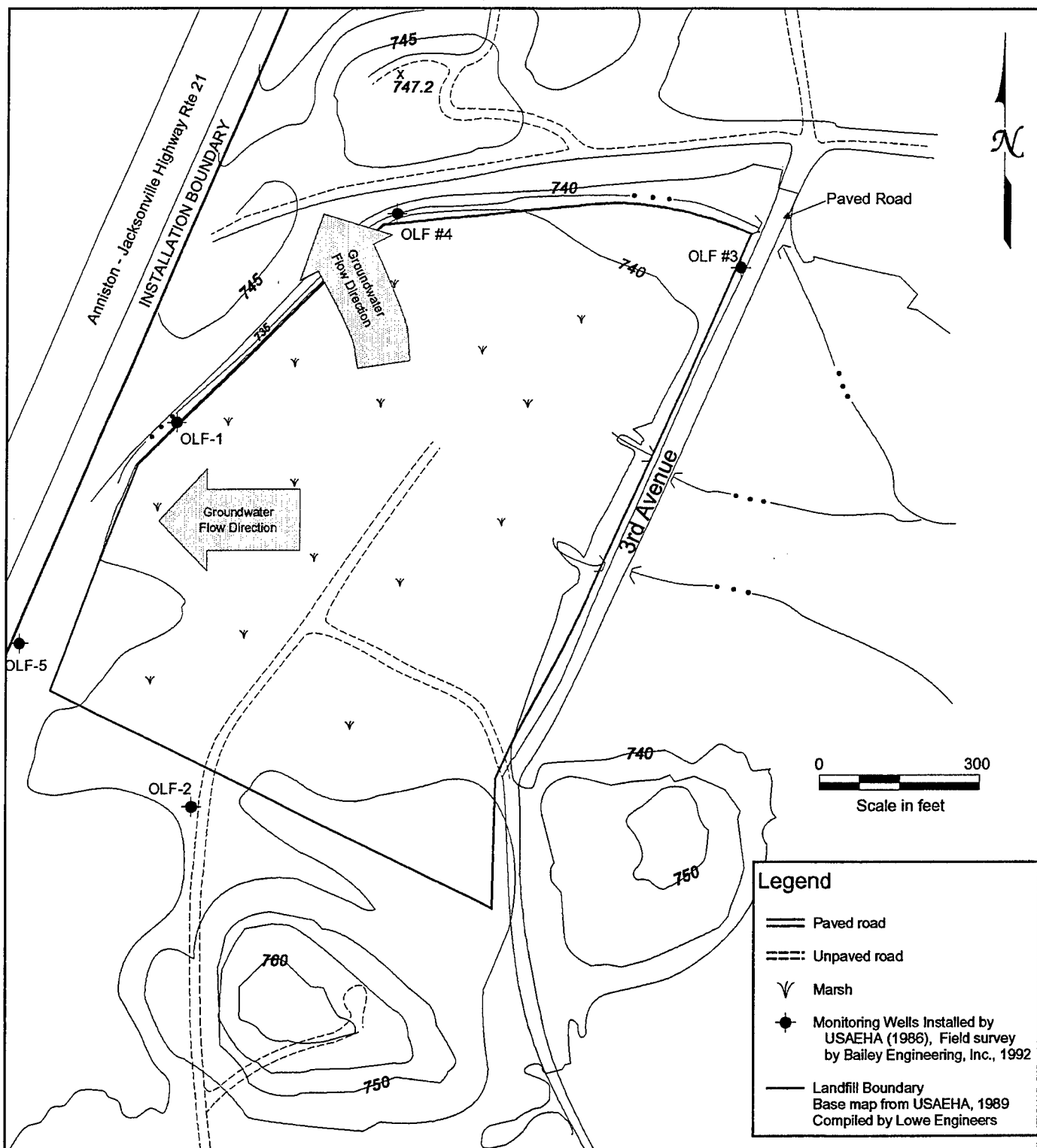
Base map source : USAEHA, 1986

**FORMER LANDFILL 2 - MAIN POST
FORT McCLELLAN, ALABAMA**

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 1-14



**FORMER LANDFILL 3
FORT McCLELLAN, ALABAMA**

SITE LOCATION MAP

Figure 1-15

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



groundwater sampling results indicated limited groundwater contamination. These results show that iron, manganese, and low pH were in excess of National Secondary Drinking Water Regulation criteria. In addition, the following six organic compounds were detected: tetrachloroethene (12 to 110 $\mu\text{g/L}$), methylene chloride (9 $\mu\text{g/L}$), 1,1-dichloroethane (18 $\mu\text{g/L}$), trans-1,2-dichloroethene (24 $\mu\text{g/L}$), benzene (4 $\mu\text{g/L}$), and bis(2-ethylhexyl)-phthalate (10 to 40 $\mu\text{g/L}$) (USATHAMA 1990).

1.4.2.17 Site 17 - Old Water Hole

Site 17 - Old Water Hole is a site located between New Mt. Sellers Cemetery and the prisoner of war (POW) camp on Pelham Range that reportedly was used for the disposal of a variety of munitions, including chemical agents (Figure 1-3). The site is reportedly a sinkhole, which would not have any release controls. A rectangular, shallow, topographic depression approximately 35 by 85 feet was located by Fort McClellan Department of Environmental Health personnel in the approximate area between the cemetery and the POW camp. An additional circular depression was located near the main depression in this area. Fort McClellan personnel indicate that the depression periodically fills with water, although it was dry during SAIC's October 1991 site visit. The depression was under water during SAIC's April 1992 site visit. Several small-caliber bullet shells were found at the site.

1.5 ENVIRONMENTAL/REGIONAL SETTING

The environmental setting at Fort McClellan is summarized in this section as a reference framework for the site-specific investigations at the facility. The information was obtained from the installation assessment of Fort McClellan (USATHAMA 1977) and updated where appropriate.

1.5.1 Demographics and Land Use

Fort McClellan is composed of three parcels of land totaling 45,679 acres and is situated within the Appalachian Valley and Ridge and Piedmont Provinces. The installation is located in northeastern Alabama and lies in the center of Calhoun County near the city of Anniston. The city of Anniston (population 26,623; 1990 census) is located between the Main Post and

Pelham Range, while the town of Weaver (population 2,715; 1990 census) is located to the north. The Anniston Army Depot bounds Pelham Range to the south, and the Choccolocco Corridor connects the Post to the Talladega National Forest to the east. The Choccolocco Corridor is leased from the State of Alabama and designated for bivouac maneuvers by foot troops, wheeled vehicles, and tracked vehicles.

The Anniston area, of which Fort McClellan is a part, is one of two major population concentrations (25,000 or more) in the region. Fort McClellan contributes to the population of Anniston and surrounding areas. Besides the military personnel living off Post, retired military personnel and their dependents live in the area surrounding Fort McClellan. Fort McClellan provides family housing units, Bachelor Officer Quarters (BOQ) units, and Bachelor Enlisted Quarters (BEQ) to military personnel and their dependents.

1.5.2 Sensitive Environments

Information on the sensitive species and habitats of Fort McClellan, Pelham Range, and the Choccolocco Corridor is provided below.

1.5.2.1 Wetlands

Wetlands are protected by the Federal Government primarily through Section 404 of the Clean Water Act. This act empowered the U.S. Army Corps of Engineers (CE) and EPA to regulate most forms of wetlands destruction. Fort McClellan, Pelham Range, and the Choccolocco Corridor have an abundance of wetlands representing important habitats for a wide variety of plants and animals as well as providing a wealth of other values for the public, including:

- Flood control
- Water quality maintenance
- Erosion buffers
- Groundwater recharge and stream flow maintenance
- Timber production.

The landscape is dominated by dry ridges composed of sandstone and chert and by valleys and stream terraces that are made up of alluvium over limestone and shale. Fort McClellan's wetlands are found in the valley along creek floodplains, near stream terraces, and in depressions.

Thirteen types of wetlands plant communities have been described on the Post. These communities and their National Wetlands Inventory (NWI) designations are as follows:

- Mixed bottomland hardwoods: first bottoms (Palustrine, forested [deciduous], seasonally flooded wetlands)
- Mixed bottomland hardwoods: second bottoms (Palustrine, forested [deciduous or deciduous-evergreen], temporarily flooded wetlands)
- Stream terrace hardwoods (Palustrine, forested [deciduous or deciduous-evergreen], temporarily flooded wetlands)
- Creekbank hardwoods (Palustrine, forested [deciduous], seasonally flooded wetlands)
- Water oak flat (Palustrine, forested [deciduous], temporarily flooded wetlands)
- Sweetgum/bulrush community (Palustrine, forested [deciduous], seasonally flooded wetlands)
- Sweetgum depression (Palustrine, forested [deciduous], temporarily flooded wetlands)
- Mixed shrub community (Palustrine, scrub/shrub [deciduous], temporarily and seasonally flooded wetlands)
- Mixed shrub/bulrush/needlerush community (Palustrine, scrub/shrub/emergent [persistent], seasonally flooded, impounded, or seasonally flooded wetlands)
- Buttonbush/bulrush community (Palustrine, shrub/scrub [deciduous], semipermanently flooded wetlands)
- Bulrush/needlerush/cattail community (Palustrine, emergent [persistent], temporarily and seasonally flooded wetlands)
- Nonforested creekback community (Palustrine, emergent [persistent and nonpersistent], seasonally flooded wetlands)
- Mud flat community (Palustrine, emergent [nonpersistent], seasonally flooded and semipermanently flooded wetlands).

1.5.2.2 Flora and Fauna

Fort McClellan and its ancillary grounds are composed of a variety of aquatic, riparian, and terrestrial habitats that provide for numerous species of game and nongame animals. An estimate of populations and habitats based on surveys performed in 1986 is as follows:

- Approximately 38,361 acres (government-owned or leased from the State of Alabama) are suitable for wildlife habitat; this includes 16,915 acres in Pelham Range, 18,946 acres in the Main Post, and 2,500 acres in the Choccolocco Corridor.
- Range conditions are generally good, with the exception of numerous areas where dense growth prohibits the production of certain wildlife foods.
- The popular game species at Fort McClellan are white-tailed deer, northern bobwhite, turkey, mourning dove, eastern cottontail, gray squirrel, raccoon, wood duck, and opossum.

The military mission at Fort McClellan supersedes fish and wildlife management and associated recreational activities, and such activities must in all instances be compatible with the military mission and the provisions of the Endangered Species Act or other applicable statutes. A study conducted from April through October 1979 concluded that the only federally recognized endangered species known to occur on Fort McClellan is the red-cockaded woodpecker (*Picoides borealis*). A recent survey conducted in June 1992 indicated that the Red Cockaded Woodpecker colonies were no longer active at Fort McClellan (Red Cockaded Woodpecker survey. June 1992). A flora and fauna survey is currently being conducted under the Alabama Heritage Program. Tennessee Yellow Eyed grass, which is a listed endangered species is known to occur on Pelham Range.

1.5.3 Meteorology

Fort McClellan is situated in a temperate, humid climate. The average annual temperature is 63° Fahrenheit (F) with summer temperatures usually reaching 90°F or higher about 70 days per year, but temperatures above 100°F are rare. Freezing temperatures are common, but are usually of short duration. The first frost may arrive by late October. At Anniston, the average date of the first 32°F temperature is 6 November and the last is 30 March. Snowfall averages 0.5 to 1 inch per year.

The average annual rainfall is approximately 53 inches and is fairly well-distributed throughout the year, as indicated in Table 1-4. The more intense rains usually occur during the warmer months and some flooding occurs nearly every year. Approximately 80 percent of the flood-producing storms are of the frontal type and occur in the winter and spring, lasting from 2 to 4 days each. Summer storms are usually thunderstorms with intense precipitation over small areas, and these sometimes result in serious local floods. Occasionally, several wet years or dry years occur in series.

Table 1-4. Average Precipitation by Month at Anniston Airport, Anniston, Alabama

Month	29-year Average 1951 - 1980 Inches ^a	1990 Inches ^b
January	5.36	7.56
February	4.82	8.99
March	6.82	8.65
April	5.35	1.90
May	3.99	2.94
June	3.89	2.63
July	4.23	3.37
August	3.80	.58
September	4.15	.58
October	2.50	2.65
November	3.35	3.03
December	4.99	2.47

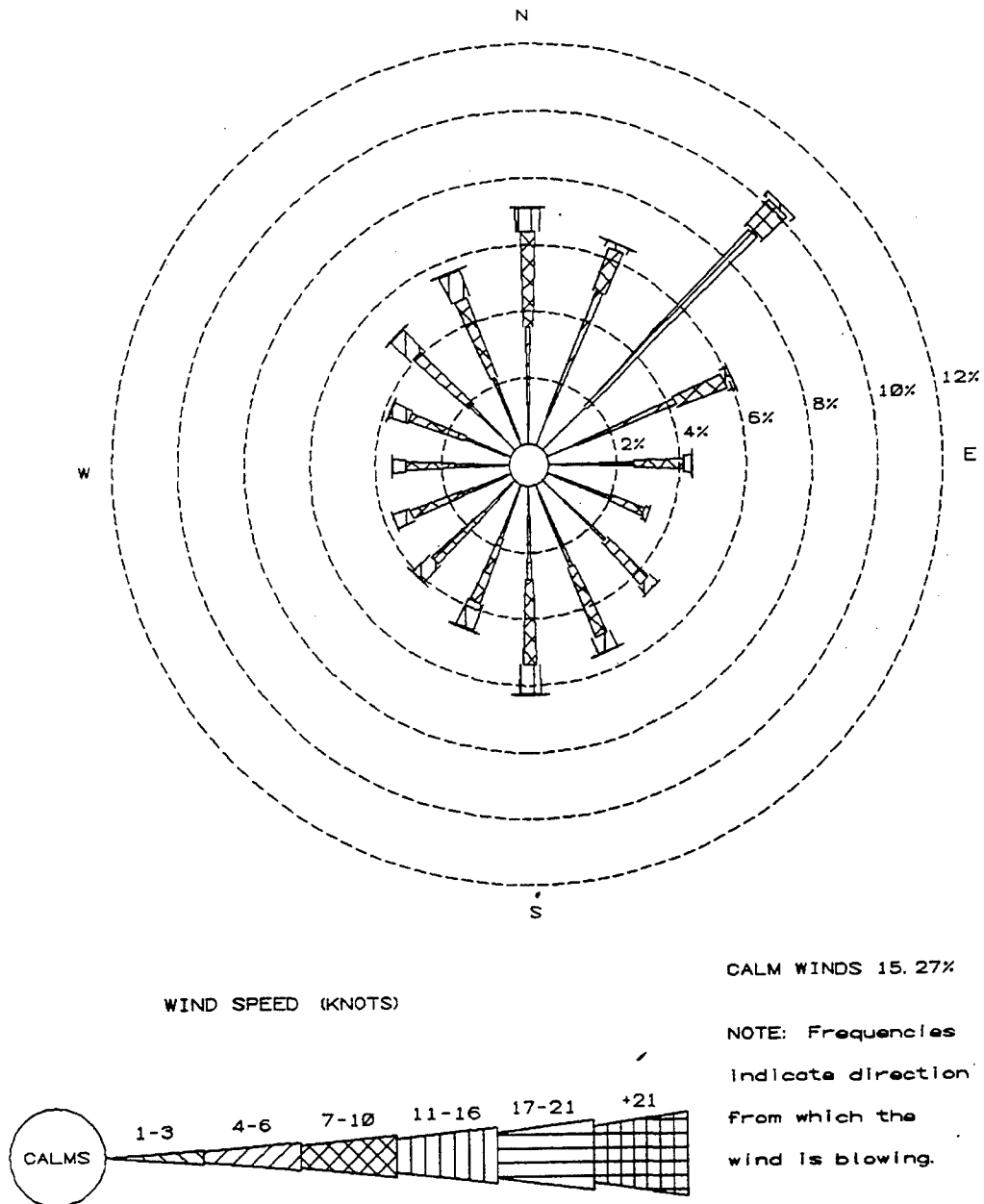
^aData obtained from *Climatology of United States No. 20*, Anniston FAA AP, Alabama.

^bData obtained from *Climatological Data Annual Summary, Alabama, 1990*, Vol. 96, No. 13, NOAA.

A brief study of wind velocity, duration, and direction reveals that winds in the Fort McClellan area are seldom strong and frequently blow down the valley from the northeast. However, there is no truly persistent wind direction. Most of the time, only light breezes or calm prevail, except during passages of cyclonic disturbances, when destructive local wind storms can develop into tornadoes, with winds of 100 miles per hour (mph) or more. Figure 1-16 is a wind rose of 1985-1989 wind conditions for the Birmingham, Alabama area. Northeast winds occur most frequently, with north winds being the second most common.

Birmingham 1985-1989

January 1-December 31; Midnight-11 PM



**WIND ROSE OF 1985 - 1989 WIND CONDITIONS
FOR BIRMINGHAM, ALABAMA**

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 1-16

1.5.4 Physiography and Surface Drainage

Pelham Range and all but the easternmost portion of Fort McClellan lie within the Valley and Ridge Province of the Appalachian Highlands. The portion of Fort McClellan west of Choccolocco Creek lies within the Piedmont Province. Local relief on Fort McClellan is in excess of 1,320 feet. The lower elevations (700 feet above mean sea level [MSL]) occur along Cane Creek, near Baltzell Gate Road, while the maximum elevations (2,063 feet above MSL) occur on Choccolocco Mountain, which traverses the area in a north/south direction, with the steep easterly slopes grading abruptly into Choccolocco Valley. The western slopes are more continuous, with the southern extension maintaining elevations up to 900 feet above MSL near the western reservation boundary. The northern extension decreases in elevation in the vicinity of Reilly Heliport. The central portion of Fort McClellan is characterized by flat to gently sloping land.

The topographic relief at Pelham Range is on the order of 445 feet. The minimum elevation is 500 feet above MSL, which occurs at the exit of Cane Creek from the range, and the maximum is 945 feet above MSL, near the southeastern boundary. The northern sector contains broad rolling topography capped with isolated round knobs rising 75 to 90 feet above the surrounding terrain. A large, relatively flat area called Battle Drill Area is situated near the western boundary.

The Choccolocco Mountains, located in the eastern portion of the Post, form a major surface water divide. East of this divide, the reservation consists of a relatively narrow strip called Choccolocco Corridor, which extends approximately 3.5 to 4 miles from the mountains across the floodplain of Choccolocco Creek, to the base of Rattlesnake Mountain. Choccolocco Creek and its tributaries drain this portion of Fort McClellan and flow southward to the Coosa River.

The entire central portion of Fort McClellan west of the drainage divide is drained by three major creeks and their tributaries. South Branch receives runoff from the south-central portion, then joins Cane Creek before leaving the reservation on the western boundary. Cane Creek receives surface runoff from the central section. The north-central section of the Post is

drained by Cave Creek, which leaves the Post on the northwestern boundary. Other surface water features within Fort McClellan include Lake Yahou (13.5 acres), Reilly Lake (8.5 acres), Cappington Ridge (0.3 acres), Duck Pond (0.5 acres), and an aqueduct. Surface drainage is collected in small, independent networks that drain areas varying from 20 to 60 acres.

The 100-year floodplain for stream drainage on Fort McClellan includes sanitary Landfills 2, 3, and 4; the Alabama Military Academy facilities; and a portion of the golf course area. Other facilities within the 100-year floodplain include the training aids and temporary Military Police (MP) academic facilities; transportation motor pool yard; industrial storage areas along Baltzell Gate Road; Directorate of Industrial Operations and Supply warehouses; Post Engineer facilities; facilities along Seventh Avenue, 21st Street, and 22nd Street; as well as the main training ranges within the Ingram Creek system.

1.5.5 Surface Water

The Cane/Cave Creek watershed is among the six major watersheds occurring within Calhoun County. Cane Creek, with its tributaries (Remount, South Branch, and Ingram Creeks), originates on the Fort McClellan Reservation. Cave Creek, which occurs as a separate body while on installation lands, also originates on Post. The on-Post drainage area of this system covers approximately 20 square miles. Dothard Creek has headwaters originating both on and off the installation. These creek systems originate in the Choccolocco Mountains on the eastern boundary of the installation and flow west through the main cantonment. They are fed by springs originating from underlying limestone strata. Cane Creek also passes through the entire length of Pelham Range, but its size and volume are greatly increased by the time it reaches this land area. One other major watershed, the Choccolocco Creek, occurs to the east of the Choccolocco Mountains, passing in a northerly to southerly direction through the Choccolocco Corridor.

Cane Creek, which flows westwardly across the center of Pelham Range, and its tributaries drain almost all of Pelham Range. Drainage entering the range from the south originates in the Anniston Army Depot, which joins Pelham Range to the south. One drainageway located in the southwestern corner flows in a northerly direction and empties into

a large topographic low (Battle Drill Area). Cane Creek traverses this low some 800 yards to the north, and all water collected in the low eventually drains into Cane Creek. Other surface water features include Lake Contreras (27 acres), Cane Creek Lake (7.5 acres), Willet Springs (0.8 acres), and Blue Hole (0.2 acres). All drainage from Fort McClellan and Pelham Range ultimately empties into the Coosa River. Floodplains up to 2,500 feet wide traverse this sector and slope toward the center of the range. The wide floodplains are absent in the southern portion of the range.

The streams of Fort McClellan are of good chemical quality and are in good biological condition. The State has classified these systems as suitable for fish and wildlife use. Averaged profiles at 16 stations (from a one-time study discussed below) over the Main Post and Pelham Range indicate that at an average temperature of 17.8°C, the dissolved oxygen is 9.3 and the pH is 7.5. These and other parameters are regularly measured by stationary probes at the exit of Cane Creek on Main Post, and just past the UTES at Pelham Range.

1.5.5.1 Ponds, Lakes, and Springs

The named water bodies on the Main Post include Lake Yahou (13.5 acres), Reilly Lake (8.5 acres), Cappington Ridge (0.3 acres), and Duck Pond (0.5 acres), or approximately 23 acres of named water bodies. Pelham Range includes Lake Contreras (27 acres), Cane Creek Lake (7.5 acres), Willet Springs (.8 acres), and Blue Hole (.2 acres), or approximately 36 acres of named water bodies. Fresh water springs occur abundantly on installation lands, often appearing along the trace of thrust faults. This is especially true of Pelham Range. All described water bodies are at least in part spring fed with the exception of Lakes Yahou and Contreras.

1.5.5.2 Fresh-water Marshes

Expansion of the installation over the years has altered the drainage patterns of the flats on the Main Post. Although many fresh-water marshes are located along Cane Creek, most are limited to the cumulatively larger downstream watershed of Pelham Range. Only one major area, the 25-acre marsh near Reilly Lake, occurs on the Main Post. The drainage area of Cane Creek on Pelham Range has an abundance of riparian flora and fauna. Areas include the 75-acre marsh beginning to the right of Gate 3 entrance; a 75-acre area to the right of Cane Creek on

the Battle Drill Area; a seasonal area surrounding Blue Hole Pond; an area south of the impact area road; and a large block from Gate 13 to the Battle Drill Area where flats occur.

A comprehensive water quality biological study of installation receiving waters was conducted by the USAEHA (1976) to determine the impact of industrial and domestic wastes generated by activities at Fort McClellan. The condition of receiving waters was assessed through analyses of benthic diatom and macroinvertebrate communities and fish and bacterial populations, as well as chemical analyses for metals and other compounds. Average diatom diversity at Fort McClellan is 4.0, and average macroinvertebrate diversity is 3.1. Diversity in clean streams commonly ranges between 3 and 4, while polluted streams are usually less than 1 unit.

1.6 REGIONAL GEOLOGY AND HYDROGEOLOGY

The regional geologic and hydrogeologic conditions in the Fort McClellan area are summarized below.

1.6.1 Regional Geology

Fort McClellan and Pelham Range lie within the Appalachian fold and thrust belt where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. Geologic contacts in this region generally strike parallel to the faults and repetition of the lithologic units is common in vertical sequences. A stratigraphic column for the Fort McClellan area is shown in Table 1-5. Geologic formations within Fort McClellan and Pelham Range vary in age from Precambrian to Mississippian (Figures 1-17 and 1-18). On the eastern boundary of Fort McClellan, Talladega Slate crops out in a narrow band between the county line and the easternmost exposure of the Paleozoic rocks.

The Cambrian Weisner Formation consists of interlayered shale, siltstone, sandstone, quartzite, and conglomerate and is the basal formation of the sedimentary rock sequence. The Weisner Formation, locally sandstone and quartzite with thin-bedded shale, underlies a large portion of the Main Post at Fort McClellan and occurs beneath SI Sites T-4, T-5, T-6, Detection and Identification Area, T-24A, Former Landfill #1, and the Old Toxic Training Area. The

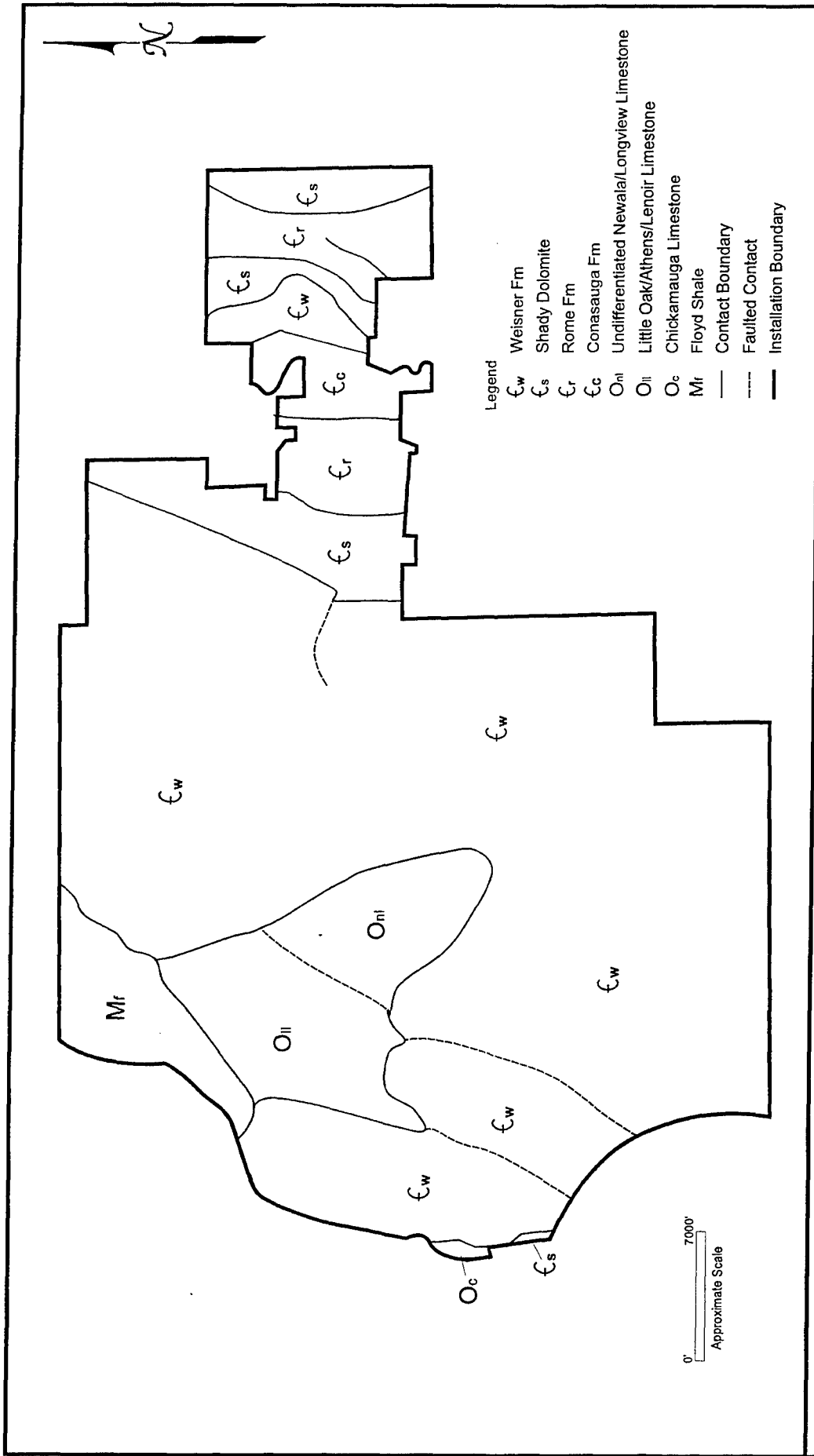
**Table 1-5. Generalized Section of the Geologic Formations in
Calhoun County, Alabama**

System	Stratigraphic Unit	Thickness (feet)	Rock Character
Quaternary	Alluvium, colluvium, and undifferentiated deposits	—	Alluvium, sandy to clayey; slope wash, gravel and sand.
Tertiary	Deposits of Paleocene or early Eocene age	10 - 100	Clay, sand, and gravel.
Pennsylvanian	Pottsville Formation	300?	Sandstone, gray and brown with interbedded gray and brown shale.
Mississippian	Parkwood Formation	350	Sandstone, gray, feldspathic, silica - cemented, fossiliferous; and gray clayey shale.
	Floyd Shale	2,000	Shale, black to greenish-black, fissile; interbedded with minor thick to thin, greenish-gray sandstone and clayey limestone beds.
	Fort Payne Chert	100 - 350	Chert, finely broken; includes some dark flint in basal part; highly fossiliferous.
	Maury Formation	2 - 3	Claystone, green, locally red, and phosphate nodules; locally interbedded with red shale.
Devonian	Frog Mountain Sandstone	50	Sandstone, brown, coarse-grained, siliceous cement; locally includes dark, hard siliceous shale or gray very coarse grained thick-bedded friable sandstone.
Silurian	Red Mountain Formation	50	Sandstone, light-gray to white, thick-bedded to massive, 30 feet thick; overlain by 20 feet of light-brown, thin-bedded sandstone interbedded with light-brown shale.
Ordovician	Sequatchie Formation	100	Siltstone and shale, calcareous, maroon and greenish-gray mottled, locally fossiliferous.
	Chickamauga Limestone	275 - 325	Sandstone, white to light-gray, thick- to thin-bedded orthoquartzitic; well-sorted medium to coarse, rounded to well-rounded grains; locally conglomeratic; bentonitic beds in upper part of formation; maroon and orange-brown variegated shale and siltstone, with irregular lenses of thinly laminated, gray to gray-green and maroon sandstone; limestone and calcareous mudstone in lower part; locally fossiliferous.
	Little Oak Limestone	15	Limestone, gray crystalline, medium- to thick-bedded, fossiliferous; black, fissile shale interbedded with dark shaley limestone.
	Athens Shale	200	Limestone, gray, crystalline, medium- to thick-bedded, fossiliferous; black, fissile shale interbedded with dark shaley limestone.

**Table 1-5. Generalized Section of the Geologic Formations in
Calhoun County, Alabama (continued)**

System	Stratigraphic Unit	Thickness (feet)	Rock Character
Ordovian (continued)	Lenoir Limestone	15	Limestone, gray, crystalline, medium- to thick-bedded, fossiliferous; black fissile shale interbedded with dark shaley limestone.
Ordovian (continued)	Newala Limestone and Longview Limestone undifferentiated	400 - 600	Limestone, pearl-gray, dark-gray, and bluish-gray, dense, medium- to thick-bedded; thin beds of coarse-grained dolomite; fine-grained chert common in the Longview.
Ordovician and Cambrian	Chepultepec Dolomite, Copper Ridge Dolomite, and Ketona Dolomite, undifferentiated	2,000	Dolomite, siliceous; abundant chert except in the Ketona.
Cambrian	Conasauga Formation	500	Limestone, dolomitic limestone, and crystalline gray dolomite; thin beds of gray shale that weathers green. Shale is dominant facies to the north and northwest.
	Rome Formation	1,000	Shale and siltstone, red; green shale and red and light-gray sandstone; locally includes lenticular beds of light-gray limestone or dolomite.
	Shady Dolomite	1,000	Limestone and dolomite, yellowish- to light- to dark-gray, crystalline, medium- to thick-bedded; variegated clayey shales in lower part.
	Weisner Formation	2,500	Shale, siltstone, sandstone, quartzite, and conglomerate; forms mountains. Local deposits of bauxite, hematite, and limonite.

Source: Neathery, et al., 1972.

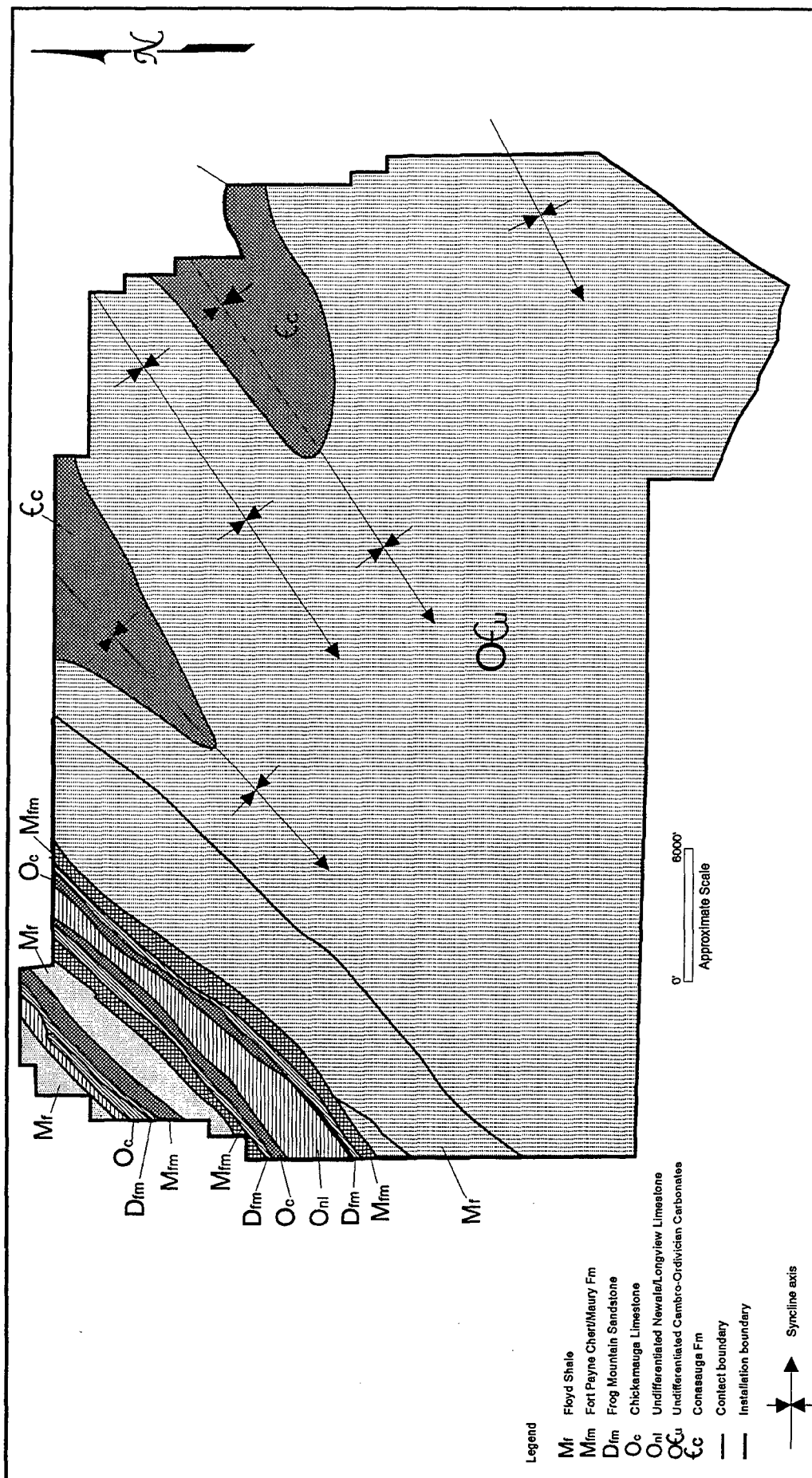


**GEOLOGIC MAP - MAIN POST
FORT MCCLELLAN, ALABAMA**

Figure 1-17

**Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland**





Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 1-18

Cambrian Shady Dolomite overlies the Weisner Formation east and south of the Main Post and consists of interlayered limestone and dolomite. The Cambrian Rome Formation is composed of red and green shale and siltstone with thinly interbedded light gray sandstone and calcareous layers. The unit locally occurs to the northwest and southeast of the Main Post and underlies Former Landfill #3. The Conasauga Formation comprises the uppermost Cambrian unit and occurs northwest and southeast of the Main Post. The Conasauga Formation is composed of interbedded limestone and dolomite with interbedded shale.

Overlying the Conasauga Formation is the Knox Group, composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group carbonates underlie a large portion of the Pelham Range area, including Range I and the Old Water Hole. The Knox Group is overlain by Ordovician limestone and shale formations, including the Newala and Longview Limestones, Lenoir Limestone, Athens Shale, Little Oak Limestone, and Chickamauga Limestone. Ordovician limestone underlies much of the developed area of the Main Post, including Sites T-31, T-38, Former Landfill #2, and several of the unidentified HD spill site areas. The limestone units also underlie sites on Pelham Range, including Ranges I, K, and L, and occur in a narrow, northeast-southwest trending, thrust-fault bounded area underlain by Ordovician carbonates in the western portion of Pelham Range. The Silurian Red Mountain Sandstone unit does not occur in the Fort McClellan area. The Frog Mountain Sandstone, of Devonian Age, is composed of sandstone and quartzitic sandstone and locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of claystone with increasing amounts of calcareous chert toward the upper portion of the formation. These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian Age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone.

1.6.2 Regional Hydrogeology

Precipitation in the form of rain is the source of most groundwater in Calhoun County, and the thrust fault zones typical of the county form large storage reservoirs for groundwater. Primary controls on groundwater flow are topography and bedrock permeability. Precipitation and subsequent infiltration provide recharge to the groundwater flow system. Points of discharge occur as springs, effluent streams, and lakes. Groundwater on Fort McClellan occurs principally in the quartzites of the Weisner Formation in the Choccolocco Mountains and locally in lower Ordovician carbonates. Bedrock permeability may be locally enhanced by fracture zones associated with thrust faults. Pelham Range groundwater flow has not been mapped due to insufficient control data. It is probable that shallow groundwater flow follows topography, with groundwater movement toward Cane Creek. The general movement of groundwater is southward along the east of the Choccolocco Mountains and then west at the southern end of the mountains. Groundwater in the Weisner Formation predominating the Main Post is typically of good quality. Abundance is dependent upon existence of fractures, and springs typically occur along fault lines. The Jacksonville Fault enters the Post in the vicinity of the Anniston Beach Club, and is generally bounded by the western foothills of the Choccolocco Mountains. Several inferred faults also are indicated across the southwestern part of the installation proper, and one fault occurs through the northeastern ridge of the Choccolocco Mountains. Extensive faulting also occurs in the leased corridor east of the Choccolocco Mountains.

The dolomites of Pelham Range typically provide adequate groundwater and yield springs at fractures or solution channels. The Pelham Faults enter the Range near Gate 6 (north) and along Brook Mountain and exit on the southwestern boundary. A wedge of Consuaga underlies 2.5 miles of Cane Creek at its eastern entrance to Pelham Range, and several large springs occur in this general vicinity, both on and off Government property.

1.6.3 Soils

The soil associations found at Fort McClellan and Pelham Range (SCS 1961) include:

- *Anniston-Allen-Decatur-Cumberland*: alluvium resulting from weathering of older saprolitic soils developed from sandstone, shale, and quartzite; deep, well-drained,

level to moderately steep soils in valleys underlain by limestone and shale; subsoil is dark red sandy clay loam; Cumberland and Decatur soils are dark reddish-brown gravelly loam developed from limestone saprolite source.

- *Clarksville-Fullerton*: well-drained to moderately well-drained stony or cherty soils developed in the residuum of cherty limestone. This association is limited to the Pelham Range. The soils are generally dark brown to dark gray brown silt loam.
- *Rarden-Montevallo-Lehew*: moderately deep or shallow soils on ridgetops and steep slopes and in local alluvium in draws; soils developed from the residuum of shale and fine-grained, micaceous sandstone; reddish-brown to dark gray brown to yellow-brown silt loam, clay, or silty clay.
- *Stony Rough Land*: shallow, steep, and stony soils formed from the weathering of sandstone, limestone, and Talladega Slate; infiltration slow; contains many boulders and fragments with clayey residuum. This association underlies a large portion of the Main Post at Fort McClellan.

In general, the soils are acidic to very strongly acidic with pH between 4.5 and 5.5 units. Table 1-6 summarizes the physical properties and ranges of permeabilities measured for the major soil types of each soil association listed above (SCS 1961). These tests are based on soils sampled throughout Calhoun County.

Table 1-6. Summary of Physical Properties for Soil Associations

Association	LL	PL	USCS	Average Depth to Water (feet)	Average Depth to Bedrock (feet)	Permeability (cm/sec)
Anniston-Allen-Decatur-Cumberland	ND	ND	ML, CL, MH, CH	20+	2 - 20+	5.61E-4 to 1.4E-3
Clarksville-Fullerton	20 - 41	1 - 3	SM, GM, GC	20+	20+	1.4E-3 to 7.0E-3
Rarden-Montevallo-Lehew	12 - 86	3 - 43	ML, CL, MH, CH	20+	1 - 4	1.4E-4 to 7.0E-3
Stony Rough Land	ND	ND	ML, CL, SC, CH, GM, GC	20+	0 - 3	1.4E-3 to 7.0E-3

Data obtained from soil survey of Calhoun County, Alabama, Soil Conservation Service, 1961.

- CH - Inorganic clays of high plasticity, fat clays.
- CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
- GC - Clayey gravels, gravel-sand-clay mixtures.
- GM - Silty gravels, gravel sand silt mixtures.
- LL - Liquid Limit; PL - Plastic Limit
- ND - Not determined.
- MH - Inorganic silts, micaceous or ditomaceous fine sandy or silty soils, elastic silts.
- ML - Inorganic silts and very fine sands, rock floor, silty or clayey fine sands, or clayey silts, with slight plasticity.
- SC - Clayey sand, sand clay mixtures.
- SM - Silty sands, sand silt mixtures.
- USCS - Unified Soil Classification System.

2. FIELD PROGRAM

Field activities for the Fort McClellan Site Investigation (SI) were conducted between April and June 1992. Prior to initiating the field program, sample and boring locations were staked by the U.S. Army Environmental Center (USAEC) and Science Applications International Corporation (SAIC) and utilities were cleared by Fort McClellan and public utility personnel. Investigation activities conducted by SAIC at Fort McClellan included geotechnical sampling and analysis, monitoring well drilling and installation, groundwater sampling, sediment and surface water sampling, and reconnaissance geophysical surveying. SI activities were conducted concurrently by personnel from SAIC and the U.S. Army Technical Escort Unit (USATEU) with SAIC oversight. The field activities conducted at each of the sites are summarized in Table 2-1. Analytical services for soil and water chemistry were provided by DATACHEM Laboratories of Salt Lake City, Utah and by Environmental Science and Engineering of Fort Lauderdale, Florida. Drilling and well installation services were provided by Environmental Exploration, Inc., of Stockbridge, Georgia. Geotechnical analyses were completed by Chattahoochee Geotechnical Consultants of Birmingham, Alabama and land surveying services were provided by Bailey Engineering, Inc., of Anniston, Alabama. Field support, including site accesses, utility clearances, road construction, and brush clearing, was provided by Fort McClellan.

2.1 FIELD ACTIVITY SUMMARY

The USATEU drilled 28 shallow soil borings and collected a total of 56 soil samples. Two soil samples from each boring were collected and submitted for chemical analysis. Chemical constituents determined from the shallow soil samples included:

- Volatile organic compounds (VOCs)(background only)
- Semivolatile organic compounds (SVOCs)(background only)
- Pesticides and polychlorinated biphenyls (PCBs)(background only)
- Metals (background and Detection and Identification Area only)
- Explosives (excluding PETN, TETR, and picric acid)

**Table 2-1. Summary of Site Investigation Field Activities
for Fort McClellan, Alabama**

Site No.	Site Name	Suspected Contamination	SI Activities	Analysis Conducted
1	Area T-4	Biological Simulants Training	• Field Reconnaissance	None
2	Area T-5	Toxic Hazards Detection and Decontamination Training Area (HD, GB, VX) 20 to 40 mL per exercise Possible 110 gal HD spill	• 4 soil borings • 8 soil samples (2 samples from each borehole) • 1 sediment sample • 1 surface water sample	Agent (HD, GB, VX) Agent Breakdown Products
3	Area T-6	Agent Decontamination Training Area (HD) Up to 40 mL per exercise Decontaminants STB & DS-2 were used on soil surface	• 3 soil borings • 6 soil samples (2 samples from each borehole)	Agent (HD) Agent Breakdown Products
4	Area T-24A	Chemical Munitions Disposal Training Area (HD, GB, CG, BZ) 4.46 kg HD per exercise 40 mL CG per exercise 1 M-6 canister BZ per exercise 740 g GB per exercise 2 burn pits Decontaminants STB & DS-2 were used on soil surface	• 2 soil borings • 4 soil samples (2 samples from each borehole) • 1 sediment sample • 1 surface water sample	Agent (HD, GB) Agent Breakdown Products
5	Area T-31	Technical Escort Reaction Area (HD, GB) 20 to 40 mL per exercise Spills of stored unknown types of chemical agents	• 4 soil borings • 8 soil samples (2 samples from each borehole) • 1 sediment sample • 1 surface water sample	Agent (HD, GB) Agent Breakdown Products
6	Area T-38	Technical Escort Reaction Area (HD, GB, VX) Storage of HD, GB, & VX Unspecified decontaminants stored onsite Suspected buried drum of agent	• 4 soil borings • 8 soil samples (2 samples from each borehole)	Agent (HD, GB, VX) Agent Breakdown Products
7	Old Toxic Training Area	Detection and Identification of HD Unknown quantities used	• 2 soil borings • 4 soil samples (2 samples from each borehole)	Agent (HD) Agent Breakdown Products
8	Range K	Agent Training Area Unknown agents used	• 1 sediment sample	Agent (HD, GB, VX) Agent Breakdown Products
9	Range I	Agent Shell Tapping Area (HD, GB)	• 2 soil borings • 4 soil samples (2 samples from each borehole)	Agent (HD, GB) Agent Breakdown Products

**Table 2-1. Summary of Site Investigation Field Activities
for Fort McClellan, Alabama (continued)**

10	Range J	Agent Training Area (HD) Disposal of soil from 110 gal HD spill (T-5) Drum pit at site	• 3 soil borings and 1 drum sample • 7 soil samples (2 samples from each borehole and 1 from drum)	Agent (HD) Agent Breakdown Products
11	Detection and Identification Area	Detection and Identification of HD and GB 40 mL per exercise Agent simulants, CK, CG, CX, and AC were used Decontaminants STB & DS-2 were used at soil surface Burn pit Training aids were burned and buried at this site	• 2 soil borings • 4 soil samples (2 samples from each borehole)	Agent (HD, GB) Agent Breakdown Products Metals
13	Range L	Chemical Munition Disposal Area Chemical munition and captured WWII munitions dump Empty ammunition crates along pond walls	• Magnetometer Survey	
14	Former Landfill 1	Suspected Sanitary Landfill	• Magnetometer Survey	
15	Former Landfill 2 (LF2)	Sanitary Landfill Rusted drums, metal, small containers, assorted building materials, and machinery parts	• 3 monitoring wells • 3 groundwater samples	Agent Breakdown Products Metals VOCs SVOCs Pesticides/PCBs Explosives
16	Former Landfill 3 (OLF)	Sanitary Landfill Limited groundwater contamination found	• 5 monitoring wells • 10 groundwater samples (5 samples from 5 existing wells) • 1 sediment sample • 1 surface water sample	Agent Breakdown Products Metals VOCs SVOCs Pesticides/PCBs Explosives
17	Old Water Hole	Munitions Disposal Area Chemical agents and variety of other munitions dump Several small-caliber bullet shells found	• Magnetometer Survey	

- Chemical agent breakdown products
 - Mustard (HD) - Breakdown products are thiodiglycol, p-chlorophenylmethyl sulfone, p-chlorophenylmethyl sulfoxide, and 1,4-dithiane.
 - Nerve agents (GB, VX) - Breakdown products for GB type nerve agents include isopropyl methylphosphonic acid (IMPA), methylphosphonic acid, dimethyl methylphosphonate, and diisopropyl methylphosphonate. Breakdown products for VX type nerve agents include ethyl methylphosphonate and isopropyl amine.

Soil samples were collected from the shallow borings at 1- and 5-foot depths below land surface (BLS) at each boring location.

SAIC collected soil samples from eight monitoring well boreholes for lithologic and geotechnical analysis. Thirteen samples were submitted for grain size and Atterberg limits analyses. The geotechnical data are provided in Appendix H.

SAIC collected groundwater samples from eight wells installed during the SI and from five existing wells. The samples were submitted to offsite laboratories for chemical analysis for the following parameters:

- VOCs
- SVOCs
- Pesticides/PCBs
- Metals
- Explosives (excluding PETN, TETR, and picric acid)
- Chemical agent breakdown products
 - Mustard (HD) - Breakdown products are thiodiglycol, p-chlorophenylmethyl sulfone, p-chlorophenylmethyl sulfoxide, and 1,4-dithiane.
 - Nerve agents (GB, VX) - Breakdown products for GB type nerve agents include IMPA, methylphosphonic acid, dimethyl methylphosphonate, and diisopropyl methylphosphonate. Breakdown products for VX type nerve agents include ethyl methylphosphonate and isopropyl amine.

Water level measurements were obtained from each of the SI wells and the existing wells to determine hydraulic gradients and flow directions at Former Landfills #2 and #3. Hydrogeologic information is presented in Section 3.1.

Surface water and sediment samples were collected by USATEU at training areas T-5, T-24A, T-31, Range K, and the background location and by SAIC at Former Landfill #3. Analytical parameters for surface water and sediment samples were the same as those for groundwater samples.

Geophysical surveys were conducted at training areas T-6, T-24A, T-31, T-38, the Old Toxic Training Area, Range K, Range I, and Former Landfill #1 by USATEU and SAIC personnel. The geophysical surveys consisted of magnetometer surveys, electromagnetic conductivity (EM) surveys, and metal detection surveys. Magnetometer and metal detection surveys were conducted to identify subsurface anomalies that may be caused by buried ferromagnetic materials. EM surveys were used as a corroborative tool to detect buried metallic materials at proposed boring locations. The data were used to place soil borings in safe locations because of the potential for encountering ordnance or chemical agents that may have been buried at the sites. The geophysical survey results are provided in Section 3 and Appendix B.

Topographic surveying was completed for new and existing monitoring wells at Former Landfills #2 and #3. Horizontal locations were determined in Alabama State plane coordinates to within 0.1 feet resolution and vertical elevations of the well casing tops were obtained to within 0.01 feet resolution. Land surveying also was completed along seven transects at Former Landfill #1. Results of the topographic surveying are provided in Appendices B and C.

All field activities were documented on the site geologist's field forms, boring forms, well completion forms, or in the logbook. These documents are part of the permanent project record.

2.2 GEOLOGIC AND HYDROGEOLOGIC INVESTIGATIONS

This section describes the activities used to quantitatively assess the presence of contamination at the sites. For the SI, sampling and analysis were limited to borehole drilling and sampling, groundwater sampling of monitoring wells, surface water sampling, and sediment sampling. The techniques and procedures used during the SI are described below. The results and interpretations are provided in Section 3 and Appendix E.

2.2.1 Shallow Soil Borings

The shallow soil boring drilling program at Fort McClellan was conducted to obtain subsurface soil samples for chemical analysis from identified former chemical and nerve agent training areas. Shallow soil sampling activities were conducted by the USATEU, operating out of Aberdeen Proving Ground, Maryland, at training areas T-5, T-6, T-24A, T-31, T-38, Old Toxic Training Area, Range I, Range J, Detection and Identification Area, and the background location. These sites were associated with the previous use of chemical agents or biological simulants for training and research purposes, or for munitions disposal, with the exception of the background location. Samples were collected at the background location for all analytical parameters to provide a baseline for the evaluation of subsequent data. A combined total of 28 borings were drilled at 10 sites.

The scope of the shallow boring effort was designed to investigate the soils in suspected chemical agent training areas to a depth of approximately 5 feet BLS. The locations of the soil borings were based on the site history, locations of site structures in the field, and topography. Geophysical surveys were conducted prior to sampling at training areas T-6, T-24A, T-31, T-38, Old Toxic Training Area, Range K, and Range I, because of the potential for encountering unexploded ordnance (UXO) or buried drums. Samples collected from the borings were screened in the field for chemical agents and were analyzed in the laboratory to determine if chemical agent breakdown products were in the soils. Drilling locations were staked in the field by USAEC and SAIC for utility clearance by Fort McClellan personnel.

Shallow soil borings were drilled by USATEU personnel using a stainless steel hand auger or a nominal 2¼-inch inside diameter (I.D.), continuous flight hollow-stem auger

advanced using a portable drilling rig. Samples were collected by rotating the hand auger downward or driving a split-spoon sampler inside the hollow stem auger flights. The rig occasionally encountered auger refusal due to buried cultural features (foundations) or other obstructions. Relocated borings were typically within a 4-foot radius of the original location.

Soil samples were screened in the field by USATEU personnel using a field-portable analyzer (MINICAMS). The MINICAMS was used to screen collected samples for the presence of chemical agent prior to releasing the samples for shipping and laboratory analysis. If agents were not detected above the time-weighted average (TWA) limit for each compound, the samples were collected for site parameters at 1 and 5 feet BLS. The MINICAMS also was used to continuously monitor ambient site conditions for worker health and safety during sampling activities. The MINICAMS was calibrated at the beginning of each day and following transporting activities. A more detailed discussion describing MINICAMS procedures and use is provided in Section 2.3 and Appendix D and the results of the MINICAMS screening are provided in Appendix D. The USATEU sampling activities are summarized in Table 2-2. Drilling and sampling waste containerization is described in Section 2.5.1.

2.2.2 Subsurface Soil Sampling

SAIC collected subsurface soil samples during monitoring well drilling activities at Former Landfills #2 and #3. Standard 2-inch outside diameter (O.D.) split-spoon samplers (ASTM D-1586) were used to collect soil samples for geotechnical testing and lithologic description. Shelby tube samplers (ASTM D-1587) also were used to collect samples from selected borings at various depths. Geotechnical samples sent for grain size analysis (ASTM D422-63) and Atterberg limits (ASTM D4318-84) tests were selected by the rig geologist in the field to include the variety of materials encountered by the borings. The analyses results are provided in Appendix H.

Soil samples initially were collected at 2.5-foot intervals and at intervals where a change in lithology occurred. The frequency was reduced to collecting samples every 5 feet because the site lithology exhibited little variation. Standard penetration test (SPT) blows per 6-inch increment were recorded in the field and used to determine the relative density of the formation.

Table 2-2. USATEU Sampling Activities - Fort McClellan SI

Site Identification	Site Location	Sample Number	Sample Type
Background	Main Post	BK-S0101	Soil
Background	Main Post	BK-S0102	Soil
Background	Main Post	BK-W01	Surface Water
Background	Main Post	BK-D01	Sediment
Site 7 - Old Toxic Training Area	Main Post	OTA-S0101/OTADS0101	Soil
Site 7 - Old Toxic Training Area	Main Post	OTA-S0102	Soil
Site 7 - Old Toxic Training Area	Main Post	OTA-S0201	Soil
Site 7 - Old Toxic Training Area	Main Post	OTA-S0202	Soil
Site 11-Detection and Identification Area	Main Post	DIA-S0201	Soil
Site 11-Detection and Identification Area	Main Post	DIA-S0202	Soil
Site 11-Detection and Identification Area	Main Post	DIA-S0101/DIASS0101	Soil
Site 11-Detection and Identification Area	Main Post	DIA-S0102	Soil
Site 2 - T-5	Main Post	T5-W01	Surface Water
Site 2 - T-5	Main Post	T5-D01/T5DD01	Sediment
Site 2 - T-5	Main Post	T5-S0401	Soil
Site 2 - T-5	Main Post	T5-S0402	Soil
Site 2 - T-5	Main Post	T5-S0301	Soil
Site 2 - T-5	Main Post	T5-S0302	Soil
Site 2 - T-5	Main Post	T5-S0201	Soil
Site 2 - T-5	Main Post	T5-S0202	Soil
Site 11-Detection and Identification Area	Main Post	DIA-S0201/(Re-sample) ¹	Soil
Site 5 - T-31	Main Post	T31-W01/T31SW01	Surface Water
Site 5 - T-31	Main Post	T31-D01/T31DD01	Sediment
Site 5 - T-31	Main Post	T31-S0201	Soil
Site 5 - T-31	Main Post	T31-S0202	Soil
Site 5 - T-31	Main Post	T31-S0301	Soil
Site 5 - T-31	Main Post	T31-S0302	Soil
Site 5 - T-31	Main Post	T31-S0401	Soil

¹ Original sample bottle broken during shipping

**Table 2-2. USATEU Sample Activities
Fort McClellan SI (continued)**

Site Identification	Site Location	Sample Number	Sample Type
Site 5 - T-31	Main Post	T31-S0402	Soil
Site 5 - T-31	Main Post	T31-S0101	Soil
Site 5 - T-31	Main Post	T31-S0102	Soil
Site 2 - T-5	Main Post	T5-S0101	Soil
Site 2 - T-5	Main Post	T5-S0102	Soil
Site 6 - T-38	Main Post	T38-S0201	Soil
Site 6 - T-38	Main Post	T38-S0202	Soil
Site 6 - T-38	Main Post	T38-S0101	Soil
Site 6 - T-38	Main Post	T38-S0102	Soil
Site 6 - T-38	Main Post	T38-S0401	Soil
Site 6 - T-38	Main Post	T38-S0402	Soil
Site 6 - T-38	Main Post	T38-S0301/T38DS0301	Soil
Site 3 - T-6	Main Post	T6-S0301	Soil
Site 3 - T-6	Main Post	T6-S0302	Soil
Site 4 - T24A	Main Post	T24A-W01	Surface Water
Site 4 - T24A	Main Post	T24A-D01	Sediment
Site 4 - T24A	Main Post	T24A-S0201	Soil
Site 4 - T24A	Main Post	T24A-S0202	Soil
Site 4 - T24A	Main Post	T24A-S0101	Soil
Site 4 - T24A	Main Post	T24A-S0102	Soil
Site 8 - Range K	Pelham Range	RK-D01 RKDD01	Sediment
Site 9 - Range I	Pelham Range	RI-S0201	Soil
Site 9 - Range I	Pelham Range	RI-S0202	Soil
Site 9 - Range I	Pelham Range	RI-S0101	Soil
Site 9 - Range I	Pelham Range	RI-S0102	Soil

**Table 2-2. USATEU Sample Activities
Fort McClellan SI (continued)**

Site Identification	Site Location	Sample Number	Sample Type
Site 10 - Range J	Pelham Range	RJ-S0201 RJSS0201	Soil
Site 10 - Range J	Pelham Range	RJ-S0202	Soil
Site 10 - Range J	Pelham Range	RJ-S0401	Soil
Site 10 - Range J	Pelham Range	RJ-S0301 RJDS0301	Soil
Site 10 - Range J	Pelham Range	RJ-S0302	Soil
Site 10 - Range J	Pelham Range	RJ-S0101	Soil
Site 10 - Range J	Pelham Range	RJ-S0102	Soil
Site 3 - T-6	Main Post	T6-S0201	Soil
Site 3 - T-6	Main Post	T6-S0202	Soil
Site 3 - T-6	Main Post	T6-S0101	Soil
Site 3 - T-6	Main Post	T6-S0102	Soil
Site 5 - T-31	Main Post	T31SS0101	Soil
Site 5 - T-31	Main Post	T31DW01	Surface Water

The sampler was removed from the borehole and the contents were placed in two 7-ounce jars for testing and archiving. Lithologic descriptions were recorded on the field boring log.

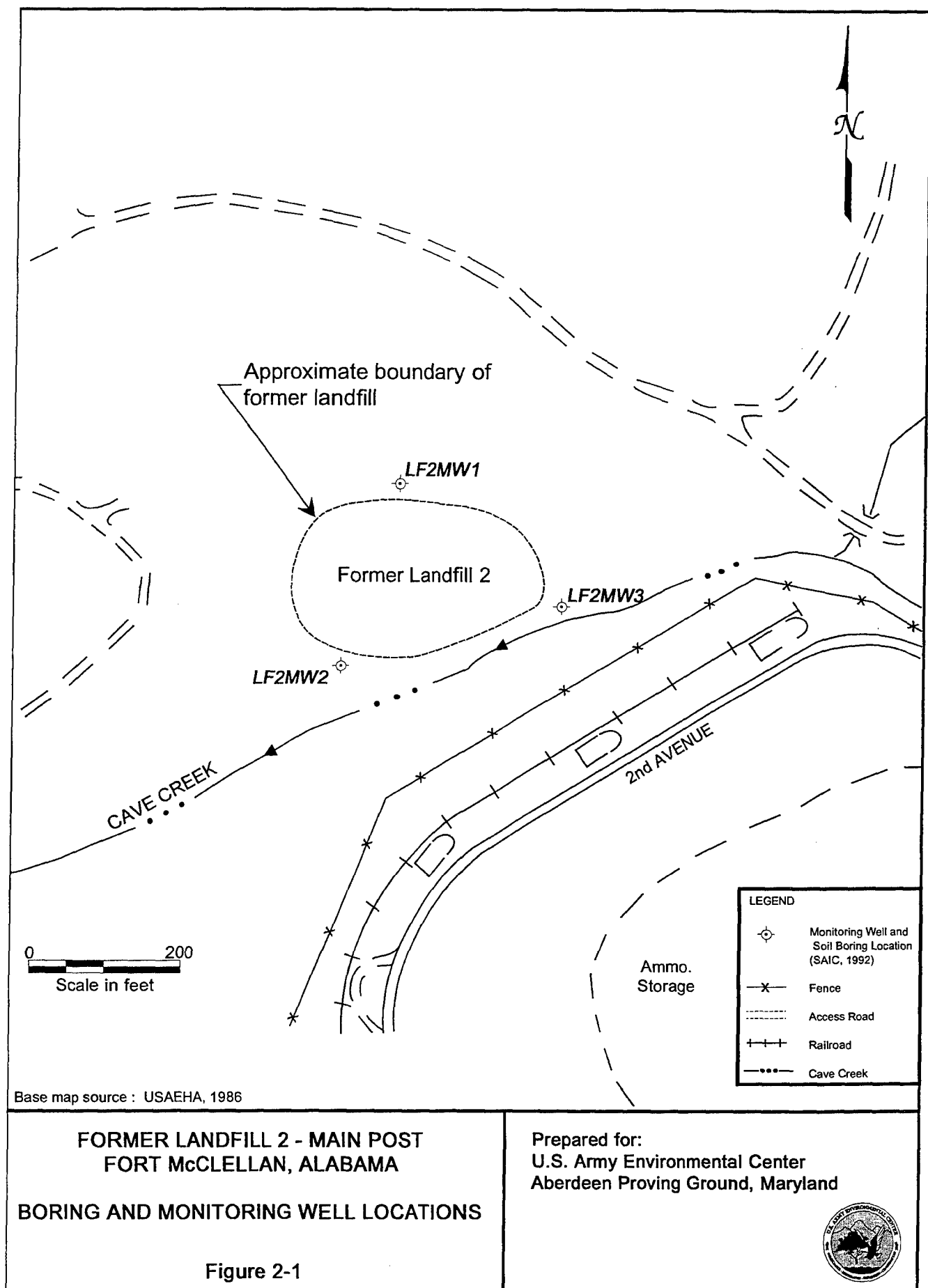
Samples were collected from eight boreholes (OLF-6 to OLF-10 and LF2MW1 to LF2MW3) drilled to depths ranging between 28 and 71 feet. SPT values ranged from 5 to 50/2-inch blows per foot (bpf). Drilling and sampling waste containerization and handling is described in Section 2.5.1.

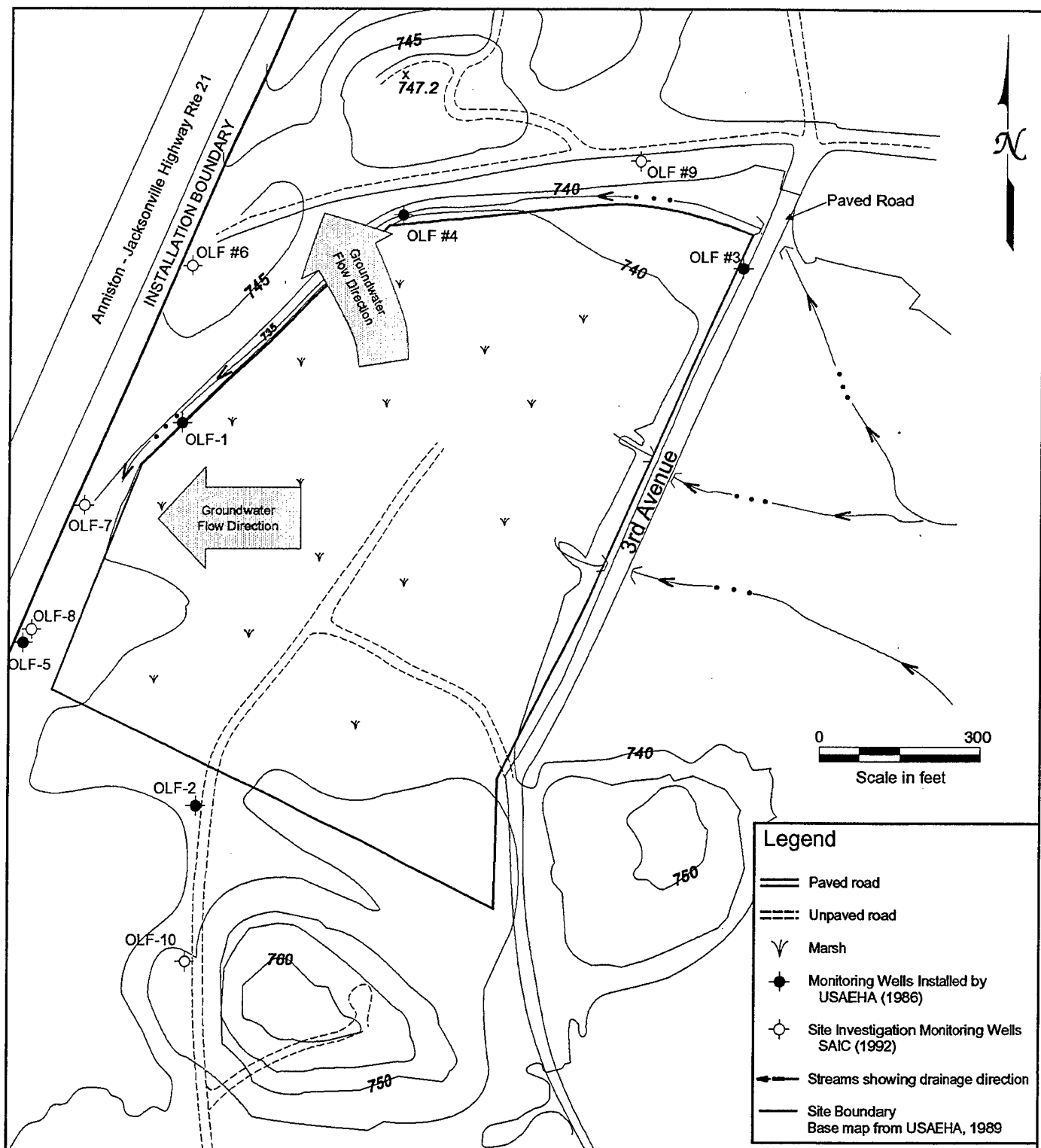
2.2.3 Monitoring Well Installation

SAIC installed monitoring wells to obtain additional information concerning the hydrogeology and groundwater chemistry at two landfill sites (Former Landfills #2 and #3) under investigation. Three 4-inch I.D. monitoring wells were installed around the perimeter of Former Landfill #2, as shown in Figure 2-1. Five 4-inch I.D. monitoring wells were installed around the perimeter of Former Landfill #3, as shown in Figure 2-2. The casing, screen, and end cap materials consisted of Schedule 40 polyvinyl chloride (PVC). Specific construction parameters, such as screen setting, were determined in the field based on information obtained during the well drilling process. Screen slot size (10 slot) and sand pack gradation were estimated from previous well installations at the Post and from previously collected geotechnical data. The sand pack consistency and gradation were submitted to USAEC for approval and are provided in Appendix H with the geotechnical data. The monitoring well drilling and installation activities are summarized in Table 2-3.

2.2.3.1 Monitoring Well Drilling

The monitoring well borings were drilled with a truck-mounted rotary rig (Mobile B-57) equipped with hollow-stem augering capabilities. Auger sizes ranged from 2¼ to 6⅝ inches I.D., depending on the formation consistency. Auger penetration was limited by weathered rock strata at varying depths and auger refusal was encountered at wells OLF-6 and OLF-7. Coring and/or rotary drilling (roller bit) methods were used to attain well completion depths when auger refusal had occurred. A dual walled core barrel was used to obtain rock core samples to the well completion depth after encountering auger refusal. In this sampling procedure, a 3-inch O.D. drill pipe with a diamond coring bit drilled a nominal 3-inch diameter borehole and





**FORMER LANDFILL 3
FORT McCLELLAN, ALABAMA
SI MONITORING WELL LOCATIONS**

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 2-2

Table 2-3. Summary of Drilling Activities For Fort McClellan Site Investigation

Site Number/ Site Name	Well Number	Total Depth Drilled (BLS)	Completion Depth (BLS)	Top of Casing Elevation (MSL)	Surface Pad Elevation (MSL)	Top of Screen Elevation (MSL)	Bottom of Screen Elevation (MSL)	Ground Surface Elevation (MSL)	Water Level (MSL)
15/FORMER LANDFILL #2 (LF2)	LF2MW1	27.0	27.0	809.59	807.53	792.93	782.93	807.03	792.81
	LF2MW2	23.0	23.0	793.89	791.66	778.76	768.76	791.16	786.96
	LF2MW3	20.5	20.5	796.88	794.53	784.73	774.73	794.03	789.28
16/FORMER LANDFILL #3 (OLF)	OLF-6	71.0	71.0	749.93	747.73	687.23	677.23	747.23	683.48
	OLF-7	62.5	62.5	741.42	739.01	686.51	676.51	738.51	697.88
	OLF-8	52.0	45.0	739.34	737.64	704.84	694.84	737.14	708.26
	OLF-9	35.0	32.0	741.20	738.96	718.66	708.66	738.46	718.48
	OLF-10	28.0	28.0	748.53	746.62	728.62	718.62	746.12	729.95

NOTE: All measurements are in feet unless otherwise noted

ABBREVIATIONS:

BLS: Below Sea Level
MSL: Mean Sea Level
MW: Monitoring Well
OLF: Old Landfill

produced a 1 7/8-inch diameter core. Potable water was added to the borehole to cool the bit and remove the cuttings. Rock samples were cored in 5- or 10-foot sections at the discretion of the rig geologist. After coring the specified interval, the core barrel was pulled from the borehole and the sample was removed. Core samples were placed in wooden boxes, described, and archived on the Post to provide a permanent lithologic record. Core recoveries were generally poor (20 to 30 percent) because of the variably weathered rock conditions encountered.

Direct rotary drilling was used to enlarge the borehole after auger drilling and coring activities to attain the borehole depth and diameter necessary to install the well materials. An 8-inch tricone bit was used to penetrate the formation and to enlarge the boreholes while downward circulation of potable water lifted the cuttings from the borehole. Cuttings removal from the cored holes was marginal and required additional hand bailing to sufficiently clean out the boreholes prior to well installation. In the event that the water table had not been encountered before coring or hydraulic rotary drilling were used, the borehole also was bailed to determine if the water table had been reached. A PVC or Teflon® bailer was used to remove the fluid water and cuttings mixture from the borehole. Water level measurements were obtained during bailing activities to estimate the location of the water table.

2.2.3.2 Monitoring Well Construction

After the water table was located and the required completion depth was reached, the monitoring well was assembled and installed in the boring through the hollow stem of the augers or in the open borehole, if rotary drilling was used. After placement of the screen within the saturated interval, the sand pack was poured or tremied between the annulus of the well casing and the augers or open borehole. If the sand pack was installed using hollow-stem augers, the sand was poured between the annulus of the well casing and the augers, while the augers were slowly withdrawn from the boring. This procedure allowed the sand to remain partially within the lead auger and enhanced the installation of a uniform sand pack.

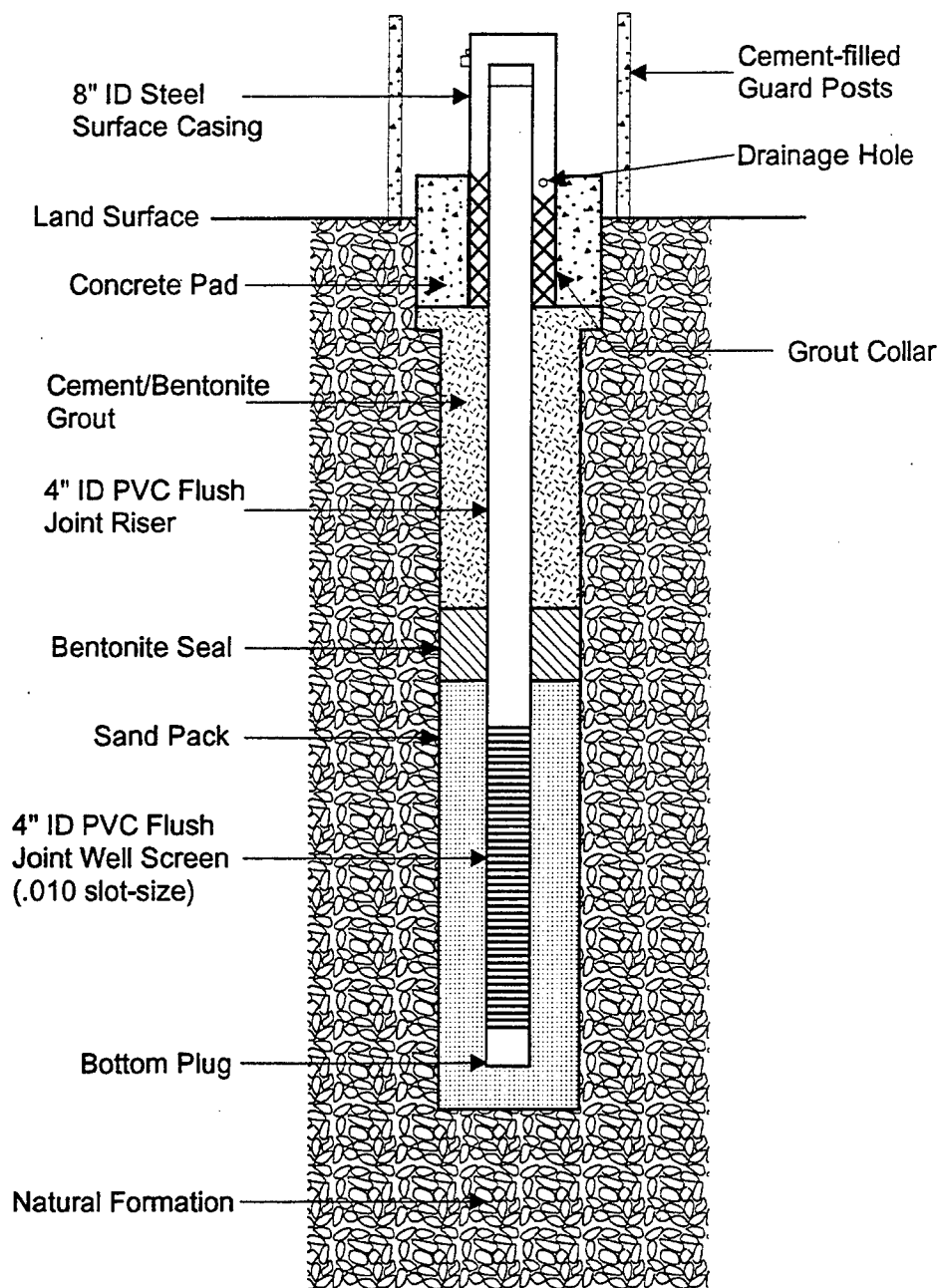
In monitoring wells OLF-6, OLF-7, OLF-8, and LF2MW3, the sand packs were tremied into place using a rigid tremie pipe. The tremie pipe was placed at the bottom of the borehole and a funnel was placed in the top of the pipe. Sand and water were poured simultaneously into

the funnel and the tremie pipe was removed incrementally as the sand pack increased. The amount of water used to install the sand pack was recorded and five times the recorded volume was removed during well development. The sand pack was placed in the borehole to extend from the bottom of the borehole to at least 5 feet above the screen. Measurements (soundings) were made and recorded during emplacement of the sand pack to ensure the proper placement depth.

After placement of the sand pack, a 5-foot thick seal of bentonite pellets was placed on top of the sand to prevent grout from flowing into the screened interval of the monitoring well. If a pellet seal was not used (as in OLF-8 and OLF-10), a bentonite slurry seal was mixed and tremied into place using a rigid tremie pipe. As the slurry seal ascended, the pipe was retracted slowly to ensure a continuous and uniform seal. Once the bentonite seal was in place, pellets were allowed to hydrate 30 minutes to 1 hour and the slurry was allowed to partially set 1 to 1½ hours. After the seal had set for the allotted time, a cement/bentonite grout was tremied in place as the remaining augers were withdrawn from the boring. The grout was mixed at one 94-pound bag of Type II cement per 5 pounds of bentonite powder with 8 gallons of water. The grout extended from the top of the pellet seal to land surface. A rigid tremie pipe was placed on top of the bentonite seal and grout was pumped down through the pipe. The pipe was retracted slowly as the grout rose to ensure a tight, continuous seal throughout the grouted interval. An 8-inch I.D. steel protective casing was placed in the cement/bentonite grout and allowed to set over a 24-hour period. After a 24-hour period, grout was added to compensate for settling. Surface completion of the monitoring wells consisted of the construction of 4- by 4-foot reinforced concrete pad around each well surface casing. Figure 2-3 illustrates the typical construction of the monitoring wells. A well construction diagram for each well is provided in Appendix A.

2.2.3.3 Monitoring Well Development

Each well installed at Fort McClellan during the SI was developed by block surging and pumping prior to utilization of the wells as sampling points. In each case, pumping continued until well water was relatively turbidity free and acceptable in clarity, pH, and specific conductivity to the Supervisory Geologist (i.e., where clarity, pH, and conductivity stabilized



**FORT MCCLELLAN SI
MONITORING WELL COMPLETION**

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 2-3

and showed no further improvement or reduction with continued development). Site activities associated with the development process are described below.

Development of the eight monitoring wells installed during the SI (OLF-6, -7, -8, -9, and -10, and LF2MW1, 2, and 3) was conducted between May 5 and May 17, 1992. Each well was developed using a Teflon® bailer, hand-pump, and/or pneumatic pump until water parameters stabilized. Field measurement of specific conductivity and pH was accomplished using a Hydac pH/conductivity meter. Specific data for each well are provided in the well development forms in Appendix I. The water level and well depth were measured prior to the initiation of development activities. An electrical water level indicator and weighted tape were used to measure the well depth and water level. All equipment lowered into the well was decontaminated prior to use, as outlined in Section 2.2.7.

In addition to the parameter stability and clarity requirements, a total volume of water to be recovered from each well was established. The total volume removed was at least five times the volume of water introduced during the well installation in addition to removal of five times the calculated well volume. This approach was used for each well except in situations where the SAIC Supervisory Geologist, in coordination with USAEC, determined that recovery of such a volume of water was impractical. A well volume was considered to be the standing column of water in the screened interval and riser pipe as well as the calculated volume of water in the sand pack. Measured depths to groundwater were used to calculate the height of the standing water in the well. The volume of water introduced to each well, calculated well volumes, calculated volumes required for removal during development, type of pump process used, and actual amount of water removed during development are provided in Table 2-4. All well development fluids were containerized onsite to await disposition based on the results of subsequent groundwater sampling. The wells were left dormant for 2 weeks prior to the initiation of purging and sampling.

Table 2-4. Summary of Well Development for Newly Constructed Wells
Fort McClellan Site Investigation, Fort McClellan, Alabama

Well Identification	Dates of Development	Volume of Water Introduced During Installation (gal)	Calculated Well Volume (gal)	Volume Required for Removal (gal)	Amount Recovered During Development (gal)	Type of Development
OLF-6	5/5/92 - 5/17/92	175	7.4	912	120	Pneumatic Pump, Bailer
OLF-7	5/5/92 - 5/9/92	175	19.8	975	690	Pneumatic Pump
OLF-8	5/8/92 - 5/11/92	200	9.2	1046	420	Hand Pump
OLF-9	5/7/92 - 5/8/92	0	13	65	240	Hand Pump
OLF-10	5/8/92 - 5/17/92	0	15	75	300	Bailer, Hand Pump Pneumatic Pump
LF2MW1	5/11/92 - 5/16/92	0	13.4	67	260	Hand Pump
LF2MW2	5/11/92 - 5/16/92	0	18.4	92	360	Hand Pump
LF2MW3	5/11/92 - 5/17/92	0	24	120	420	Hand Pump, Pneumatic Pump

Volume Required for Removal = (5 x Volume of water introduced during drilling) + (5 x Calculated Well Volume)

2.2.4 Potable Water Sampling

Potable water samples were collected and analyzed from two water sources identified by USAEC. Samples were collected from Building 8802 located on Pelham Range and from Building 1298 (garbage truck wash rack) located on the Main Post. A suite of samples was collected in March 1992, and a resampling for VOCs was conducted in April 1992 because of a missed holding time at the testing laboratory. These samples were analyzed for all SI sampling parameters to provide a baseline for subsequent data evaluation. The source at Building 1298 was the only source used throughout the SI because 12 of the 17 sites were located on the Main Post and the source at Pelham Range was not needed. Samples from both sources were collected from spigots or attached hoses after 15 to 30 minutes of purging. Parameters, including temperature, pH, and specific conductivity, were monitored during purging and after sample collection.

2.2.5 Groundwater Sampling

Groundwater samples were collected between June 3 and 11, 1992, from 13 monitoring wells (OLF-1 to OLF-10 and LF2MW1 to LF2MW3) at Former Landfills #2 and #3. Prior to well sampling, the water level in the well and the depth to the well bottom were measured and referenced to a point at the top of the PVC riser. The difference between these two measurements was calculated to determine the height of the standing water column in the well. The well volume was considered to be the standing column of water in the screened interval and riser pipe, and the volume of water in the sand pack. The volume of water in the well casing was calculated using the following equation:

$$V_1 = \pi(r)^2 \times h \times 7.48$$

where:

- V = volume of water in well (gal)
- r = well radius (ft)
- h = height of standing water column (ft).

The volume of water in the sand pack was calculated using the equation:

$$V_2 = \pi(R-r)^2 \times h \times .30 \times 7.48$$

where:

V = volume of water in the sand pack (gal)
R = radius of the sand pack (ft)
r = radius of the well casing (ft)
h = height of water in the sand pack (ft)
porosity = .30

The two volumes (V_1 and V_2) were summed to provide the calculated volume of water contained in a single well volume.

After all necessary measurements and calculations had been made and recorded, the well was purged using the most appropriate method for a particular well based on estimated water productivity. Generally, the wells were purged using a submersible pump, Teflon® bailer, or a PVC hand pump. Regardless of the method used to purge the wells, five well volumes of water were removed from the well before sampling, unless the well had a slow recharge rate, defined as recharge less than 95 percent in 1 hour. In the case of a well with slow recharge, only two well volumes were removed before sampling. Field measurements for temperature, pH, and specific conductivity were taken at 9 of the 13 wells during the purging process and recorded. Readings were not obtained from four wells due to mechanical difficulties with the measurement equipment. This was initially attributed to weather conditions before corrective actions were taken.

Groundwater samples were collected immediately following purging, or as soon as the well contained a sufficient volume of water for the intended analyses. Groundwater samples were collected using a point-source, bottom-filling Teflon® bailer, and dispensed into appropriately labeled sample bottles after each bottle had been rinsed three times with the collected sample water. The metals fraction was preserved with nitric acid (HNO_3) before shipment preparation. The samples were immediately placed into a cooler with ice until all

sample fractions were collected, and the samples were refrigerated at 4°C until they were prepared for shipment.

Groundwater samples were prepared for shipment to the laboratory by wiping the sample containers using paper towels and affixing signed custody seals around or over the container cap. Glass containers were wrapped in bubble wrap and all containers were placed in separate sealable plastic bags. After the samples were ready for shipping, they were packed into a cooler with blue ice and padding material. A chain-of-custody form was completed and included sampling information regarding the laboratory number, matrix, sample number, date, time, site/zone, requested parameters, number of containers, and comments or special instructions. The chain-of-custody form was placed into a sealable plastic bag and taped to the inside of the cooler lid. Strapping tape was wrapped around each end of the cooler approximately three times to secure the lid. The samples remained under the supervision of SAIC personnel until delivery services had taken custody of the shipment.

Field calibration of measurement instruments was performed at the beginning of each sampling day and checked periodically throughout the day to ensure accurate field measurements.

2.2.6 Surface Water and Sediment Sampling

Surface water and sediment sampling was conducted to provide data on the presence or absence of contamination in the environmental media accessible at the surface. Surface water and sediment samples were collected at areas T-5, T-24A, T-31, Range K (sediment only), and Former Landfill #3. The samples from Former Landfill #3 were analyzed for:

- VOCs
- SVOCs
- Pesticides and PCBs
- Metals
- Explosives

- Chemical agent breakdown products
 - Mustard (HD) - Breakdown products are thiodiglycol, p-chlorophenylmethyl sulfone, p-chlorophenylmethyl sulfoxide, and 1,4-dithiane.
 - Nerve agents (GB, VX) - Breakdown products for GB type nerve agents include IMPA, methylphosphonic acid, dimethyl methylphosphonate, and diisopropyl methylphosphonate. Breakdown products for VX type nerve agents include ethyl methylphosphonate and isopropyl amine.

Samples from the chemical/biological agent training areas were screened for chemical agent in the field and were analyzed in the laboratory for chemical agent breakdown products.

Surface water and sediment samples were collected using stainless steel sampling equipment. Depending on the actual sample location, either a stainless steel bucket auger or trowel was used. Surface water samples were collected by submerging the sampling container into the water at an upstream location or using a stainless steel ladle. Sample materials that were analyzed for volatiles were quickly placed into the sample containers and cooled to 4°C.

Material collected for nonvolatile analyses was placed in a stainless steel container for mixing and subsequently divided into the appropriate sample containers, cooled to 4°C, and packed in a cooler for transport to the laboratory. All samples were shipped by overnight carrier to contracted laboratories.

2.2.7 Equipment Decontamination Procedures

Before sampling activities began, between sampling intervals, and after sampling activities at a site had been completed, all sampling equipment (e.g., split-spoon samplers and bailers) was decontaminated according to the procedures outlined in Section 2.4.1.3. The equipment was scrubbed using a non-phosphate laboratory grade detergent (Alconox) solution, rinsed with potable and diagnostic grade water, rinsed with isopropanol, and allowed to air dry. After the equipment had air dried, it was rinsed with diagnostic grade water again, air dried, and wrapped in aluminum foil. Field blanks were collected and submitted to the laboratory to provide baseline data for the water used to decontaminate equipment (i.e., diagnostic grade

water). In addition, water samples from the water tank used in well drilling or installation were collected for analysis.

Well purging and development equipment was decontaminated by washing with laboratory-grade detergent and rinsing with potable and diagnostic grade water, unless a bailer was used. Bailers were decontaminated using the procedures specified above. With the exception of bailers, the decontaminated well purging equipment was wrapped in visqueen plastic or placed in plastic bags for transport to the site to prevent contamination of the purging equipment.

Between drilling locations, drilling equipment (i.e., rig, augers, and rods) was cleaned at the portable decontamination area using a steam cleaner, laboratory-grade detergent (i.e., Liquinox/Alconox), and a potable water rinse. Decontamination pads were established by the drilling contractor at Former Landfills #2 and #3. Both temporary decontamination pads contained materials and means to collect and store all decontamination fluids. The decontamination area was cleaned after each use, and all decontamination-generated wastes were collected and stored in 55-gallon drums pending disposition in accordance with U.S. Environmental Protection Agency (EPA), Fort McClellan, State of Alabama, and City of Anniston Water Works and Sewer Board requirements.

2.3 FIELD SCREENING ACTIVITIES

Before any intrusive or non-intrusive site activities were undertaken, an initial site survey was conducted. Each site was visually inspected to identify surficial features that could add further insight to the history and conditions of the site. The visual surveys provided information on potential contamination, areal boundaries of the sites, and features that might interfere with the planned investigations. In addition to the visual site reconnaissance, geophysical surveys, chemical agent screening, and air monitoring were conducted as precautionary measures during the field investigations.

2.3.1 Geophysical Surveys

Reconnaissance geophysical surveys consisting of electromagnetic terrain conductivity and magnetometer soundings were conducted by SAIC on five sites at Fort McClellan between

April 24 and May 8, 1992. The surveys were conducted at Former Landfill #1, Area T-24A, Area T-38, Range J, and Range K. The objectives of the reconnaissance geophysical surveys were to determine whether evidence shows that Former Landfill #1 was used as a municipal landfill and to confirm and corroborate, via use of a second surface geophysical method (electromagnetics), the results of USATEU metal detection surveys conducted at Area T-24A, Area T-38, Range J, and Range K. EM surveys conducted at these four sites were used to investigate the presence or absence of objects buried beneath locations previously selected and staked for subsurface soil sampling. Previous surveys that USATEU conducted with metal detectors at Range L indicated the presence of metal debris within the pond.

Electromagnetic and magnetic techniques were selected based on expected changes in subsurface electrical and magnetic properties produced by the targets. The information obtained was intended to help identify potential contaminant-source areas at Former Landfill #1 and to guide the placement of sampling locations. The procedures for magnetometer and EM surveys are discussed in Sections 2.3.1.1 and 2.3.1.2, respectively. Geophysical survey results for specific sites are provided in Section 3. Geophysical survey data are presented in Appendix B.

2.3.1.1 Magnetometer Surveys

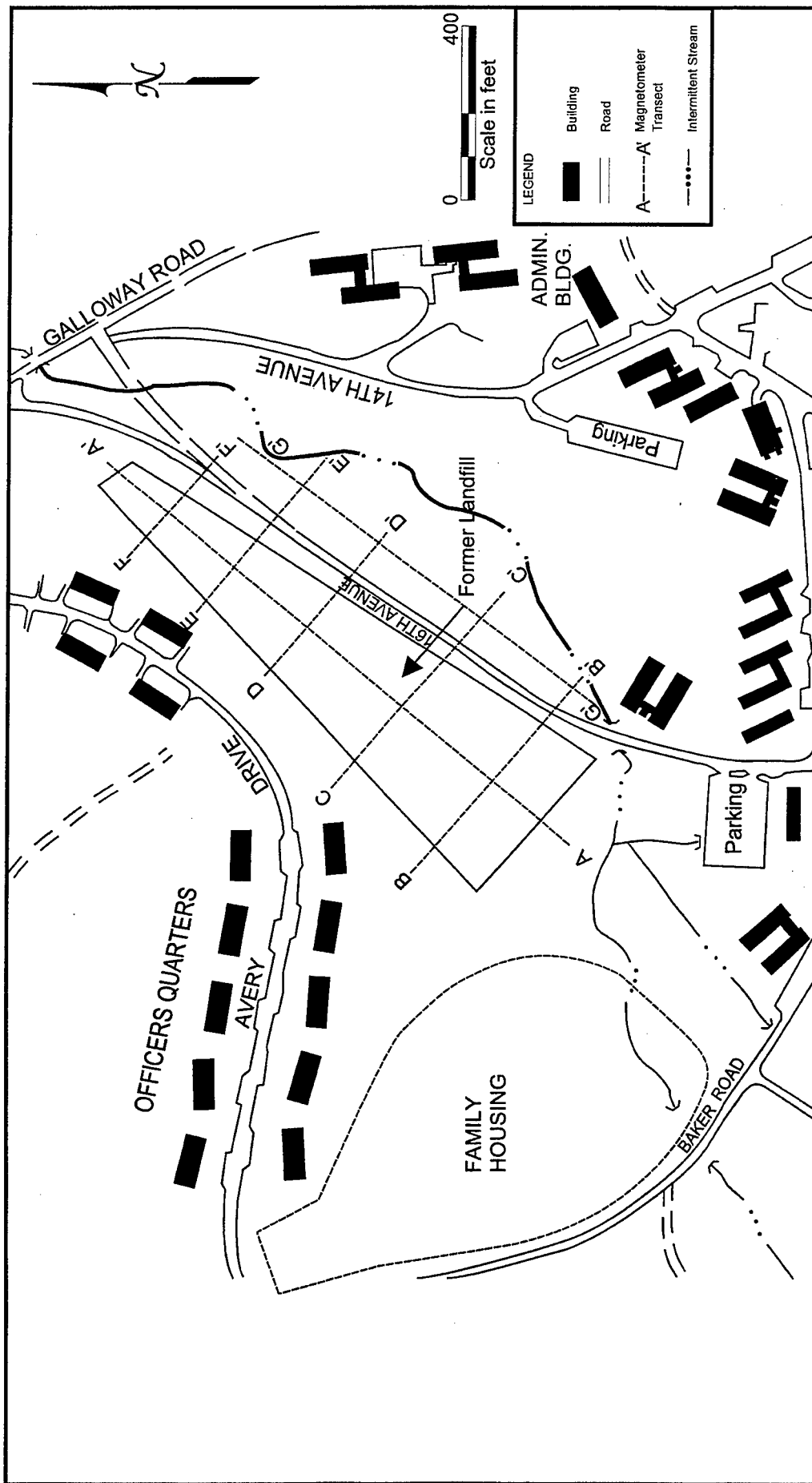
Magnetometer surveying is based on the measurement of the geomagnetic field. The intensity of the geomagnetic field is affected by ionospheric conditions, which can cause large and rapid variations. Local distortions (anomalies) are caused by changes or contrasts in magnetization due to the presence of both natural and artificial near-surface features, which magnetically interact with the field. Anomalies may be caused by the natural distribution of iron oxides within soil and rock or by the presence of ferrous metals, such as iron and steel. Anomalies generally are not produced by nonferrous metals, such as aluminum, copper, tin, and brass. The fundamental assumption of the magnetic method is that anomalies caused by near-surface features can be discerned from the natural field. An interpretation may be made concerning the source of a magnetic anomaly (i.e., natural or artificial) based on the size and shape of the anomalous signature. Total-field magnetic measurements are used to determine the absolute value of the ambient geomagnetic field using one sensor and gradient magnetic

measurements are used to define the gradient of the field by using two sensors separated by a known distance.

Prior to collecting magnetic data at Former Landfill #1, seven transects were superimposed over the site (Figure 2-4). SAIC selected the transect locations to provide coverage over the entire area of the suspected landfill. Along a given transect, stations were land surveyed and staked at 20-foot intervals. In some instances, bushes and trees needed to be removed to provide access. All field data were recorded using a GEM GSM-19 Overhausen proton-precession magnetometer. The instrument consists of two sensors, which are mounted on an 8-foot pole. The sensors were connected to a portable unit to display and store the data. The instrument measures total-field values to an accuracy and precision of approximately 0.2 and 0.01 nanoTeslas (nT), respectively. A base-station was established in the wooded area southeast of Profile C to measure diurnal variations during magnetic surveying. Base-station data were recorded with an EG&G Geometrics G-856AX proton-precession magnetometer, which measures total-field values to an accuracy and precision of approximately 1 and 0.1 nT, respectively. The base-station monitored diurnal variations of the geomagnetic field at 2-minute intervals while field data were collected. During the course of magnetic surveying, the maximum diurnal variation was less than 55 nT. Magnetic storms were not detected during the survey. Internal clocks on the base-station and field magnetometers were synchronized to facilitate data reduction.

At the beginning of each day of field work, the operator removed all metallic objects from his person. Readings that consisted of total-field and gradient components were collected at individual stations. The readings, time, and station identification were stored internally in the field magnetometer; readings, station identification, and observations were recorded in a bound field notebook. Measurement repeatability between data sets collected on different days was checked by reoccupying station A-24 at the beginning and end of each field day. The repeatability between all data sets was to within several nT.

Magnetic measurements consisting of both total-field and gradient components were collected at a 10-foot station spacing by interpolating between staked locations. Data consisting



**FORMER LANDFILL 1 - MAIN POST
FORT MCCLELLAN, ALABAMA**

MAGNETOMETER TRANSECT LOCATIONS

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 2-4

of 500 magnetic stations were collected along the seven transects, which covered approximately 4,750 linear feet. The station density enabled rapid reconnaissance while providing sufficient detail to detect relatively small magnetic features (i.e., surface expressions on the order of 10 feet or the distance between two stations). The results of the field survey and interpretation of magnetic data for Former Landfill #1 are provided in Section 3.16.1.

Upon the completion of each day of field work, data were transferred from the magnetometers to diskettes using a portable computer. The raw data were then processed to remove diurnal variations from the total-field data and to create ASCII files for data plotting. Graphs of gradient and diurnally corrected total-field magnetic data and raw data measurements are provided in Appendix B.

2.3.1.2 Electromagnetic Conductivity Survey

Electromagnetic methods measure apparent ground conductivity by driving an alternating current through either a loop of wire or a straight wire grounded at both ends. Induced or eddy current will flow within any conductive solid or fluid material beneath the area of investigation. The eddy currents generate their own magnetic fields such that, at any point in space, the total magnetic field is a superposition of the primary (normal) field due to the source current and the secondary (anomalous) fields due to eddy currents. By discriminating between primary and secondary fields, qualitative interpretations are made regarding regions of anomalous conductivity. Apparent ground conductivity reflects true conductivity when the subsurface is homogeneous and isotropic. When heterogeneous conditions exist, apparent ground conductivity represents an integrated effect of subsurface conductivities. However, it does not represent an average conductivity and can be lower or higher than the lowest or highest conductivity, respectively.

A lateral variation in apparent ground conductivity often indicates a lateral change in subsurface physical properties. The relative conductivity of the subsurface is particularly sensitive to fluid content and dissolved salts or ions. Accordingly, wet sand, clay, and materials with high ion content typically show high conductivity; dry sand and crystalline rock typically show low conductivity. Standard EM instruments measure both quadrature- and in-phase

components of the induced magnetic field. The quadrature-phase component is a measure of apparent ground conductivity, while the in-phase component is more sensitive to the presence of metallic objects.

EM conductivity surveys were conducted on four sites (Area T-24A, Area T-38, Range J, and Range K) to confirm and corroborate previous results obtained from magnetometer sweeps conducted by USATEU at these sites. Data consisting of 36 electromagnetic profiles were collected at 9 proposed sampling locations (i.e., four profiles per sampling location) within the four sites. Electromagnetic measurements, consisting of both quadrature- and in-phase components, were collected along transects of various lengths (50 to 200 feet) that were centered over the proposed sampling locations. Approximately 4,245 linear feet were traversed during the course of electromagnetic surveying. Surveying at a fifth site (Range L) was not conducted because the USATEU detected large quantities of buried metallic objects in the pond and determined that additional investigation activities or sampling should be precluded for the present time for safety reasons.

For each sampling site, EM data were collected along four transects (two 200-foot and two 100-foot), which were centered over the sampling location. The profile direction was determined by using a surveyor's compass and in general were oriented north to south, east to west, northwest to southeast, and southwest to northeast. Stations were staked at approximately 20-foot intervals using a measuring tape. Data were collected by setting the instrument to record in an automatic vertical-dipole mode. Readings were taken at 1.5-second intervals, which corresponded to a reading every 3 feet along a given transect. Both apparent ground conductivity (i.e., quadrature-phase) and in-phase data were recorded. The operator aligned himself along a profile and paced between marked stations, which were separated by 20 feet. The overall precision in distance is estimated to be approximately 3 feet.

A base-station was established near each site to calibrate the meter. Prior to each day of field work, the instrument was calibrated. To assess repeatability, quadrature-phase values were recorded at the beginning and end of each day at the base-station. These values of

apparent ground conductivity typically agreed to within 1 millimhos per meter (mmhos/m). All pertinent readings and observations were recorded within a bound field notebook.

During the course of each day of field activity, data were transferred from the data logger to diskettes using a portable computer. Graphs of apparent ground conductivity and in-phase data of profiles for the sampling points at Area T-24A, Area T-38, Range J, and Range K and field measurements are provided in Appendix B. Interpretations of the EM data are summarized in Sections 3.7.1, 3.9.1, 3.11.1, and 3.13.1.

2.3.1.3 USATEU Geophysical Surveying

The USATEU conducted reconnaissance geophysical surveys at Areas T-5, T-6, T-24A, T-31, and T-38; the Detection and Identification Area; the Old Toxic Training Area; Ranges I, J, K, and L; and the Old Water Hole. Qualitative surveys were conducted over each proposed boring location at all of these sites (note: sampling was not conducted at Lima Pond [Range L] and the Old Water Hole) to investigate the potential presence of buried metallic objects. The surveys were conducted using military issue metal detection equipment that produced qualitative results. The surveys conducted at Range L and the Old Water Hole were generally more areally extensive and were used to characterize the inferred locations of former munitions dumping sites with respect to the presence of buried metallic objects. In general, buried metallic objects were not detected at the sampling locations; however, instrument responses indicative of large concentrations of metal were reported at Range L and the Old Water Hole sites.

2.3.2 Field Screening

During the USATEU borehole drilling and sampling, a representative portion of material from each split-spoon or bucket auger sample was placed in a lithologic sample jar for head space analysis of chemical agents. Two fixed site MINICAMS units mounted in Commercial Utility Cargo Vehicles (CUCV) were used to screen and monitor for chemical agent. MINICAMS S/N 1361 was used to monitor for HD at all of the SI sites. MINICAMS S/N 1587 was used to monitor for GB or VX at seven SI sites. The MINICAMS S/N 1587 also could be converted to the HD mode of operation if a problem occurred with the MINICAMS S/N 1361.

Thermal desorption of CWA potentially contaminating a soil sample was accomplished by heating the sample in excess of 100°F. Evolved vapors were collected and injected into the MINICAMS for analysis. TWA concentrations for HD, GB, and VX are established by the Surgeon General of the United States and are shown below:

Agent	TWA* (mg/m ³)	TWA* (ng/L)	MINICAMS Detection Limit* (ng/L)
HD	.003	3	1
GB	.0001	0.1	.005
VX	.00001	0.01	.005

* Data provided by CMS Research Corporation (1993, written communication).

The TWA concentrations are 8-hour exposure limits established for worker safety. The relationship between the concentration of CWA detected in the desorbed vapor sample and the concentration of CWA contained in the soil is variable and depends on the lithology, moisture content, and pH of the soil sample. In general, more CWA vapor is recovered from coarse soils than from fine-grained soils at an optimum moisture content that varies with soil type (Sage and Howard 1989).

The MINICAMS unit can report concentrations in the units of mg/m³, however, the significance of a given concentration varies from agent to agent. As an example, a concentration reading of 0.0001 mg/m³ would be insignificant for HD (that is, only about 3 percent of the TWA level for this agent) but would be very significant for VX (that is, 1,000 percent of the TWA level).

To avoid confusion about decimal points and to make it easier for operators to interpret MINICAMS data, the monitoring system is normally set up to report concentrations in relative units. For example, if a concentration of 0.003 mg/m³ of HD is detected by the MINICAMS, then it is reported as 1.00 TWA. If a concentration of 0.00001 mg/m³ of VX is detected, then it is reported as 1.00 TWA. Thus, the TWA reading has the same significance no matter which agent is being detected. The TWA reading reported for a given agent may be converted to

mg/m³ simply by multiplying the reported TWA reading by the definition given above. For example, a reading of 0.5 TWA for GB corresponds to 0.00005 mg/m³.

MINICAMS is calibrated for a given agent simply by injecting the quantity of agent that would be found in the volume of air sampled by the MINICAMS during one cycle if the concentration of agent in the air sample was equal to 1.00 TWA. For example, if a MINICAMS sampled air at 1 liter per minute (1.00 LPM) for three minutes (3 min) during a given cycle, then a total of 3 liters of air would be sampled. If the MINICAMS were being used to sample GB at its TWA level, then the 3 liters of air would contain 0.3 nanograms of GB (that is, 3 L x 0.1 ng/L). Thus, to calibrate the MINICAMS for the detection of 1.00 TWA of GB for the flow rate and cycle time given, 0.3 ng of GB would be injected into the monitor. The GB is normally contained in a solution of the agent in an organic solvent, such as hexane. For the example given, one microliter (μ L) of a standard solution containing 0.3 nanograms per microliter (ng/ μ L) of GB could be injected into the MINICAMS inlet during its sample period to calibrate the unit.

Ideally, every time the proper quantity of agent was injected into the MINICAMS after it had been calibrated, the unit would report a concentration reading of 1.00 TWA. That is, any reading at or above 1.00 TWA would cause the unit to sound an alarm. In reality, there is scatter in the concentration data reported by the MINICAMS. For this reason, if the alarm level were set to 1.00 TWA, then an alarm would sound only half the time (if the distribution of the concentrations reported is gaussian or bell-shaped).

The alarm level for the MINICAMS was set to correspond to a 95 percent confidence level which would sound an alarm if the instrument were challenged with the equivalent of 1.00 TWA of agent. Statistical studies have shown that an alarm level of 0.80 TWA is a suitable setpoint for MINICAMS to achieve a 95 percent confidence level; that is, at this alarm level setpoint, a 1.00 TWA challenge of the MINICAMS will result in a concentration reading greater than or equal to 0.80, and thus, an alarm, 95 percent of the time.

In field work that involves monitoring at the extremely low concentrations represented by TWA levels, there is the distinct possibility of an interference. A concentration reading of 0.75 TWA is certainly within the capabilities of the MINICAMS, but this concentration reading may be the result of a nonagent compound that is present in high concentrations and that causes a false positive. The flame-photometric detector (FPD) used in the MINICAMS is about 10,000 times more sensitive to compounds that contain phosphorus (such as VX) than to compounds that do not contain phosphorus (such as hexane). Thus, if the concentration of a nonphosphorus-containing compound is more than 10,000 times greater than the TWA level for a given agent, it may interfere with the agent resulting in a false positive for the agent). This will occur only if the interferant compound is present at extremely high concentrations relative to the agent and if the boiling point of the interferant compound is about the same as the agent so that the two compounds elute from the gas-chromatographic column and enter the detector at the same time. Interferences in field monitoring may result, for example, if the exhaust from a portable power generator or from a vehicle is allowed to blow across the inlet or intake of the MINICAMS or a sample line attached to the MINICAMS.

The MINICAMS were set up and calibrated each morning following the procedures outlined in Appendix D. All accepted readings were recorded on a floppy disk and printed to a field printer. A 20- to 30-minute calibration period was used each day to ensure stable operation. The MINICAMS were calibrated at least twice each morning using an HD, GB, and/or VX standard. Standards for MINICAMS calibration were obtained each day from Anniston Army Depot chemical surety personnel and were returned each day after use.

The split-spoon samples that SAIC collected for geotechnical analysis during monitoring well drilling were screened using an HNu photoionization detector (PID). After the split-spoon sample was removed from the borehole, the SAIC supervisory geologist conducted the screening. The shoe at the lead part of the spoon was removed and a small quantity of the soil was removed to allow access to the HNu probe. The probe of the HNu PID was inserted into the space to measure the level of volatile organics in the spoon. After opening the sampler, the sample was screened a second time along its length. The results were recorded on the site geologist's boring logs. The results of these measurements were used to select the samples to be shipped to the

analytical laboratory. The HNu meter also was used to monitor ambient air conditions in the drilling area.

During monitoring well drilling activities, a lower explosive limit (LEL) meter was used to continuously monitor the borehole. This type of monitoring was conducted to ensure a safe drilling environment and prevent the possibility of an explosion occurring due to the release of methane or other combustible gases. The LEL was calibrated at the beginning of each day.

2.4 DEVIATIONS FROM PLANNED ACTIVITIES

Although activities conducted under the SI were extensively planned and agreed to by SAIC, USAEC, and EPA Region IV personnel, site conditions encountered during the investigation necessitated deviations from the original planned effort.

The following sections discuss the deviations of procedures, methods, and any other criteria in the approved final draft of the SI Sampling and Analysis Plan (SAIC 1992). These modifications, which are discussed below, were instituted in the field due to unforeseeable circumstances and did not adversely affect the SI data quality objectives (DQOs).

2.4.1 Well Construction

The wells constructed during the SI were in accordance with the well construction specifications detailed in the SI Sampling and Analysis Plan (SAIC 1992), with the exception of monitoring well LF2MW3. The amount of sand pack above the screen in this well was 1.5 feet less than the minimum amount of 5 feet. The length of the bentonite seal in this well was 1.8 feet less than the specified minimum of 5 feet. The sand pack and seal were both affected by the shallow depth of the water table. The field procedures were modified to allow for an acceptable sand pack placement, bentonite pellet seal, and proper placement of the steel protective casing. To accomplish this, the amount of sand pack above the screen and the bentonite seal were reduced so that the protective casing could be properly placed in the cement/bentonite grout.

The monitoring well surface pads were modified in size and composition. The surface pads originally were planned to be 8 by 8 feet and composed of coarse gravel. The pads were reduced to 4 by 4 feet and formed using commercially mixed concrete with a strength of 3,000 pounds per square inch (psi). All other procedures for drilling and installing the monitoring wells followed the procedure presented in the final draft of the SI Sampling and Analysis Plan (SAIC 1992) and USAEC's *Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition, and Reports* (1987).

2.4.2 Decontamination Procedures

The decontamination procedure for the sampling equipment (e.g., split-spoons, spatulas, and bailers) used during sample collection for chemical analysis was modified from the final draft of the SI Sampling and Analysis Plan (SAIC 1992). EPA Region IV protocols required the addition of an isopropanol rinse for sampling equipment coming in direct contact with the sample. The modified decontamination procedure for sampling equipment to include the isopropanol rinse is:

- Scrub wash with a non-phosphate, laboratory-grade detergent (Alconox)
- Potable water rinse
- Diagnostic-grade water rinse
- Isopropanol rinse and allow equipment to air dry
- Diagnostic-grade rinse, allow equipment to air dry, and wrap in aluminum foil, shiny side out, to prevent contamination during transport or storage.

SAIC and USATHAMA implemented the isopropanol modification into the decontamination procedure for sampling equipment.

2.4.3 Sample Containerization

USATEU collected the soil samples for chemical analysis using split-spoon samplers, as mentioned in Section 2.4.1.2. VOCs were collected first in two amber 40-mL volatile organic analysis (VOA) vials. The remainder of the sample material was composited and the SVOC/pest/PCB sample was placed in the same 4-ounce amber glass containers. Explosive and

metals samples were placed in separate 4-ounce jars. Samples collected for the agent breakdown products were placed in one 16-ounce amber jar and sent to a different laboratory for analysis.

2.5 DISPOSAL OF WASTES FROM FIELD ACTIVITIES

All wastes generated during the field portion of the SI were accumulated in specific interim storage containers, analyzed for hazardous characteristics, and were disposed of through onsite spreading of uncontaminated solids, discharge of liquids meeting regulatory requirements to the sanitary sewer on Fort McClellan, and disposal of liquids quantified as hazardous waste through Fort McClellan Waste Management. A total of 139 drums were handled from Fort McClellan and Pelham Range. Procedures for handling specific wastes are outlined below. Documentation of waste management activities at Fort McClellan are provided in Appendix K.

2.5.1 Drill Cuttings

Drill cuttings and soil samples generated from field activities conducted by USATEU and SAIC were visually inspected during drilling for evidence of contamination. The presence of volatile organics and chemical agents in the drilling wastes was screened using an HNu PID or a MINICAMS.

Borehole cuttings obtained from shallow borings during USATEU field activities were stored in plastic bags that were left onsite at each boring location. Cuttings were retained at the sites until the results of the chemical analyses for the soil samples taken from the shallow boreholes were received. Based on the nondetection of chemical agent breakdown products, the soils were spread onsite at each sample location and the plastic bags were disposed of as uncontaminated trash.

Monitoring well cuttings generated during SAIC field activities were stored in 55-gallon U.S. Department of Transportation (DOT) approved drums. Composited samples were collected from monitoring well cuttings at each well for Toxicity Characteristic Leaching Procedure (TCLP) analysis using EPA Method 1311. Sampling of the cuttings in each drum consisted of continuously hand augering through a random location to the bottom of the drum. Samples were composited from the drums at each well into a 5-gallon stainless steel bucket or a large stainless

steel bowl and were placed in the appropriate containers for analysis. The results of the TCLP analysis of eight composited soil samples from Former Landfills #2 and #3 drilling wastes are provided in Table 2-5.

Containerized cuttings were determined to be uncontaminated based on the results of the TCLP soil analysis, and the cuttings were spread onsite in accordance with the requirements of the Fort McClellan Department of Environmental Management (DEM). The disposition of the soil material was supervised by SAIC personnel. Drum handling and soil spreading were conducted by the drilling contractor between May 10, 1993 and May 15, 1993. Emptied drums were cleaned using a steam cleaner and were stockpiled at a storage yard on Fort McClellan.

2.5.2 Drilling, Development, and Purge Water

Well development water, purge water, and water generated during well drilling were consolidated by well in sealed, 55-gallon, DOT-approved drums. Investigation derived water was held at each well site until chemical analyses from the individual wells were available. Based on the chemical data, SAIC provided calculations to the Anniston City Water Works and Sewer Board (SAIC, written communication, May 1993) indicating the volumes of water, pH, specific conductivity, the total weight of metals contained in the water and the calculated concentration of metals contained in each batch. Metals at or below their detection level were considered to be present at the detection level in the calculated totals. Based on the chemical data and calculations, SAIC received approval from the Board (Mr. Charles Lay, written communication, May 1993) to discharge the uncontaminated investigation derived water to a sanitary sewer location on Fort McClellan. Approximately 4,005 gallons of water was discharged to the sanitary sewer between May 10, 1993 to May 15, 1993. Decontaminated drums were stored on-Post at a storage yard on Fort McClellan. Water from wells OLF-2 and OLF-4, which contained excessive concentrations of lead, was consolidated and moved to the Fort McClellan Waste Management area for disposal by the Base as hazardous waste.

Table 2-5. Toxicity Characteristic Leaching Procedure Results for Soil Cuttings
Ft. McClellan Site Investigation, Anniston, Alabama

Parameter	Regulatory Level (mg/L)	TCLPLF2S01 (mg/L)	TCLPLF2S02 (mg/L)	TCLPLF2S03 (mg/L)	TCLPOLF06 (mg/L)	TCLPOLF07 (mg/L)	TCLPOLF08 (mg/L)	TCLPOLF09 (mg/L)	TCLPOLF10 (mg/L)
Percent Moisture		15.5	16.2	9.7	55.9	24.4	26.6	30.6	24.2
Arsenic	5.0	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Barium	100.0	0.8	<0.5	0.7	0.6	0.7	0.6	<0.5	<0.5
Benzene	0.5	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016	<0.0016
Cadmium	1.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	0.5	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015
alpha-Chlordane	0.03	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
gamma-Chlordane	0.03	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chlorobenzene	100.0	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Chloroform	6.0	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018
Chromium	5.0	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	<0.05
o-Cresol (a)	200.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
m-Cresol (a)	200.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
p-Cresol (a)	200.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2,4-D	10.0	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
1,4-Dichlorobenzene	7.5	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044	<0.044
1,2-Dichloroethane	0.5	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
1,1-Dichloroethylene	0.7	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
2,4-Dinitrotoluene	0.13	<0.057	<0.057	<0.057	<0.057	<0.057	<0.057	<0.057	<0.057
Endrin	0.02	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor	0.008	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Heptachlor Epoxide	0.008	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexachlorobenzene	0.13	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Hexachlorobutadiene	0.5	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Hexachloroethane	3.0	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Lead	5.0	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Lindane	0.4	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	0.2	<0.0002	<0.0002	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Methoxychlor	10.0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methyl ethyl ketone	200.0	<0.0038	<0.0038	<0.0038	<0.0038	<0.0038	<0.0038	<0.0038	<0.0038
Nitrobenzene	2.0	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Pentachlorophenol	100.0	<0.036	<0.036	<0.036	<0.036	<0.036	<0.036	<0.036	<0.036
Pyridine	5.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium	1.0	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Silver	5.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Tetrachloroethylene	0.7	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015
Toxaphene	0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trichloroethylene	0.5	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
2,4,5-Trichlorophenol	400.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2,4,6-Trichlorophenol	2.0	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027
2,4,5-TP (Silvex)	1.0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl chloride	0.2	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017

(a) Cresol isomers, o-, m-, and p-cresol, are reported as 2-, 3-, and 4-methylphenol, respectively.

2.5.3 Decontamination Wastes

All disposable clothing and other material from decontamination activities were stored in plastic bags, checked with an HNu PID, and visually inspected, and disposed of on-Post as trash.

All liquid decontamination wastes were collected and stored in DOT-approved drums. Disposal was managed following the same procedures as the containerization of development and purge water described in Section 2.5.2. Decontamination liquids associated with soil sampling, monitoring well installation, and groundwater sampling activities were containerized and stored onsite until the data results were received. If the data results indicated no contamination, the liquid decontamination wastes were discharged into the Post sanitary sewer system. Decontamination wastes that were considered hazardous were disposed of through Fort McClellan Waste Management. USATEU liquid decontamination wastes were consolidated by SAIC into eight drums which were disposed of by Fort McClellan.

3. RESULTS OF FIELD INVESTIGATIONS

This section details the results of the Site Investigation (SI) activities conducted at Fort McClellan and provides an assessment of each site regarding available information, environmental contamination, and recommended additional activities. Data used to assess each site are provided below and detailed analytical data for the sites are presented in Appendix E.

3.1 SITE GEOLOGY AND HYDROGEOLOGY

Subsurface geologic and hydrogeologic conditions were investigated at Former Landfills #2 and #3 during the Fort McClellan SI. The investigations consisted of drilling and sampling three boreholes at Former Landfill #2 and five boreholes at Former Landfill #3, and lithologic logging of the collected samples. Geotechnical analyses were conducted on 13 representative soil samples and standard penetration test (SPT) values were obtained to evaluate the relative density of the subsurface materials. Hydrogeologic assessments were confined to measurement of water levels in eight new wells and five existing wells and determination of hydraulic gradients and flow directions. The scope of the SI was not established to fully characterize the geologic and hydrogeologic conditions impacting the investigated sites; however, sufficient data were collected to allow a preliminary assessment of contaminant migration pathways from the two landfill sites.

3.1.1 Site Geology

Borehole samples obtained during monitoring well drilling at the landfill sites indicate that the subsurface materials underlying these areas are variably dense, and consist predominantly of low plasticity silt and clay residual soils. Bedrock mapped (USGS 1962) beneath Former Landfill #2 consists of Ordovician limestone with thinly interbedded black shale that attains an aggregate thickness of approximately 230 feet in Calhoun County. Bedrock underlying Former Landfill #3 is mapped as Cambrian Rome Formation and consists of interlayered red to green shale and siltstone, and red to light gray sandstone. Local light gray limestone or dolomite interbeds may be encountered in the Rome Formation. The Rome Formation attains an aggregate thickness of approximately 1,000 feet in Calhoun County.

Soils at Former Landfill #2 are predominantly massive silt and clay except at monitoring well LF2MW3, where approximately 10 feet of sand and silty sand was encountered. Boring LF2MW2 was located adjacent to the floodplain of Cane Creek and may have encountered alluvial deposits associated with the creek migration. Fill debris, including glass and metal, was encountered at LF2MW1 after portions of the landfill were reworked to construct an access road to the well location. SPTs in the soil horizons ranged from 6 to 55 blows per foot (bpf). Hard siltstone and claystone units were encountered at 16.5 to 25.7 feet below land surface (BLS) at Former Landfill #2. The bedrock showed evidence of iron staining, differential weathering, and horizontal bedding.

The observed soil profile underlying Former Landfill #3 is the result of differential weathering of the Cambrian Rome Formation shale and siltstone layers to predominantly silt and clay soils. Sand horizons observed during drilling were typically discontinuous and likely the result of weathering of formerly interlayered sandstone. The soil horizons are variably colored yellow-brown (10YR 5/0) to reddish-yellow (7.5YR) to red-brown(2.5YR 5/3). Hard claystone to siltstone bedrock units were encountered at depths ranging between 25.0 and 40.0 feet BLS. The bedrock units are highly weathered, laminated to thinly bedded, and highly fractured, as evidenced by the observed variable weathering and the poor core recoveries. Differential weathering of the fine-grained siltstone and claystone bedrock in the area of Former Landfill #3 has resulted in a variable subsurface bedrock topography. Highly weathered bedrock that required diamond bit coring was encountered at wells OLF-6 and OLF-7; however, in other areas, the claystone bedrock was augered to depth. The variability in the bedrock weathering is shown in Figure 3-1.

3.1.2 Site Hydrogeology

Science Applications International Corporation (SAIC) obtained groundwater level measurements from 10 wells located in the vicinity of Former Landfill #3 and from the 3 wells at Former Landfill #2. The groundwater level measurements are summarized in Table 3-1. Measured groundwater elevations ranged between approximately 787 and 793 feet above mean sea level (MSL) at Former Landfill #2. Groundwater elevations ranged between approximately 683 and 730 feet MSL at Former Landfill #3.

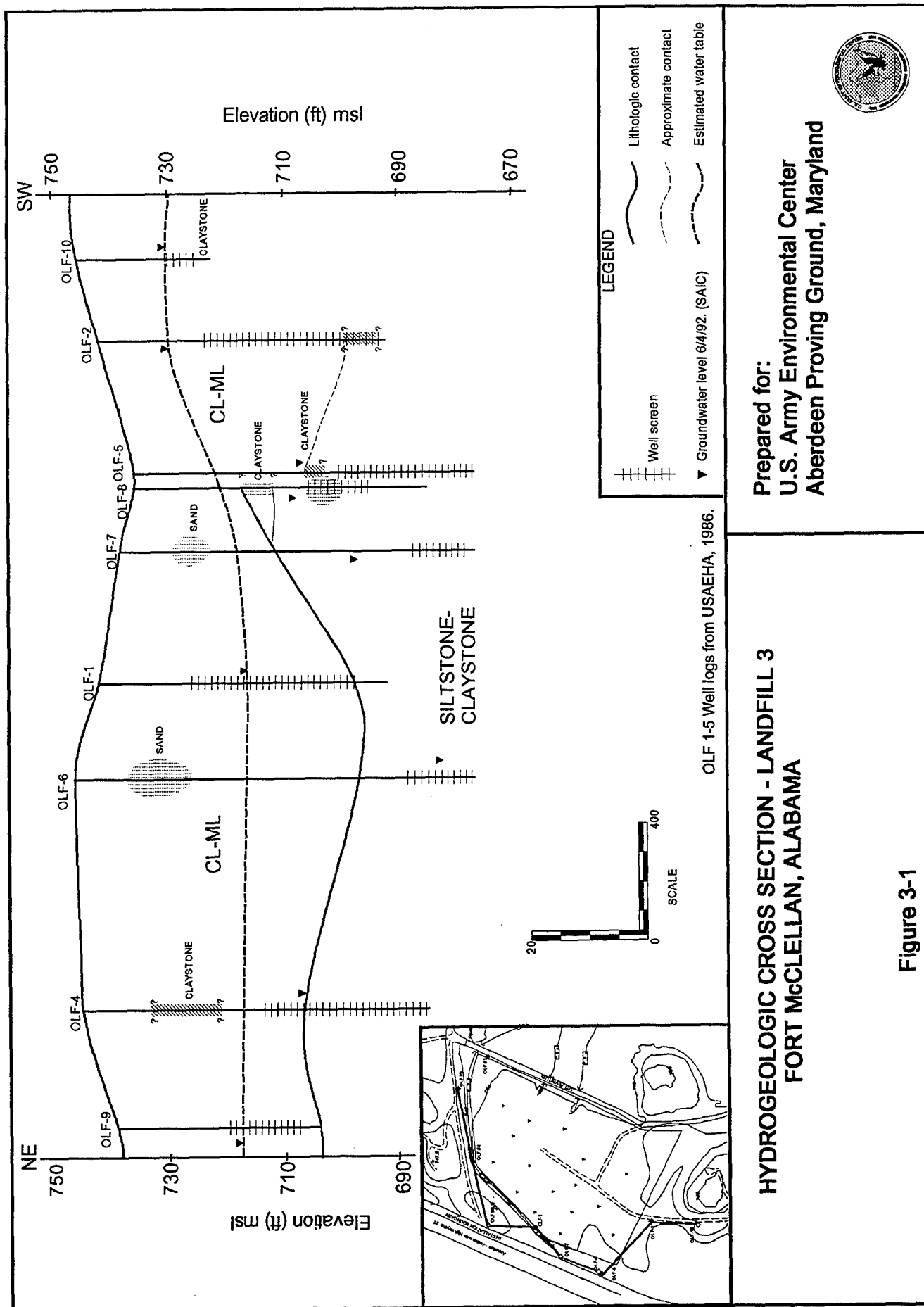


Table 3-1. Groundwater Elevations - June 4, 1992
Fort McClellan Site Investigation, Alabama

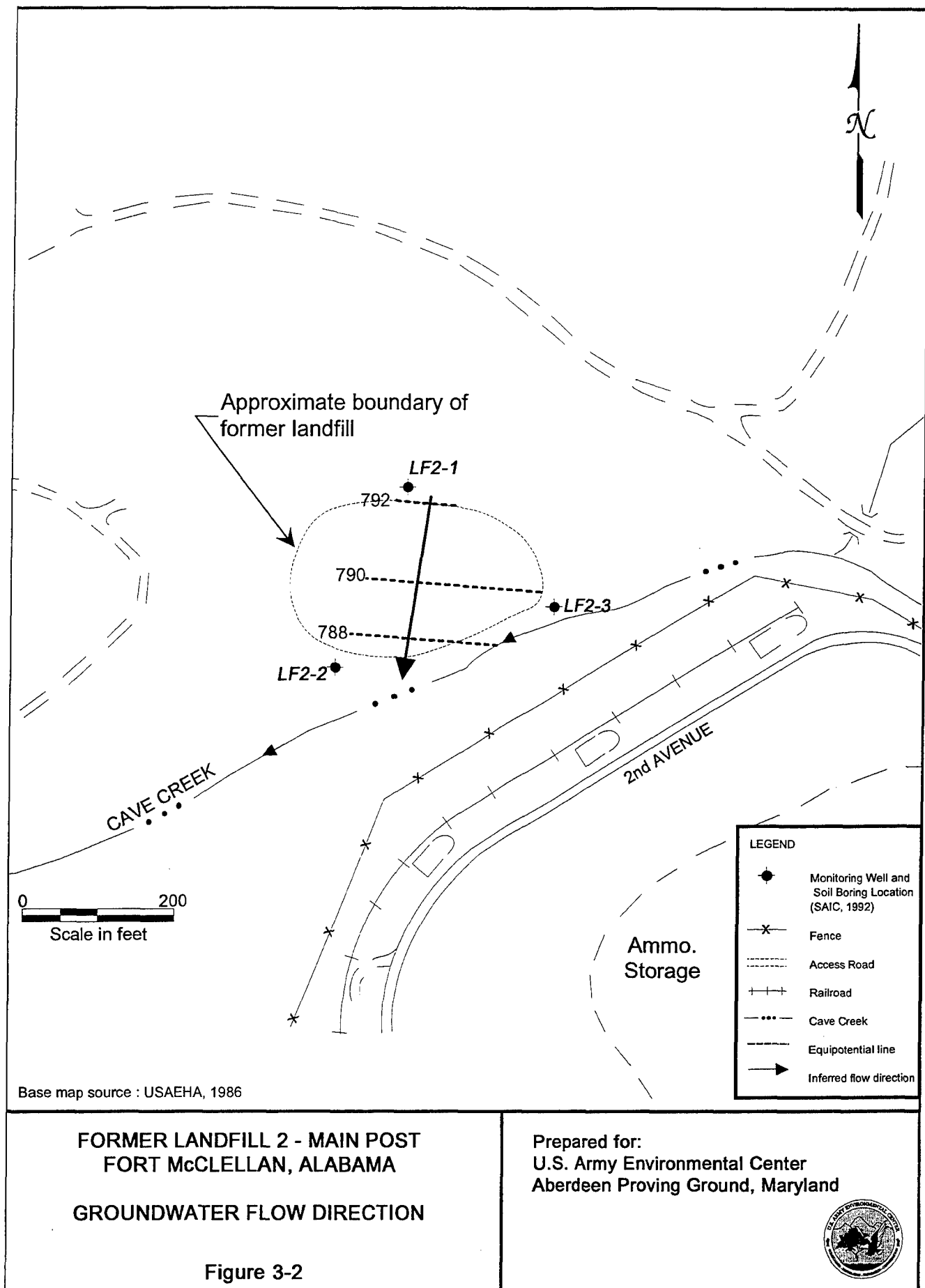
Well No.	Easting (feet)	Northing (feet)	TOC Elevation (MSL)	Measured Depth (feet)	Water Elevation (MSL)
LF2MW1	1175402.322	516724.2968	809.59	16.78	792.81
LF2MW2	1175099.162	516586.1663	793.89	6.93	786.96
LF2MW3	1175177.242	516947.634	796.88	7.6	789.28
OLF-1	1180274.094	512531.8982	743.67	17.09	726.58
OLF-2	1179585.464	512586.1126	744.28	13.91	730.37
OLF-3	1180579.839	513569.6554	739.92	14.05	725.87
OLF-4	1180704.449	512956.2302	747.49	41.45	706.04
OLF-5	1179903.41	512263.5525	740.25	33	707.25
OLF-6	1180592.987	512566.2491	749.93	66.45	683.48
OLF-7	1180113.993	512352.3211	739.01	43.54	697.88
OLF-8	1179911.237	512279.7217	739.34	31.08	708.26
OLF-9	1180782.946	513343.8477	741.2	22.72	718.48
OLF-10	1179303.451	512538.8248	748.53	18.58	729.95

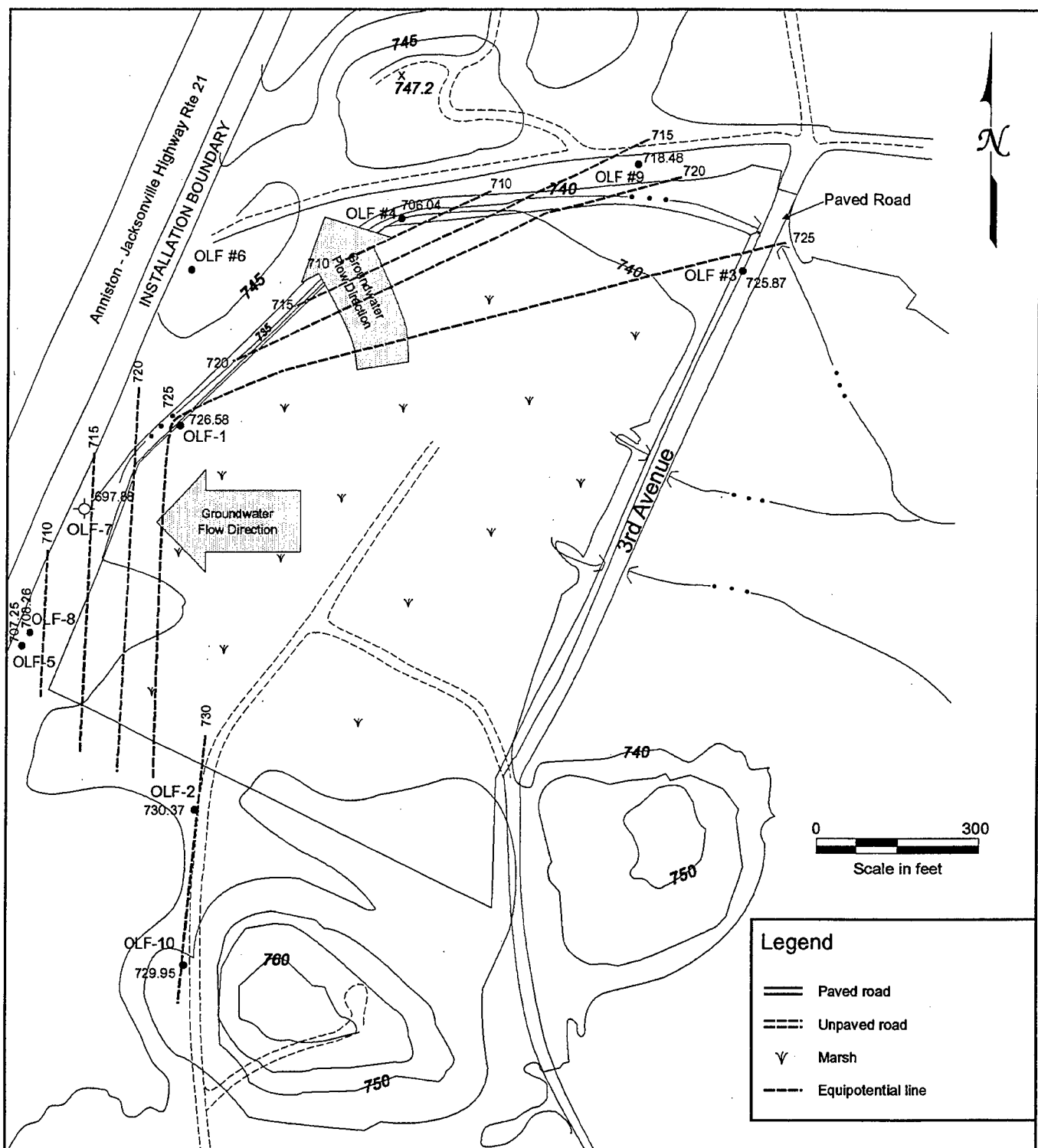
Groundwater flow direction and hydraulic gradient calculations were completed by triangulation between the measured groundwater elevations in the monitoring wells at Former Landfills #2 and #3. The inferred groundwater flow direction (Figure 3-2) at Former Landfill #2 is south-southeast toward a tributary of Cane Creek. The calculated hydraulic gradient for this site is 0.018 ft/ft.

Groundwater flow at Former Landfill #3 is more complex, with two wells (OLF-6 and -7) screened in the weathered claystone bedrock showing groundwater elevations much lower than the surrounding wells. Generally, wells that were screened in whole or partly in the hard, highly weathered claystone and siltstone layers (OLF-4, -6, and -7) produced lower observed water levels than wells screened in the soil horizons (OLF-1, -2, -9, and -10 in Figure 3-1). Wells OLF-5 and -8 appear to be in a transitional zone where the bedrock weathering extends deeper. The estimated groundwater table based on wells screened in the soil horizons is shown in Figure 3-1. Groundwater flow directions at Former Landfill #3 are inferred from triangulation between the measured groundwater elevations at each well excluding wells OLF-6 and -7. The inferred flow directions are shown in Figure 3-3 and indicate that flow is to the west and northwest under a hydraulic gradient of approximately .07 ft/ft. Lower groundwater production rates were observed at wells OLF-6 and -7 during well development.

3.2 DATA QUALITY ASSESSMENT

A standardized quality assurance/quality control (QA/QC) program was followed during the Fort McClellan SI during sample collection and analysis to ensure that analytical results and the decisions based on these results were representative of the environmental condition at the sites. The objectives of the SI were to assess the presence of contamination, collect and analyze sufficient numbers of samples to support recommendations for further investigation or to recommend no further remedial investigation, and conduct a hazard ranking system (HRS) score at the site determined to exhibit the highest level of environmental contamination. The SI was conducted in accordance with the Fort McClellan Sampling and Analysis Plan which was formulated using guidance from the 1985 Region IV U.S. Environmental protection Agency (EPA) Engineering Support Branch document *Standard Operating Procedures and Quality Assurance Manual*; the 1990 U.S. Army Toxic and Hazardous Materials Agency (USATHAMA)





**FORMER LANDFILL 3
FORT McCLELLAN, ALABAMA
GROUNDWATER FLOW DIRECTION**

Figure 3-3

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



report *Quality Assurance Program for Environmental Sample Collection and Analysis*; the 1987 USAEC report *Geotechnical Requirements for Drilling Monitoring Wells, Data Acquisition and Reports*; and the guidelines and specifications described in the Quality Assurance Project Plans (QAPPs) submitted as part of the project work plans prepared by SAIC (i.e., *Site Investigation Sampling and Analysis Plan* for Fort McClellan, Alabama, 1991). The number of soil, sediment, surface water, and groundwater samples collected during the SI, in addition to the number of field QC samples collected and selected laboratory QC (i.e., matrix spikes and duplicates) samples analyzed, are summarized in Appendix F. The data validation worksheets are referenced within the subsection describing the applicable analysis. The QC checks and results are summarized below.

All data were submitted by the laboratories using the guidelines and specifications described in the 1990 USAEC *Quality Assurance Program*, and validated and qualified by the Installation Restoration Data Management Information System (IRDMIS). IRDMIS is used for the entry, validation, and output of chemical data and the generation of data files to be submitted to USAEC IR and base closure programs. As data are entered into the IRDMIS system, they are validated by comparison to the program's chemical data base files. IRDMIS contains specifications for data validation (i.e., acceptable criteria, acceptable entries). Chemical data are compared to these specifications to determine their validity. The laboratory is required to initially validate the data and comment on the data's usability through the use of flagging codes. The qualifiers are entered into the IRDMIS Flagging Code Field and indicate other than usual analytical conditions or results.

The laboratory must correct data that are found in error. The laboratory/contractor are notified of lots that must be corrected and resubmitted. Some errors (i.e., out of control, but data accepted due to high recoveries) may be qualified useable (i.e., Flagging Code = H) by the USAEC Chemistry Branch; these situations are explained further in Appendix F. Data are entered by the laboratory as Level 1; if approved, the data are elevated to Level 3, at which time they are accepted and validated in the IRDMIS Data Base Subsystem.

3.2.1 Data Quality Objectives

The following sections summarize the data quality objectives (DQOs) for precision, accuracy, representativeness, comparability, and completeness (PARCC) obtained during the Fort McClellan SI.

3.2.1.1 Precision

Precision was defined as the reproducibility, or degree of agreement, among replicate measurements of the same quantity. The closer the numerical values of the measurements are to each other, the more precise the measurement is. Analytical precision was expressed as the percentage of the difference between the results of duplicate samples for a given compound or element. Precision was determined using matrix spike/matrix spike duplicate (MS/MSD) and duplicate sample analyses conducted on samples collected during the Fort McClellan SI. The laboratory selected 1 sample in 20 and split the sample into 2 additional aliquots. MS/MSD samples were prepared by routinely analyzing the first aliquot for the parameters of interest, while the remaining two aliquots were spiked with known quantities of the parameters of interest before analysis. Duplicate samples were prepared by subdividing 1 sample of every 20 samples received and analyzing both samples of the duplicate pair. The relative percent difference (RPD) between the two detected concentrations was calculated using the equation given in Appendix F and used as an indication of the analytical precision for the analyses performed.

For each lot of samples, USAEC spiked QC samples (i.e., standard matrix spike/standard matrix spike duplicate) were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticide/polychlorinated biphenyls (PCBs), explosives, agent breakdown products, and metals, as specified by the 1990 USAEC *Quality Assurance Plan* and the specific method for each parameter. The RPD between the spike results was calculated, plotted on the single day $\bar{x}$ R control charts, and submitted to USAEC. These control charts have established control limits and are used by USAEC to determine the acceptability of the applicable data. USAEC may approve or reject data associated with a lot based on the control chart results. Lot SZX (analyzed for pesticides/PCBs) was rejected due to its inability to meet the QC criteria established for Method LH17.

Sample collection reproducibility and media variability were measured in the laboratory by the analysis of field replicates. Field replicates were collected using the same techniques as those used to collect the environmental samples. One sample in 10 similar matrices was collected, and sample collection reproducibility and media variability were evaluated based on the RPD values between two duplicate samples. Corrective action was not taken based on RPD values.

All soil samples to be analyzed by the analytical laboratories were collected using stainless steel sampling equipment. After the split-spoon sampler was retrieved from the borehole, the samples were placed in appropriate sample containers and labeled, and each sample was then shipped to the laboratory. Therefore, the replicate concentrations measured by the laboratory reflect the natural matrix variability inherent in the subsurface soils at Fort McClellan and were not used to assess sample collection precision. Field RPD values were calculated only for compounds and elements detected in concentrations greater than the certified reporting limits (CRLs) in both replicate pair samples and only for those compounds and elements not considered to be common laboratory contaminants (e.g., methylene chloride).

1,1,2,2-Tetrachloroethene was detected in two groundwater replicate pairs. The RPD value for one replicate pair met criteria, the RPD for the other replicate pair was 87 percent. Trichloroethylene was detected in one replicate pair. The RPD was calculated as 45 percent. All RPD criteria were met for SVOCs and pesticides/PCBs. All trace metals and RPDs met criteria except for lead and nickel in one soil sample, and beryllium and aluminum in one groundwater sample. RPD values for explosives and agent breakdown products were not calculated.

3.2.1.2 Accuracy

Accuracy was defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement is to the true value, or actual concentration, the more accurate the measurement is. Analytical accuracy is expressed as the percent recovery of a compound or element that has been added to the environmental sample at a known concentration before analysis. Laboratory accuracy was qualitatively assessed

by evaluating the following laboratory QC information: sample holding times, method blanks, calibrations, surrogate recoveries, USAEC QC samples, and initial and continuing calibration results calculated from all analyses conducted on environmental samples.

Data validation qualifiers were applied to selected data points by USAEC. These qualifiers, their definitions, and the applicable samples are presented in the data validation worksheet in Appendix F. These qualifiers indicate that environmental samples and their corresponding dates were rejected, accepted with limitations, or accepted as originally submitted. Sampling accuracy was maximized by adherence to the strict QA program presented in the SI QAPP. Field QC blanks (i.e., trip blanks, field blanks, and equipment blanks) were prepared to ensure that all samples represent the particular site from which they were collected, assess any cross-contamination that may have occurred, and qualify the associated analytical data accordingly.

Because of field QC blank interference, data validation qualifiers were applied to the benzene detected in one groundwater sample and to the alpha-BHC detected in each of three groundwater samples to indicate that these compounds were less than five times the level detected in the associated field QC blank. Several metals (i.e., barium, calcium, magnesium, sodium, iron, manganese, zinc, potassium, and selenium) were detected in the field QC blanks that were prepared using potable water. The potable water was used for the initial rinse of the sample equipment during the decontamination process. The equipment was then given a final rinse with the diagnostic grade water. The field QC blanks that were prepared using diagnostic water were found to have no detected metals. Therefore, no qualifiers were applied to the metals samples results.

Based on an evaluation of the compounds and elements detected in the field QC blanks, the overall field accuracy is acceptable, except where noted. As a result, the field DQO for accuracy is considered to have been met. A comprehensive discussion of the field QC results is presented in Appendix F (Section F.2).

3.2.1.3 Representativeness

Representativeness was defined as the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition, or an environmental condition. Sample representativeness was ensured during the SI by collecting sufficient samples of a population medium, properly distributed with respect to location and time. Representativeness was assessed by reviewing the drilling techniques and equipment; well installation procedures and materials; and sample collection methods, equipment, and sample containers used during the SI, in addition to evaluating the RPD values calculated from the duplicate samples and the concentrations of interferents detected in the field and laboratory QC blanks. The reproducibility of a representative set of samples reflects the degree of heterogeneity of the sampled medium, as well as the effectiveness of the sample collection techniques.

Based on the evaluation of the factors described above and summarized in Appendix F, the samples collected during the SI are considered to be representative of the conditions at Fort McClellan.

3.2.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another and is limited to the other PARCC parameters, because only when precision and accuracy are known can one data set be compared to another. To optimize comparability, only the specific methods and protocols that were specified in the SI QAPP were used to collect and analyze samples during the SI. By using consistent sampling and analysis procedures, all data sets were comparable within and between the sites at Fort McClellan to ensure that remedial action decisions and priorities were based on a consistent data base. Comparability was ensured by the analysis of standard analytical reference materials (SARMs), establishing that the analytical procedures used were generating valid data.

All samples collected for VOC, SVOC, pesticide/PCB, metals, and explosives were analyzed using DATACHEM Laboratories, Inc., USAEC-certified methods. Samples collected for HD, GB, and VX agent breakdown products, except for isopropyl amine, were analyzed

using Environmental Sciences and Engineering, Inc. (ESE) USAEC-certified methods. ESE analyzed isopropyl amine by mobile phase ion chromatography, which is a noncertified method.

Based on the precision and accuracy assessment presented above, the data collected during the SI are considered to be comparable with the data collected during previous investigations.

3.2.1.5 Completeness

Completeness was defined as the percentage of valid data obtained from a measurement system. For data to be considered valid, they must have met all acceptance criteria, including accuracy and precision, as well as any other criteria specified by the analytical methods used.

Furthermore, project completeness was defined as the percentage of data used to establish the HRS score and upon which recommendations for site remediation are based. For analytical data to be considered usable for the HRS score and remediation recommendations, each data point must be satisfactorily validated. Rejected (e.g., due to USAEC QC samples being outside of allowable limits) concentrations reported for all analyses were not used due to the increased potential of using the concentrations of compounds and elements (i.e., false positives) or omitting compounds or elements (i.e., false negatives) that may have an adverse impact on human health. In addition, some analyses were not performed due to laboratory problems (i.e., loss of sample during extraction, insufficient sample volume). As a result, 84 pesticide/PCB, 1 thiodiglycol, 1 IMPA and MPA, 1 isopropylamine, and 1 DIMP and DMMP data points were not included in the HRS score. The 84 pesticide/PCB data points are the environmental samples in Lot SZX, which were rejected due to the lot's inability to meet QC criteria.

3.3 BACKGROUND SAMPLING

Background samples were collected to provide a basis for comparing detected chemical compounds to a value determined to represent ambient conditions at a site. Samples were collected from an area west of Area T-24A along a tributary to the south branch of Cane Creek. Surface water, sediment, and shallow soil samples were collected at this location and analyzed

for VOCs, SVOCs, metals, pesticides/PCBs, explosives, and agent breakdown products. The results of these analyses for detected values are provided in Tables 3-2 to 3-4.

3.3.1 Soil Sampling - Background

Shallow soil samples were collected at 1 and 5 feet BLS at the background location west of Area T-24A. The detected results of the laboratory analyses for the samples are provided in Table 3-2. The analytical data detected the presence of metals, including 3.2 $\mu\text{g/g}$ of arsenic, and did not detect organic compounds in the samples. Analytical data for organochlorine pesticides in the shallow soil samples were rejected at the testing laboratory because of low QC spike recoveries.

3.3.2 Surface Water/Sediment Sampling - Background

Analyses of surface water (BK-W01) collected at the background location detected naturally occurring metals, including barium, calcium, magnesium, potassium, and sodium. The laboratory analyses results of the background surface water sample are presented in Table 3-3. Organic compounds were not detected in the sample. The specific conductivity of the surface water at this location was measured at 230 μS with a pH of 8.33 units. Organic compounds also were not detected in the background sediment sample (BK-D01); however, analyses for organochlorine pesticides in the sediment were rejected at the testing laboratory because of insufficient recoveries of QC spikes. Metals detected in the background sediment include aluminum, barium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, vanadium, and zinc. Arsenic also was detected in the sample at 6.81 $\mu\text{g/g}$, although the source of this metal is not known. The laboratory analyses results of the background sediment sample are provided in Table 3-4.

3.3.3 Potable Water Sampling

Laboratory analyses of the potable water used from the Fort McClellan sources during the SI activities are provided in Table 3-5. The Pelham Range source was not used during the SI. The potable water source at Pelham Range produces groundwater drawn from a shallow well and is chlorinated prior to discharge. The potable water source located on the Main Post

Table 3-2. Data Summary: Soil – Background, Ft. McClellan, Anniston, Alabama

SAIC ID Number	BK-S01	BK-S01	Units	CRL	UCR	Parameter
Depth BLS	(1.0)	(5.0)				
Collection Date	4/13/92	4/13/92				
Associated Field QC Sample	TB-006	TB-006				
	FMP002, FAS001	FMP002, FAS001				
	RB-001	RB-001				
Method B9 (As in Soil)						
Arsenic	3.2	3.26	µg/g	2.50	50.0	
Method JS12 (ICP Metals in Soil)						
Aluminum	19700	19500	µg/g	11.2	50,000	
Barium	211	205	µg/g	3.29	1,000	
Beryllium	1.41	1.43	µg/g	0.427	1,000	
Calcium	513	297	µg/g	25.3	50,000	
Chromium	13.2	16.2	µg/g	1.04	1,000	
Cobalt	8.17	11.4	µg/g	2.50	1,000	
Copper	7.32	7.64	µg/g	2.84	1,000	
Iron	23600	26500	µg/g	6.66	50,000	
Magnesium	1040	990	µg/g	10.1	50,000	
Manganese	612	592	µg/g	9.87	1,000	
Nickel	8.09	7.51	µg/g	2.74	2,000	
Potassium	4380	4760	µg/g	131	50,000	
Vanadium	18.4	18	µg/g	1.41	1,000	
Zinc	28.5	24.7	µg/g	2.34	1,000	
Lead	21.7	12.1	µg/g	7.44	1,000	
Method LM23 (VOCs in Soil)						
Unknown	6 (1)	6 (1)	µg/g	--	--	
Method LM25 (SVOCs in Soil)						
Unknown	52.5 (10)	287.9 (17)	µg/g	--	--	

— The certification of these analytes will be submitted at a later date

CRL – Certified Reporting Limit

UCR – Upper Certified Range

Unknown – The following tentatively identified compounds were identified for sample:

BK-S01 at 1 foot - UNK147 6 S $\mu\text{g/g}$, UNK579 4 S $\mu\text{g/g}$, UNK603 30 S $\mu\text{g/g}$, UNK606 2 S $\mu\text{g/g}$, UNK623 5 S $\mu\text{g/g}$, UNK626 4 S $\mu\text{g/g}$, UNK630 0.9 S $\mu\text{g/g}$, UNK633 0.6 S $\mu\text{g/g}$, UNK637 2 S $\mu\text{g/g}$, UNK642 2 S $\mu\text{g/g}$, UNK649 2 S $\mu\text{g/g}$.

BK-S01 at 5 foot – UNK148 6 S $\mu\text{g/g}$, UNK579 2 S $\mu\text{g/g}$, UNK581 60 S $\mu\text{g/g}$, UNK592 40 S $\mu\text{g/g}$, UNK600 2 S $\mu\text{g/g}$, UNK603 20 S $\mu\text{g/g}$, UNK612 10 D $\mu\text{g/g}$, UNK612 6 S $\mu\text{g/g}$, UNK615 5 S $\mu\text{g/g}$, UNK616 6 S $\mu\text{g/g}$, UNK619 0.9 S $\mu\text{g/g}$, UNK624 2 D $\mu\text{g/g}$, UNK624 2 S $\mu\text{g/g}$.

UNK624 40 D $\mu\text{g/g}$, UNK624 30 S $\mu\text{g/g}$, UNK626 4 S $\mu\text{g/g}$, UNK629 2 S $\mu\text{g/g}$, UNK632 8 S $\mu\text{g/g}$, UNK644 50 S $\mu\text{g/g}$.

Method LH17 (Organochlorine Pesticides) is
be re-analyzed within holding time.

Table 3-3. Data Summary: Surface Water - Background, Ft. McClellan, Anniston, Alabama

SAIC ID Number	BK-W01			
Depth	(1.0)			
Collection Date	4/13/92			
Associated Field QC Sample	TB-006			
	FMP002, FAS001			
Parameter	Units	CRL	UCR	RB-001

Method SS12 (ICP Metals in Water)

Barium	µg/L	2.82	12,000	20.3
Calcium	µg/L	105	200,000	292
Magnesium	µg/L	135	250,000	338
Potassium	µg/L	1240	250,000	1930
Sodium	µg/L	279	50,000	1060

CRL - Certified Reporting Limit

UCR - Upper Certified Range

Table 3-4. Data Summary: Sediment – Background, Ft. McClellan, Anniston, Alabama

SAIC ID Number				BK-D01
Depth BLS				(1.0)
Collection Date				4/13/92
Associated Field QC Sample				TB-006
				FMP002, FAS001
Parameter	Units	CRL	UCR	RB-001

Method B9 (As in Soil)

Arsenic	µg/g	2.50	50.0	6.81
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Method JS12 (ICP Metals in Soil)

Aluminum	µg/g	11.2	50,000	9620
Barium	µg/g	3.29	1,000	67
Beryllium	µg/g	0.427	1,000	0.979
Calcium	µg/g	25.3	50,000	71.7
Chromium	µg/g	1.04	1,000	10.1
Cobalt	µg/g	2.50	1,000	3.98
Copper	µg/g	2.84	1,000	3.74
Iron	µg/g	6.66	50,000	19000
Magnesium	µg/g	10.1	50,000	443
Manganese	µg/g	9.87	1,000	141
Nickel	µg/g	2.74	2,000	4.59
Potassium	µg/g	131	50,000	3800
Vanadium	µg/g	1.41	1,000	11.4
Zinc	µg/g	2.34	1,000	12

Method LM25 (SVOCs in Soil)

Unknown	µg/g	--	--	17.6 (7)
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-- The certification of these analytes will be submitted at a later date

CRL – Certified Reporting Limit

UCR – Upper Certified Range

Unknown – The following tentatively identified compounds were identified for sample:

BK-D01 – UNK592 2 S µg/g, UNK612 0.7 S µg/g, UNK620 0.3 S µg/g, UNK623 8 D µg/g,

UNK623 0.8 S µg/g, UNK629 0.8 S µg/g, UNK642 5 S µg/g.

Method LH17 (Organochlorine Pesticides in Soil) analysis was requested, but all the data were rejected because of spike recoveries and could not be re-analyzed within holding time.

Table 3-5. Data Summary: Field Blanks and Potable Water Samples, Ft. McClellan, Anniston, Alabama

SAIC ID Number Collection Date Parameter	FMP001 2/27/92	FMP002 4/2/92	FMP003 6/5/92	FAS001 4/16/92	FPR001 2/27/92	FPR002 4/2/92
Units	CRL	UCR				
Method SS12 (ICP Metals in Water)						
Barium	2.82	12,000	21.6	29.4	2.82 LT	351
Calcium	105	200,000	22500	23500	105 LT	26000
Iron	77.5	500,000	150	77.5 LT	77.5 LT	5850
Magnesium	135	250,000	11000	11500	135 LT	8740
Manganese	9.67	10,000	9.67 LT	9.67 LT	9.67 LT	461
Potassium	1240	250,000	1520	1240 LT	1240 LT	1240 LT
Sodium	279	50,000	1190	1340	279 LT	7170
Zinc	18.0	10,000	22.5	47.0	18.0 LT	431
Method UM21 (VOCs in Water)						
Chloroform	1	150	Reanalyzed because of Missed holding time	1 LT	2.2	Reanalyzed because of Missed holding time
Trichloroethene	1	150	See FMP002	2.4	1 LT	See FPR002
Method UM25 (SVOCs in Water)						
Unknown	---	---	4 (1)	10 (1)	0 (0)	0 (0)
Method UIH20 (Organochlorine Pesticides in Water)						
alpha-Hexachlorocyclohexane	0.0025	0.500	0.0025 LT	0.003 LT	0.004	0.003 LT
delta-BHC	0.0034	0.500	0.005	0.003 LT	0.003 LT	0.005 LT
Isodrin	0.0025	0.500	0.0025 LT	0.003	0.003 LT	0.003 LT
Lindane	0.0025	0.500	0.0025 LT	0.003	0.003 LT	0.003 LT

--- The certification of these analytes will be submitted by the analytical laboratory at a later date.

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

Unknown - The following tentatively identified compounds were identified for sample:

FMP001 - UNK533 4 S µg/L

FMP003 - UNK563 10 S µg/L

of Fort McClellan is supplied by public water from a spring source and is chlorinated prior to distribution. Potable water was used in the SI program for equipment rinsing during decontamination activities. The results of the potable water sampling at the Main Post source (FMP) indicate that the water contains low concentrations of chloroform (1.1 $\mu\text{g/L}$), trichloroethylene (2.1 to 2.4 $\mu\text{g/L}$), and the pesticides δ -BHC (0.00482 $\mu\text{g/L}$), α -hexachlorocyclohexane (.00424 $\mu\text{g/L}$), isodrin (.0025 $\mu\text{g/L}$), and lindane (.0025 $\mu\text{g/L}$). The concentrations of organics are attributed to the chlorination of the water source and to pesticide usage in the small building housing the water source. Detected metals include naturally occurring barium, calcium, iron, potassium, magnesium, selenium, sodium, and zinc. The measured pH of the Main Post source was 7.02 to 7.25 units with a specific conductivity of 178 to 182 μS . The Pelham Range source (FPR) contained naturally occurring metals, including barium, calcium, iron, magnesium, manganese, sodium, and zinc. A concentration (.00528 $\mu\text{g/L}$) of the pesticide δ -BHC was detected in the Pelham Range sample and may be related to pesticide usage in the small building housing the water source. The measured pH of the Pelham Range source was 6.92 to 6.95 units with a specific conductivity of 207 to 220 μS .

3.4 SITE 1 - AREA T-4

Site 1 - Area T-4 reportedly consisted of a .25 acre area used between 1965 and 1971 for training using the biological simulants BG and SM. The identified area of the former site has been extensively reworked and no evidence of a former site was observed during an October 1991 site visit by SAIC and USAEC personnel. SI activities were not conducted in the vicinity of Area T-4 because the site could not be located and was not pursued because of the nonpersistence of biological simulants in the environment. SAIC recommends additional field reconnaissance to locate the site with subsequent sampling of environmental media prior to removal of the site from consideration.

3.5 SITE 2 - AREA T-5

Site 2 - Area T-5 consists of a wooded, approximately 11-acre site that currently houses kennels for canine units. The site formerly was used for chemical agent training between 1961 and 1973 using HD, GB, and VX. The training sites were reportedly decontaminated after each exercise using supertropical bleach (STB) and DS-2.

3.5.1 Soil Sampling Results - Area T-5

Eight soil samples were collected by the U.S. Army Technical Escort Unit (USATEU) from four locations at Area T-5 (Figure 3-4). The samples were screened in the field by USATEU personnel for chemical agent using a MINICAMS analyzer and were analyzed in the laboratory for the presence of chemical agent breakdown products. The results of the field screening for HD, GB, and VX are provided in Table 3-6 and range between 0.0 and 0.36 (sample T5-S0101) time-weighted average (TWA) (below the 0.8 TWA threshold for detection of HD, GB, and VX). Background readings at the site ranged between 0.12 and 0.36 TWA (below the 0.8 TWA threshold for detection of HD, GB, and VX). Field screening at high-probability locations for chemical agents at Area T-5 was negative. Laboratory analyses for HD, GB, and VX breakdown products in eight soil samples collected from the screened locations did not detect the presence of the degradation compounds in the samples. The laboratory analyses results are provided in Table 3-7.

Table 3-6. USATEU Results of MINICAMS Screening - Area T-5

Sample Number	Sample Depth	HD*	GB*	VX*
T5-S0401	12 - 15"	.05	.01	0.15
T5-S0402	74 - 76"	0.00	0.00	0.23
T5-S0301	9 - 12"	0.04	0.00	0.00
T5-S0302	60 - 63"	0.04	0.00	0.19
T5-S0201	9 - 12"	0.04	0.01	0.12
T5-S0202	57 - 60"	0.03	0.00	0.15
T5-S0101	13 - 15"	0.36	0.00	0.00
T5-S0102	63 - 65"	0.21	0.00	0.20

* Reported values are below the 0.8 TWA for the MINICAMS and are determined to be obtained from background sources (USATEU 1992)

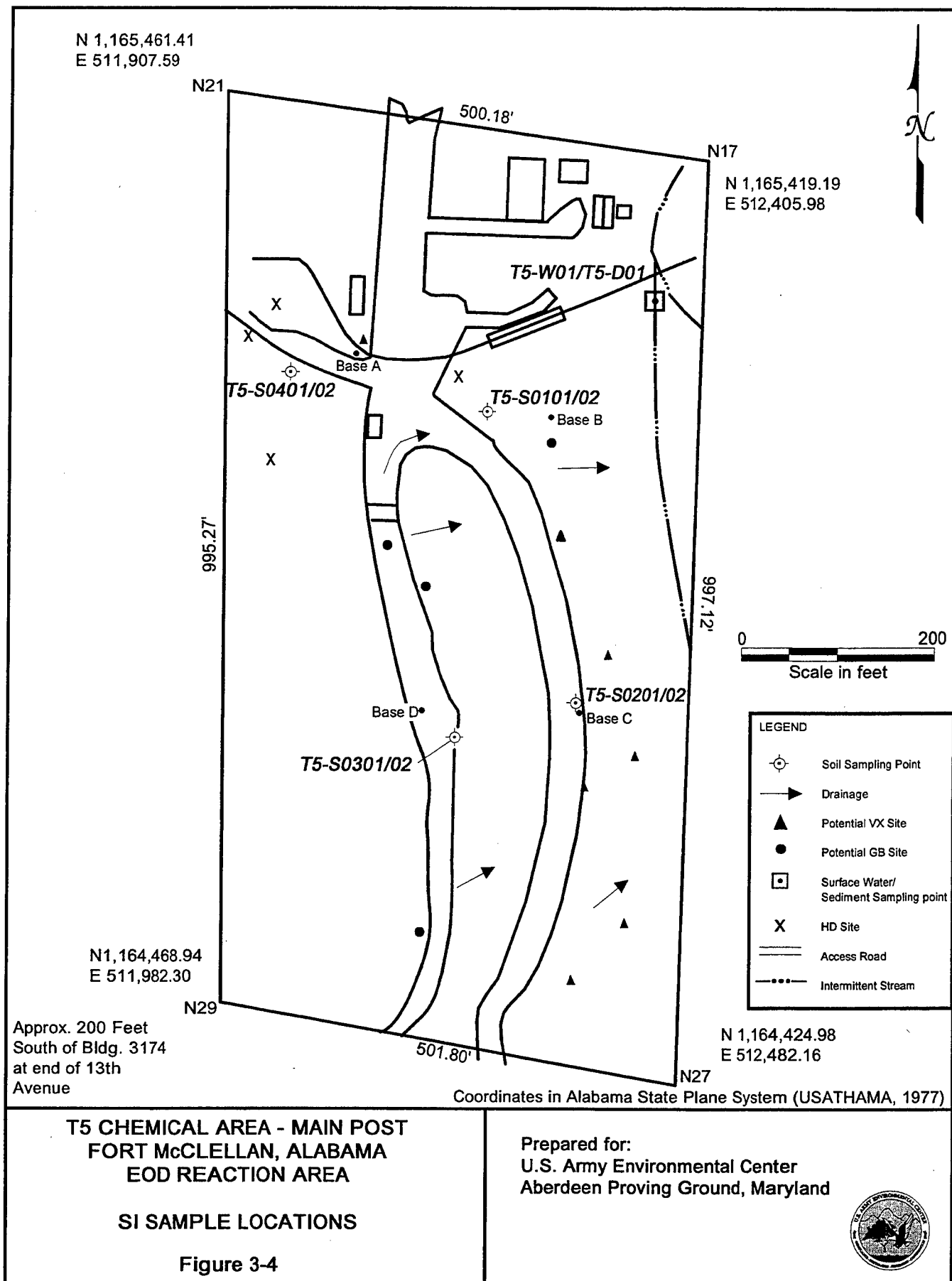


Table 3-7. Data Summary: Soil - Area T-5, Ft. McClellan, Anniston, Alabama

SAIC ID Number	T5-S01			T5-S01			T5-S02			T5-S02		
Depth BLS	(1.0)			(5.0)			(1.0)			(5.0)		
Collection Date	4/22/92			4/22/92			4/16/92			4/16/92		
Associated Field QC Sample	N/A			N/A			N/A			N/A		
Parameter	Units	CRL	UCR	FMP002, FAS001 RB-004	FMP002, FAS001 RB-004	FMP002, FAS001 RB-004	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	T5-S02
Method AAA9 (IMPA and MPA in Soil)												
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT		2.10 LT	2.10 LT	2.10 LT	2.10 LT	2.10 LT	2.10 LT	2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT		2.00 LT	2.00 LT	2.00 LT	2.00 LT	2.00 LT	2.00 LT	2.00 LT
Method LL03 (Organosulfur Compounds in Soil)												
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT		0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT		1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT		2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT		2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT
Method 99 (Isopropylamine in Soil)												
Isopropylamine	µg/g	--	--	1.26 LT		1.20 LT	1.20 LT	1.20 LT	1.20 LT	1.20 LT	1.20 LT	1.19 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)												
Thiodiglycol	µg/g	3.94	102.0	3.94 LT		3.94 LT	3.94 LT	3.94 LT	3.94 LT	3.94 LT	3.94 LT	3.94 LT
Method TT9 (DIMP and DMMP in Soil)												
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT		0.114 LT	0.114 LT	0.114 LT	0.114 LT	0.114 LT	0.114 LT	0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT		0.133 LT	0.133 LT	0.133 LT	0.133 LT	0.133 LT	0.133 LT	0.133 LT

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

Table 3-7. Data Summary: Soil - Area T-5, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	T5-S03			T5-S04			T5-S04		
Depth BLS	(1.0)			(5.0)			(1.0)		
Collection Date	4/16/92			4/16/92			4/16/92		
Associated Field QC Sample	N/A			N/A			N/A		
Parameter	Units	CRL	UCR	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003	FMP002, FAS001 RB-003
Method AAA9 (IMPA and MPA in Soil)									
Isopropylme	µg/g	2.10	40	2.10 LT	2.10 LT	2.10 LT	2.10 LT	2.10 LT	2.10 LT
Methyl phos	µg/g	2.00	40	2.00 LT	2.00 LT	2.00 LT	2.00 LT	2.00 LT	2.00 LT
Method LL03 (Organosulfur Compounds in Soil)									
1,4-Oxathia	µg/g	0.856	17.1	0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT
1,4-Dithian	µg/g	1.47	11.3	1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT
p-Chloroph	µg/g	2.25	45.0	2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT
p-Chloroph	µg/g	2.37	47.4	2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT
Method 99 (Isopropylamine in Soil)									
Isopropylam	µg/g	--	--	1.00 LT	1.17 LT	1.17 LT	1.19 LT	1.16 LT	1.16 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)									
Thiodiglycol	µg/g	3.94	102.0	3.94 LT	3.94 LT	3.94 LT	3.94 LT	3.94 LT	3.94 LT
Method TT9 (DIMP and DMMP in Soil)									
Diisopropylm	µg/g	0.114	4.57	0.114 LT	0.114 LT	0.114 LT	0.114 LT	0.114 LT	0.114 LT
Dimethylme	µg/g	0.133	4.18	0.133 LT	0.133 LT	0.133 LT	0.133 LT	0.133 LT	0.133 LT

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

3.5.2 Surface Water/Sediment Sampling - Area T-5

A surface water and sediment sample were collected from a tributary to the south branch of Cane Creek where it traverses the eastern portion of Area T-5 (Figure 3-4). The samples were collected by USATEU personnel from the preselected downstream location and were submitted for laboratory analysis of chemical agent breakdown products. The laboratory analyses (Tables 3-8 and 3-9) did not detect the presence of degradation compounds in the samples.

3.5.3 Site Assessment - Area T-5

Area T-5 has not been fully assessed for the presence of ordnance that potentially occurs at the site. Since evidence of ordnance was observed on the site in March 1992 (near the surface water/sediment sampling point), the site area should be cleared by Fort McClellan ordnance specialists and a thorough records search should be conducted for ordnance disposal or use at Area T-5. Subsurface sampling and analysis at high-probability locations for the presence of chemical warfare agents and their degradation products did not detect the presence of these compounds at the former training area. The quantities of the materials reported to have been used during the training exercises and the decontamination protocols used after each exercise further reduces the likelihood that these materials exist at the site.

3.6 SITE 3 - AREA T-6

Site 3 - Area T-6 is an approximately 7.5-acre site formerly used for chemical agent (HD) decontamination training. Six shallow soil samples were collected by the USATEU at the site from three locations (Figure 3-5). The site area is heavily wooded with small concrete structures and a network of drainage trenches at various locations on the site.

3.6.1 Soil Sampling - Area T-6

Six shallow soil samples were collected from Area T-6 (Figure 3-5) by the USATEU and were screened onsite for the presence of HD. The results of the field screening are provided in Table 3-10 and indicate that HD was not detected at the sampled locations.

Table 3-8. Data Summary: Surface Water – Area T-5,
Ft. McClellan, Anniston, Alabama

SAIC ID Number				T5-W01
Depth				(1.0)
Collection Date				4/15/92
Associated Field QC Sample				N/A
				FMP002, FAS001
Parameter	Units	CRL	UCR	RB-003
Method UT02 (IMPA and MPA in Water)				
Isopropylmethyl phosphonic acid	µg/L	100	9000	100 LT
Methyl phosphonic acid	µg/L	128	9000	128 LT
Method UL04 (Organosulfur Compounds in Water)				
1,4-Oxathiane	µg/L	1.98	39.5	1.98 LT
1,4-Dithiane	µg/L	1.11	22.2	1.11 LT
p-Chlorophenylmethysulfoxide	µg/L	4.23	106	4.23 LT
p-Chlorophenylmethysulfone	µg/L	4.72	106	4.72 LT
Method 99 (Isopropylamine in Water)				
Isopropylamine	µg/L	--	--	100.0 LT
Method UW22 (TDGCL and TDGCLA in Water)				
Thiodiglycol	µg/L	48.8	4,880	48.8 LT
Method T8 (DIMP and DMMP in Water)				
Diisopropylmethylphosphonate	µg/L	10.5	209.6	10.5 LT
Dimethylmethylphosphonate	µg/L	15.2	304.8	15.2 LT

-- The certification of these analytes will be submitted at a later date

CRL – Certified Reporting Limit

UCR – Upper Certified Range

LT – less than the certified reporting limit

Table 3-9. Data Summary: Sediment – Area T-5, Ft. McClellan, Anniston, Alabama

SAIC ID Number				T5-D01	T5-D01D
Depth BLS				(1.0)	(1.0)
Collection Date				4/15/92	4/15/92
Associated Field QC Sample				N/A	N/A
				FMP002, FAS001	FMP002, FAS001
Parameter	Units	CRL	UCR	RB-003	RB-003
Method AAA9 (IMPA and MPA in Soil)					
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT	2.10 LT D
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT	2.00 LT D
Method LL03 (Organosulfur Compounds in Soil)					
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT	0.856 LT D
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT	1.47 LT D
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT	2.25 LT D
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT	2.37 LT D
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)					
Thiodiglycol	µg/g	3.94	102.0	3.94 LT	3.94 LT D
Method TT9 (DIMP and DMMP in Soil)					
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT	0.114 LT D
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT	0.133 LT D

CRL – Certified Reporting Limit

UCR – Upper Certified Range

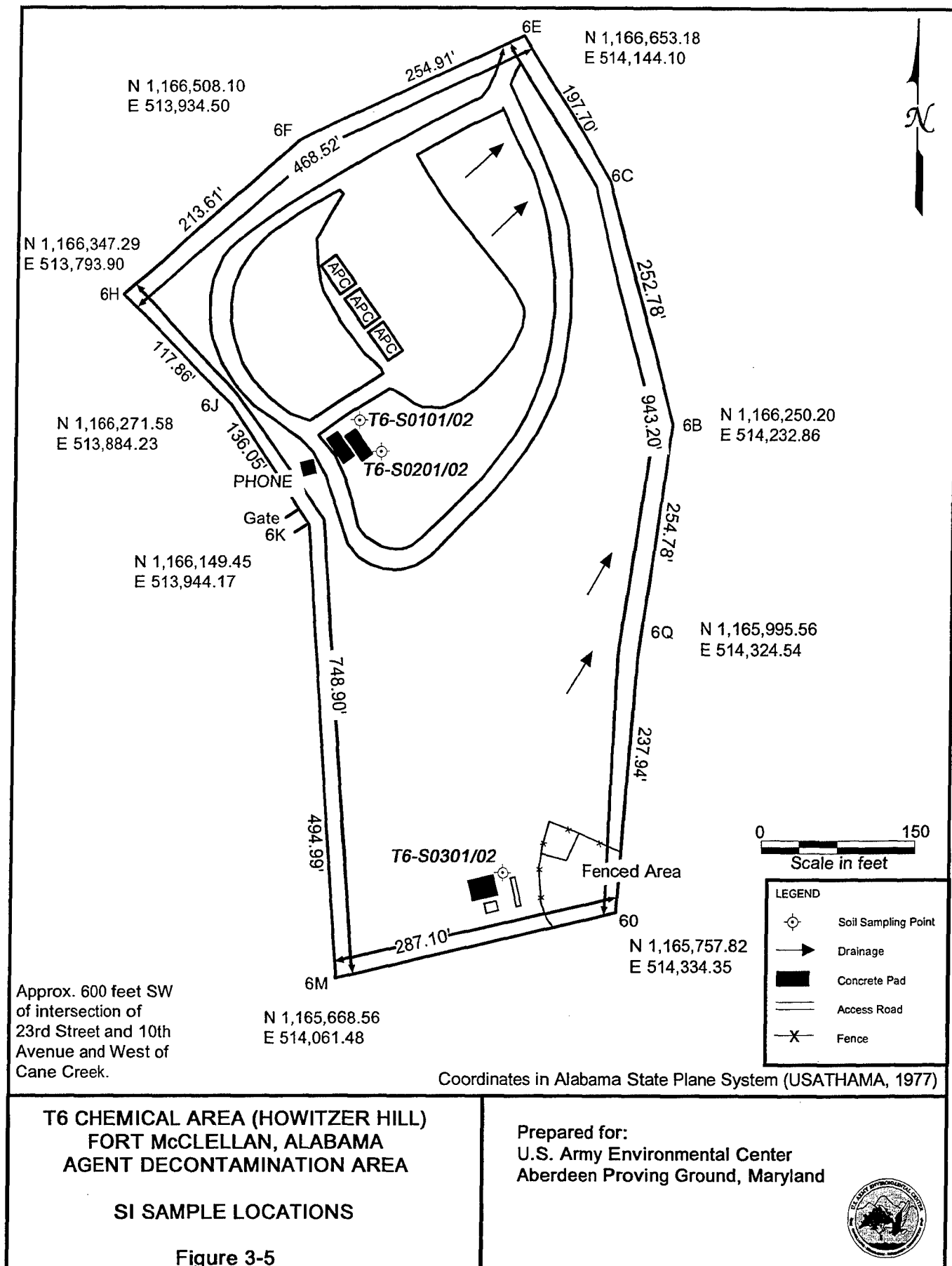
LT – less than the certified reporting limit

D – duplicate sample

Table 3-10. USATEU Results for MINICAMS Screening - Area T-6

Sample Number	Sample Depth	HD*
T6-S0101	8 - 11"	0.0
T6-S0102	60 - 66"	0.0
T6-S0201	8 - 11"	0.0
T6-S0202	58 - 64"	0.0
T6-S0301	10 - 12"	0.0
T6-S0302	60 - 64"	0.0

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU, 6/92).



Laboratory analyses for HD breakdown products did not detect the presence of these compounds in the screened soil samples. The results of the laboratory analyses for Area T-6 are provided in Table 3-11.

3.6.2 Site Assessment - Area T-6

Samples collected from identified locations at Area T-6 did not detect the presence of HD or HD breakdown products. Since the site was decontaminated when closed and was subsequently cleared for surface usage, no further activities are recommended for the site based on current land usage.

3.7 SITE 4 - AREA T-24A

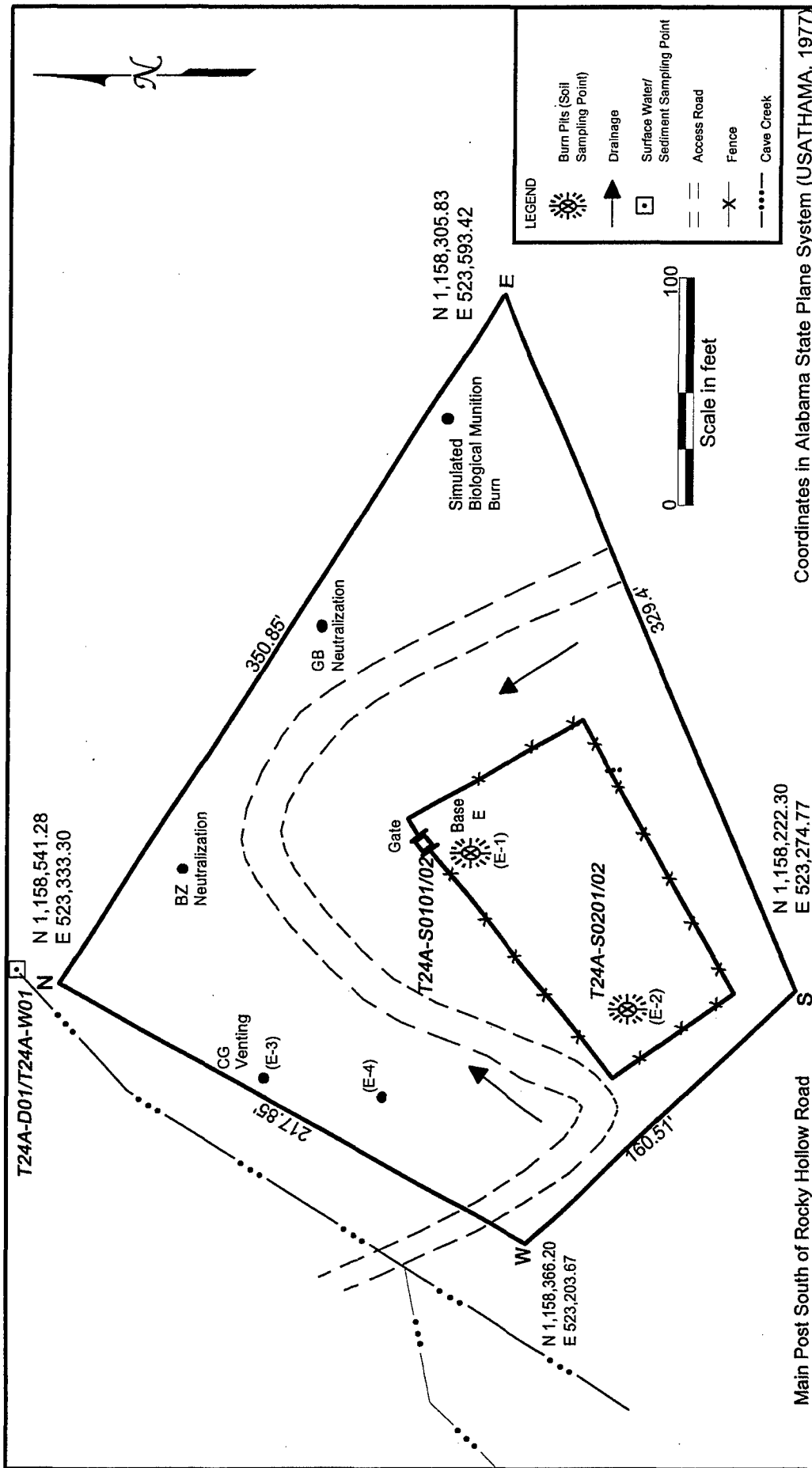
Site 4 - Area T-24A (Figure 3-6) is a former chemical munitions disposal training area used until 1973 for training in the disposal of CG, BZ, GB, and HD ordnance. The 1.5-acre site area is contained within a chain-link fenced enclosure with a secured gate. Two large burn pits were used at the site for training exercises. The site area was heavily overgrown during the October 1991 and April 1992 site visits; however, a survey marker for a former burn pit location was identified within the fenced area. Two 81-mm mortar shells also were discovered at the site in October 1991. A portion of the site is located within currently active artillery range target areas. Sampling at the site consisted of reconnaissance geophysical surveys, soil sampling at two locations, and surface water/sediment sample collection.

3.7.1 Geophysical Survey Results - Area T-24A

The location of transects and interpretation of EM data for sampling locations S1 and S2 at Area T-24A are shown in Figure 3-7. Small-scale EM anomalies centered around sampling location S1 indicate ground disturbance. The remainder of the profiles for S1 and S2, including sampling location S2, appear undisturbed. Minor variations in EM values are observed near the edges of several profiles (Figures B-1 and B-2, Appendix B) and are attributed to a fence that surrounds the site.

Table 3-11. Data Summary: Soil - Area T-6, Ft. McClellan, Anniston, Alabama

SAIC ID Number	Depth BLS	Collection Date	Associated Field QC Sample	Parameter	Units	CRL	UCR	T6-S01 (1.0) 4/29/92 FAS001 FMP002 RB-007	T6-S02 (1.0) 4/29/92 FAS001 FMP002 RB-007	T6-S02 (5.0) 4/29/92 FAS001 FMP002 RB-007	T6-S03 (1.0) 4/24/92 FAS001 FMP002 RB-005	T6-S03 (5.0) 4/24/92 FAS001 FMP002 RB-005
Method LL03 (Organosulfur Compounds in Soil)												
1,4-Oxathiane					µg/g	0.856	17.1	0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT
1,4-Dithiane					µg/g	1.47	11.3	1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide					µg/g	2.25	45.0	2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone					µg/g	2.37	47.4	2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)												
Thiodiglycol					µg/g	3.94	102.0	3.94 LT	3.94 LT	3.94 LT	3.94 LT	3.94 LT
CRL - Certified Reporting Limit												
UCR - Upper Certified Range												
LT - less than the certified reporting limit												



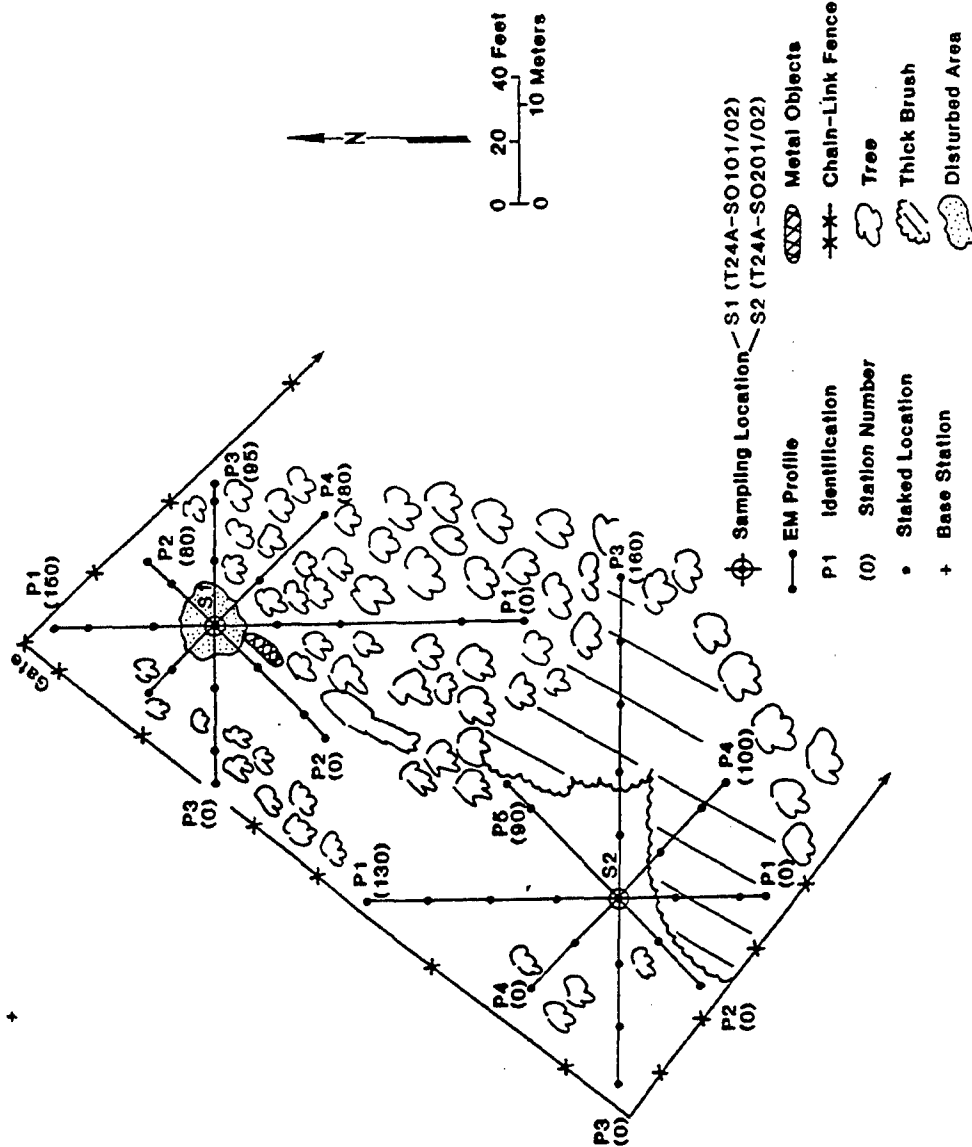
Prepared for:
 U.S. Army Environmental Center
 Aberdeen Proving Ground, Maryland



RANGE T24 - MAIN POST
FORT MCCLELLAN, ALABAMA
EOD DISPOSAL AREA

SI SAMPLE LOCATIONS

Figure 3-6



AREA T-24A LOCATION OF TRANSECTS AND
INTERPRETATION OF EM DATA FOR
SAMPLING LOCATIONS S1 AND S2
FORT McCLELLAN, ALABAMA

Figure 3-7

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



3.7.2 Soil Sampling - Area T-24A

Four shallow soil samples were collected by USATEU from two locations within the fenced enclosure at Area T-24A (Figure 3-6). The sampled locations were initially cleared for the presence of buried metallic objects and the collected samples were screened for the presence of HD and GB chemical agent using a MINICAMS analyzer. The results of the MINICAMS screening are provided in Table 3-12.

Table 3-12. USATEU Results of MINICAMS Screening - Area T-24A

Sample Number	Sample Depth	HD*	GB*
T24A-S0101	9 - 12"	0.0	0.0
T24A-S0102	34 - 36"	0.0	0.0
T24A-S0201	8 - 11"	0.0	0.0
T24A-S0202	50 - 54"	0.0	0.0

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU, 6/92).

Laboratory analysis of the soil samples for GB and HD breakdown products did not detect the presence of these compounds. The results of the laboratory analysis are provided in Table 3-13.

3.7.3 Surface Water/Sediment Sampling - Area T-24A

A surface water and sediment sample were collected by USATEU from a preselected location along a tributary of the south branch of Cane Creek downgradient from the training site. The samples were analyzed in the laboratory for HD and GB breakdown products and the results of the analyses are provided in Tables 3-14 and 3-15. The analytical data do not indicate the presence of chemical agent breakdown products in the samples.

3.7.4 Site Assessment - Area T-24A

Screening and analysis of four shallow soil samples at two high-probability locations within Area T-24A did not detect the presence of chemical agent or agent breakdown products at the sampled locations. Because the actual burn pits were not observable at the surface,

Table 3-13. Data Summary: Soil - Area T-24A, Ft. McClellan, Anniston, Alabama

SAIC ID Number	T24A-S01				T24A-S02				T24A-S02			
Depth BLS	(1.0)				(5.0)				(1.0)			
Collection Date	4/24/92				4/24/92				4/24/92			
Associated Field QC Sample	FAS001				FAS001				FAS001			
Parameter	Units	CRL	UCR	RB-005	FMP002	RB-005	FMP002	RB-005	FMP002	RB-005	FMP002	RB-005
Method AAA9 (IMPA and MPA in Soil)												
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT			2.10 LT		2.10 LT			2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT			2.00 LT		2.00 LT			2.00 LT
Method LL03 (Organosulfur Compounds in Soil)												
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT			0.856 LT		0.856 LT			0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT			1.47 LT		1.47 LT			1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT			2.25 LT		2.25 LT			2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT			2.37 LT		2.37 LT			2.37 LT
Method L W18 (Thiodiglycol and Chloroacetic Acid in Soil)												
Thiodiglycol	µg/g	3.94	102.0	3.94 LT			3.94 LT		3.94 LT			3.94 LT
DIMP and DMMP in Soil												
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT			0.114 LT		0.114 LT			0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT			0.133 LT		0.133 LT			0.133 LT
CRL - Certified Reporting Limit												
UCR - Upper Certified Range												
LT - less than the certified reporting limit												

Table 3-14. Data Summary: Surface Water – Area T-24A,
Ft. McClellan, Anniston, Alabama

SAIC ID Number				T24A-W01
Depth				(1.0)
Collection Date				4/24/92
Associated Field QC Sample				FAS001 FMP002 RB-005
Parameter	Units	CRL	UCR	
Method UT02 (IMPA and MPA in Water)				
Isopropylmethyl phosphonic acid	µg/L	100	9000	100 LT
Methyl phosphonic acid	µg/L	128	9000	128 LT
Method UL04 (Organosulfur Compounds in Water)				
1,4-Oxathiane	µg/L	1.98	39.5	1.98 LT
1,4-Dithiane	µg/L	1.11	22.2	1.11 LT
p-Chlorophenylmethylsulfoxide	µg/L	4.23	106	4.23 LT
p-Chlorophenylmethylsulfone	µg/L	4.72	106	4.72 LT
Method UW22 (TDGCL and TDGCLA in Water)				
Thiodiglycol	µg/L	48.8	4,880	48.8 LT
Method T8 (DIMP and DMMP in Water)				
Diisopropylmethylphosphonate	µg/L	10.5	209.6	10.5 LT
Dimethylmethylphosphonate	µg/L	15.2	304.8	15.2 LT
CRL – Certified Reporting Limit				
UCR – Upper Certified Range				
LT – less than the certified reporting limit				

Table 3–15. Data Summary: Sediment – Area T–24A,
Ft. McClellan, Anniston, Alabama

SAIC ID Number				T24A–D01
Depth BLS				(1.0)
Collection Date				4/24/92
Associated Field QC Sample				FAS001
				FMP002
Parameter	Units	CRL	UCR	RB–005
Method AAA9 (IMPA and MPA in Soil)				
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT
Method LL03 (Organosulfur Compounds in Soil)				
1,4–Oxathiane	µg/g	0.856	17.1	0.856 LT
1,4–Dithiane	µg/g	1.47	11.3	1.47 LT
p–Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT
p–Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)				
Thiodiglycol	µg/g	3.94	102.0	3.94 LT
Method TT9 (DIMP and DMMP in Soil)				
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT
CRL – Certified Reporting Limit				
UCR – Upper Certified Range				
LT – less than the certified reporting limit				

assurance that the samples were collected from the actual burn pit locations is based solely on the reference marker identified at the site. In addition, the location of the reference marker with respect to the overall pit area is unknown. The estimated size of the pits (16 by 16 by 6 feet) suggests that additional geophysical surveying, including electromagnetics and magnetometry, may be needed to delineate the pit boundaries. Once the boundaries have been established, additional soil samples should be collected, screened for HD and GB, and analyzed for HD and GB breakdown products. The site has not been extensively assessed for the presence of buried ordnance and should be geophysically evaluated on a closely spaced grid within the fenced portion at Area T-24A. The site lies within a currently active artillery range target area. Surface water and sediment samples collected immediately downgradient from the site did not detect the presence of agent breakdown products based on the SI sampling and analysis.

3.8 SITE 5 - AREA T-31

Site 5 - Area T-31 is a 3.4-acre former toxic training area used between 1957 and 1969 for training with small quantities of GB and HD and storage of unknown types of chemical agent. The available site map for this site is of marginal quality and the location of structures based on the map is qualitative. The site was heavily overgrown during two site visits. The site was investigated by collecting and analyzing shallow soil samples from identified high-probability areas and analysis of surface water and sediment samples downstream from the site (Figure 3-8).

3.8.1 Soil Sampling - Area T-31

Eight shallow soil samples were collected by the USATEU from four locations identified near existing decontamination structures and drainage features at Area T-31. The soil samples were screened onsite by USATEU using a MINICAMS analyzer. The results of the sample screening are provided in Table 3-16. The field screening did not detect the presence of HD or GB chemical agent in concentrations above background in the collected samples. The values ranged between 0.0 and 0.04 TWA and were below the 0.8 TWA threshold for the agents. Laboratory analysis of the screened samples did not detect the presence of HD or GB degradation products. The results of the laboratory analyses are provided in Table 3-17.

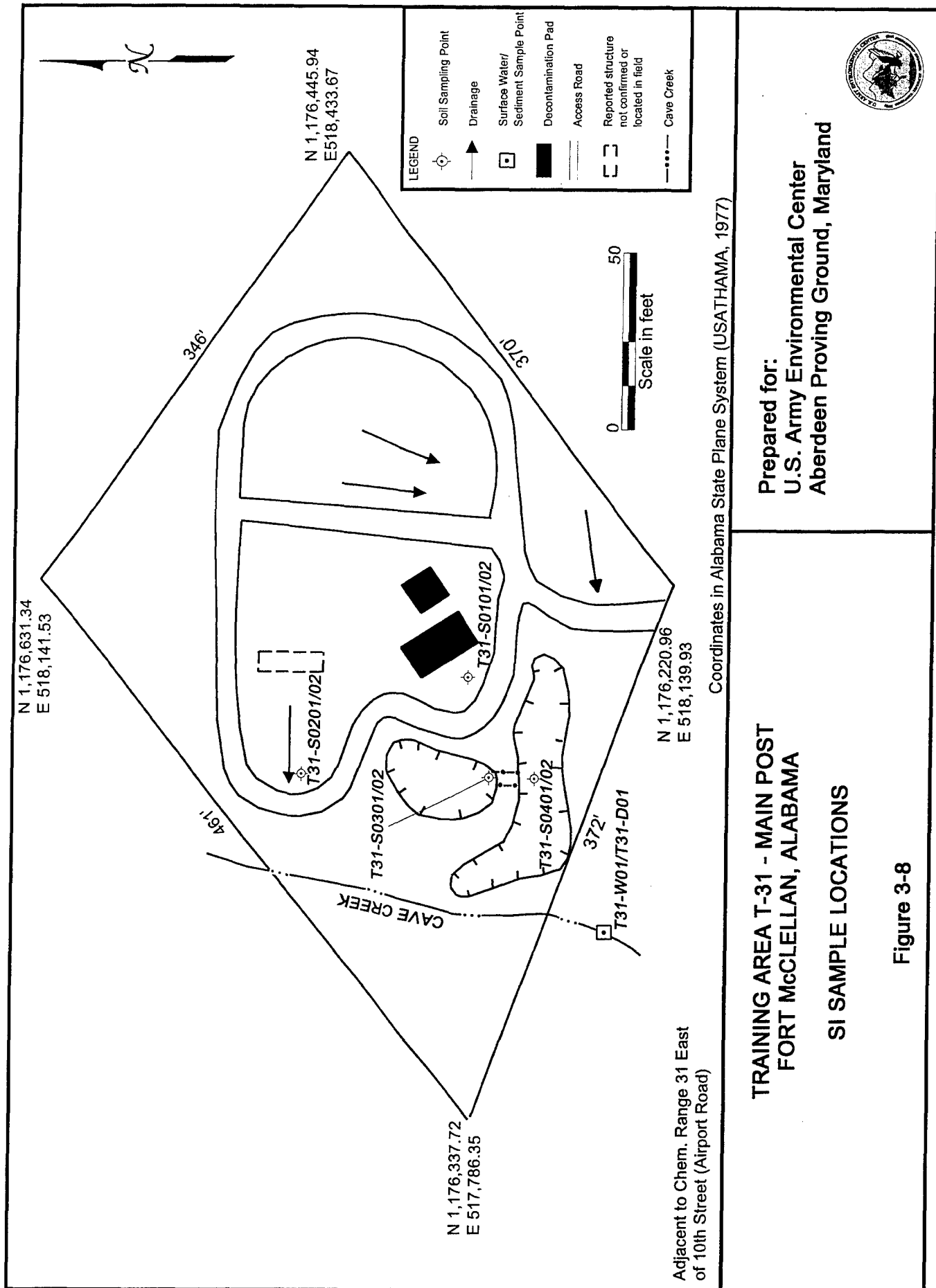


Table 3-16. USATEU Results of MINICAMS Screening - Area T-31

Sample Number	Sample Depth	HD*	GB*
T31-S0101	11 - 14"	.04	0.0
T31-S0102	60 - 63"	0.0	0.0
T31-S0201	9 - 12"	0.0	.01
T31-S0202	57 - 60"	0.0	.01
T31-S0301	10 - 13"	0.0	0.0
T31-S0302	67 - 70"	0.0	0.0
T31-S0401	12 - 18"	.03	0.0
T31-S0402	67 - 70"	0.0	0.0

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU, 6/92).

Table 3-17. Data Summary: Soil - Area T-31, Ft. McClellan, Anniston, Alabama

SAIC ID Number	T31-S01			T31-S01D			T31-S01			T31-S02			T31-S02		
Depth BLS	(1.0)			(1.0)			(5.0)			(1.0)			(5.0)		
Collection Date	4/22/92			4/29/92			4/22/92			4/20/92			4/20/92		
Associated Field QC Sample	FAS001			FAS001			FAS001			FAS001			FAS001		
Parameter	Units	CRL	UCR	RB-004	FMP002	FAS001	RB-004	FMP002	FAS001	RB-004	FMP002	FAS001	RB-004	FMP002	FAS001
Method AAA9 (IMPA and MPA in Soil)															
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT											
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT											
Method LL03 (Organosulfur Compounds in Soil)															
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT											
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT											
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT											
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT											
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)															
Thiodiglycol	µg/g	3.94	102.0	3.94 LT	I										
Method TT9 (DIMP and DMMP in Soil)															
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT											
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT											

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample

I - out of control, data rejected due to low recoveries

Table 3-17. Data Summary: Soil - Area T-31, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	T31-S03	T31-S03	T31-S03	T31-S04	T31-S04
Depth BLS	(1.0)	(5.0)	(1.0)	(5.0)	(5.0)
Collection Date	4/22/92	4/22/92	4/22/92	4/22/92	4/22/92
Associated Field QC Sample	FAS001	FAS001	FAS001	FAS001	FAS001
Parameter	Units	CRL	UCR	RB-004	RB-004
Method AAA9 (IMPA and MPA in Soil)					
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT	2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT	2.00 LT
Method LL03 (Organosulfur Compounds in Soil)					
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT	0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)					
Thiodiglycol	µg/g	3.94	102.0	3.94 LT	3.94 LT
Method TT9 (DIMP and DMMP in Soil)					
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT	0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT	0.133 LT

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

3.8.2 Surface Water/Sediment Sampling - Area T-31

Surface water and sediment samples were collected from a tributary of Cave Creek downstream from Area T-31. Laboratory analysis of the samples for chemical agent breakdown products did not indicate the presence of these compounds at the sampled location. The results of the laboratory analyses are provided in Tables 3-18 and 3-19.

3.8.3 Site Assessment - Area T-31

Chemical analysis of soil, surface water, and sediment samples from high-probability locations at Area T-31 did not detect the presence of chemical agent or agent breakdown products at the site. Based on the existing knowledge of the site and the SI analytical results, no additional SI activities are recommended based on the present land usage.

3.9 SITE 6 - AREA T-38

Site 6 - Area T-38 is a 6-acre site formerly used for training escort personnel in techniques for eliminating toxic hazards caused by mishaps to chemical munitions during transport. The area also was used to store toxic agents and munitions, including GB, VX, and HD. Unreported burial of chemical agent drums and training pits also may have occurred at the site. Area T-38 was investigated by sampling four high-probability areas for chemical agent screening and laboratory analysis (Figure 3-9). The sampling locations were geophysically screened prior to sampling.

3.9.1 Geophysical Survey Results - Area T-38

The locations of transects and interpretation of EM data for sampling locations S1 and S2 at Area T-38 are shown in Figure 3-10. An in-phase EM anomaly present on Profile 3 (P3) for sampling location S2 (Figure B-4, Appendix B) at 17 to 41 feet indicates ground disturbance. The remainder of the profiles for S1 and S2 appear relatively undisturbed, with the exception of interference due to the decontamination pad located toward the center of the site. Interference on the northwest end of P4 for sampling location S2 is attributed to a fence.

Table 3-18. Data Summary: Surface Water - Area T-31, Ft. McClellan, Anniston, Alabama

SAIC ID Number	T31-W01			T31-W01D			T31-W01D2		
Depth	(1.0)			(1.0)			(1.0)		
Collection Date	4/20/92			4/20/92			4/20/92		
Associated Field QC Sample	FAS001			FAS001			FAS001		
Parameter	Units	CRL	UCR	RB-004	FMP002	FMP002	RB-004	FMP002	RB-007
Method UT02 (IMPA and MPA in Water)									
Isopropylmethyl phosphonic acid	µg/L	100	9000	100 LT	100 LT	100 LT	D	100 LT	D
Methyl phosphonic acid	µg/L	128	9000	128 LT	128 LT	128 LT	D	128 LT	D
Method UL04 (Organosulfur Compounds in Water)									
1,4-Oxathiane	µg/L	1.98	39.5	1.98 LT	1.98 LT	1.98 LT	D	1.98 LT	D
1,4-Dithiane	µg/L	1.11	22.2	1.11 LT	1.11 LT	1.11 LT	D	1.11 LT	D
p-Chlorophenylmethylsulfoxide	µg/L	4.23	106	4.23 LT	4.23 LT	4.23 LT	D	4.23 LT	D
p-Chlorophenylmethylsulfone	µg/L	4.72	106	4.72 LT	4.72 LT	4.72 LT	D	4.72 LT	D
Method UW22 (TDGCL and TDGCLA in Water)									
Thiodiglycol	µg/L	48.8	4,880	48.8 LT	48.8 LT	48.8 LT	D	48.8 LT	D
Method T8 (DIMP and DMMP in Water)									
Diisopropylmethylphosphonate	µg/L	10.5	209.6	10.5 LT	10.5 LT	10.5 LT	D	10.5 LT	D
Dimethylmethylphosphonate	µg/L	15.2	304.8	15.2 LT	15.2 LT	15.2 LT	D	15.2 LT	D

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample

Table 3-19. Data Summary: Sediment - Area T-31, Ft. McClellan, Anniston, Alabama

SAIC ID Number				T31-D01	T31-D01D	
Depth BLS				(1.0)	(1.0)	
Collection Date				4/20/92	4/20/92	
Associated Field QC Sample				FAS001	FAS001	
				FMP002	FMP002	
Parameter	Units	CRL	UCR	RB-004	RB-004	

Method AAA9 (IMPA and MPA in Soil)

Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT	2.10 LT	D
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT	2.00 LT	D

Method LL03 (Organosulfur Compounds in Soil)

1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT	0.856 LT	D
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT	1.47 LT	D
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT	2.25 LT	D
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT	2.37 LT	D

Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)

Thiodiglycol	µg/g	3.94	102.0	3.94 LT	3.94 LT	D
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Method TT9 (DIMP and DMMP in Soil)

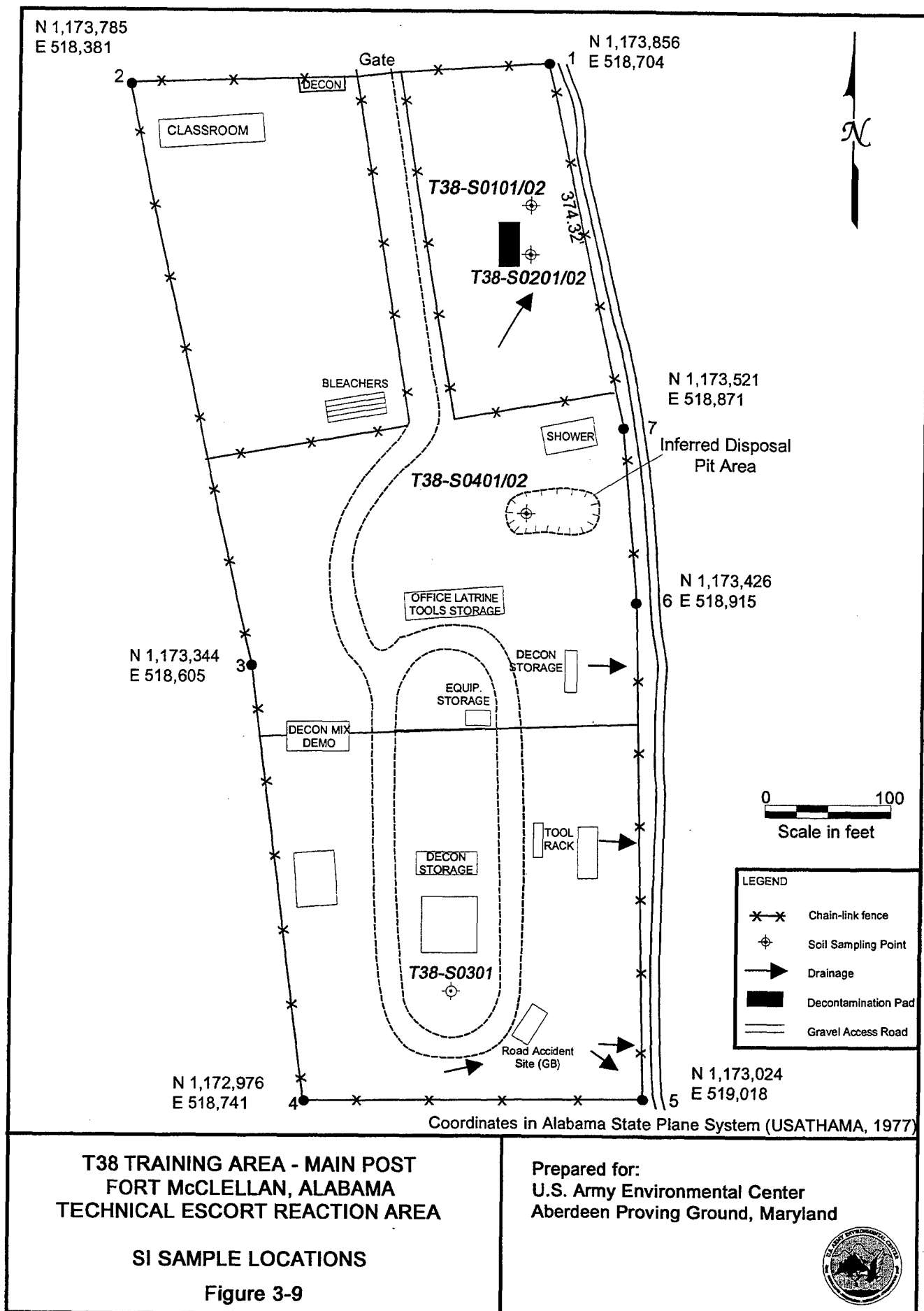
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT	0.114 LT	D
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT	0.133 LT	D

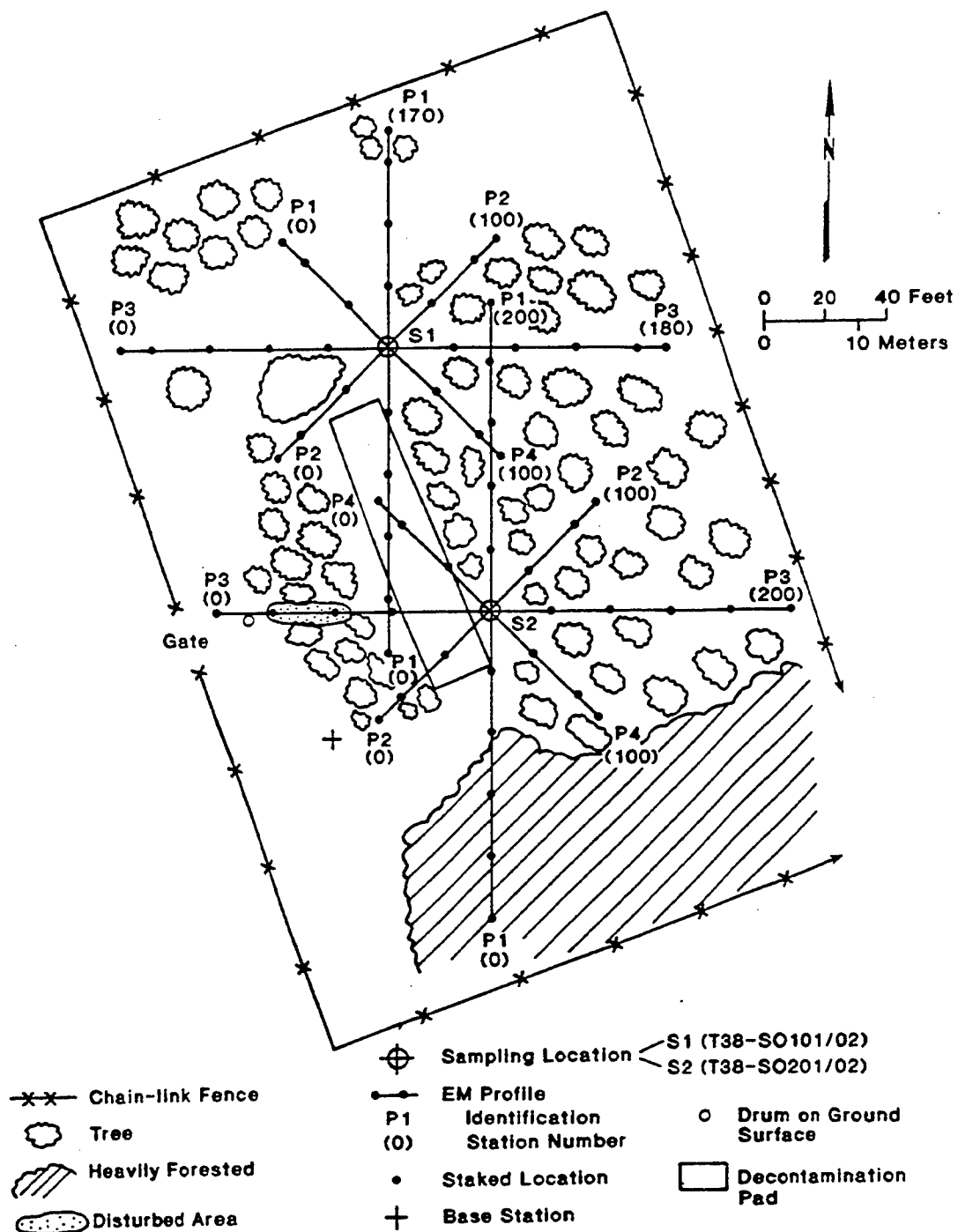
CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample





AREA T-38 LOCATION OF TRANSECTS AND
INTERPRETATION OF EM DATA FOR
SAMPLING LOCATIONS S1 AND S2
FORT McCLELLAN, ALABAMA

Figure 3-10

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



The location of transects and interpretation of EM data for sampling locations S3 and S4 at Area T-38 are shown in Figures 3-11 and 3-12, respectively. The profiles for sampling location S3 appear undisturbed. EM anomalies are present on P1 for sampling location S4 (Figure B-6, Appendix B) at 25 to 48 feet and may be related to a grandstand structure located in this area. Anomalies on P2 at 48 to 90 feet indicate ground disturbance in this area. Another in-phase anomaly (5 ppt) is present on P4 at 63 to 78 feet. The area at sampling location S4 appears undisturbed.

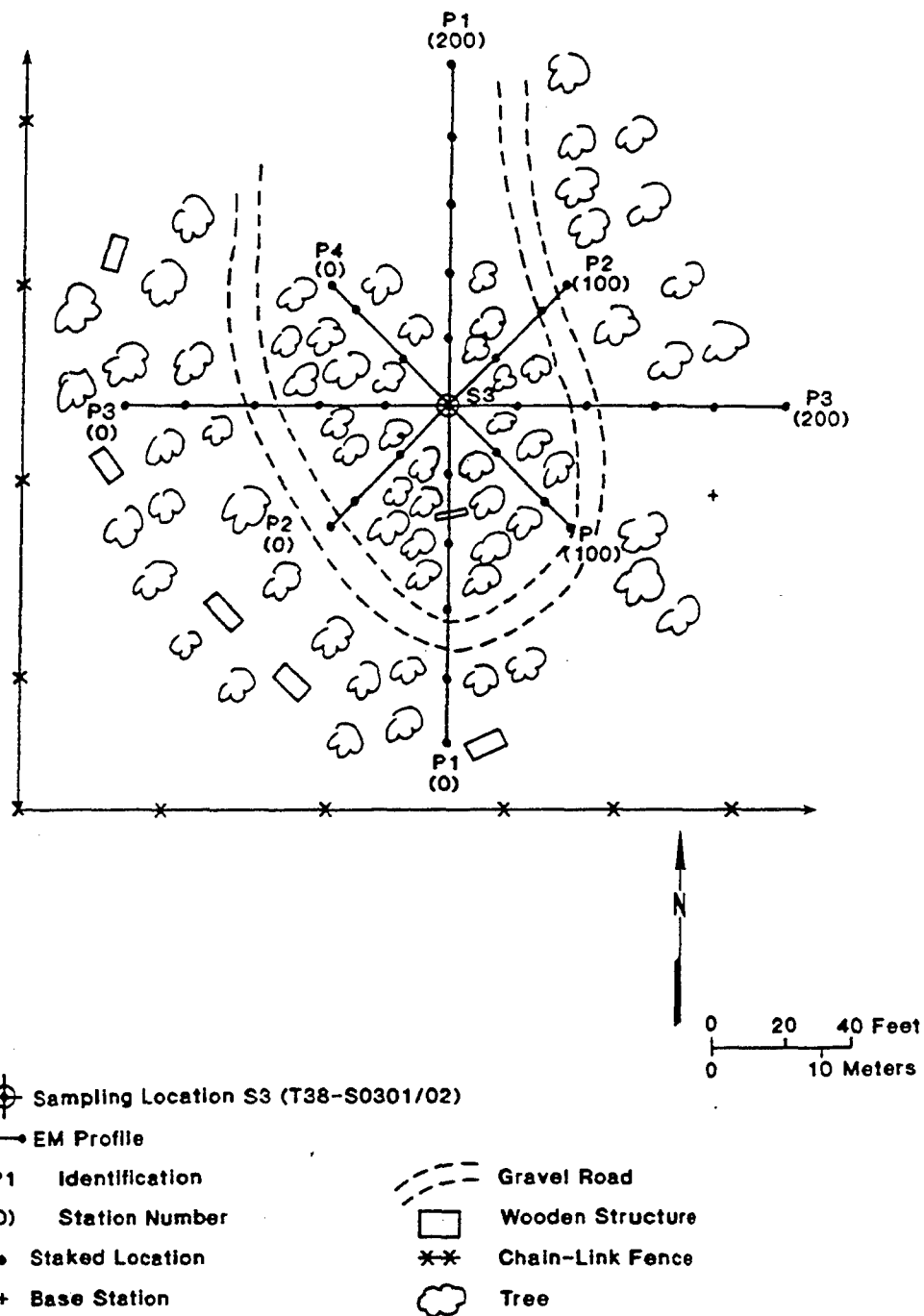
3.9.2 Soil Sampling - Area T-38

Eight soil samples were collected in Area T-38 from four locations. Two of the locations were downhill from a rectangular decontamination pad located in the northeastern corner of the site. The remaining samples were obtained from two locations established from Post personnel recollections of operations at Area T-38. A former training pit was approximately located in the middle-eastern portion of Area T-38 and a possible buried drum of chemical agent was reported in the southern portion of the site. The training pit reportedly extended to approximately 20 feet BLS; however, because of a communication error, sampling at the approximate location was not extended to that depth. Detected concentrations of HD and VX based on MINICAMS screening of the collected soil samples were determined to be the result of background sources (USATEU 1992) in the shallow soils at Area T-38. The obtained results were below the alert limit of 0.8 TWA for the MINICAMS instrument. The results of the MINICAMS field screening are provided in Table 3-20.

Table 3-20. USATEU Results of MINICAMS Screening - Area T-38

Sample Number	Sample Depth	HD*	GB*	VX*
T38-S0101	9 - 12"	0.00	0.00	0.1
T38-S0102	60 - 67"	0.16	0.00	0.09
T38-S0201	9 - 12"	0.00	0.00	0.10
T38-S0202	60 - 67"	0.11	0.00	0.00
T38-S0301	7 - 10"	0.00	0.00	0.09
T38-S0401	13 - 15"	0.58	0.00	0.00
T38-S0402	60 - 67"	0.52	0.00	0.18

* Reported values are below the 0.8 TWA for the MINICAMS and are determined to be the result of background Sources (USATEU 1992)

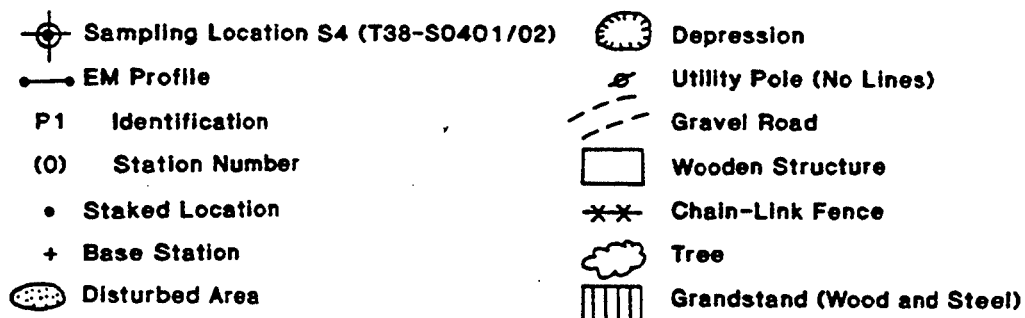
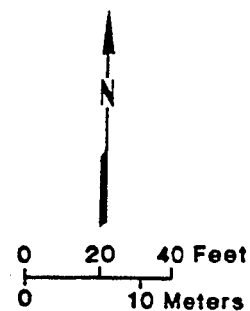
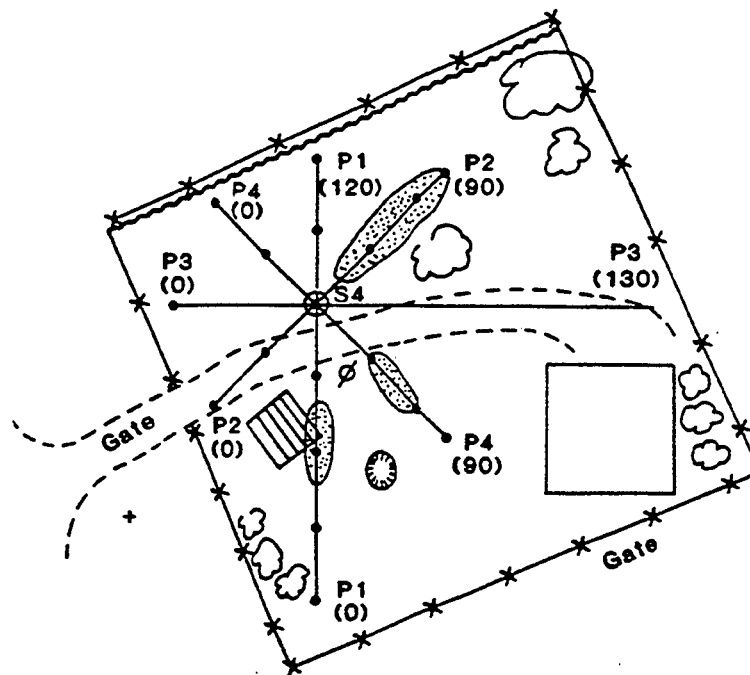


AREA T-38 LOCATION OF TRANSECTS AND
 INTERPRETATION OF EM DATA FOR
 SAMPLING LOCATION S3
 FORT McCLELLAN, ALABAMA

Prepared for:
 U.S. Army Environmental Center
 Aberdeen Proving Ground, Maryland



Figure 3-11



AREA T-38 LOCATION OF TRANSECTS AND
INTERPRETATION OF EM DATA FOR
SAMPLING LOCATION S4
FORT McCLELLAN, ALABAMA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 3-12

Laboratory analysis of the soil samples did not detect the presence of chemical agent degradation products at the sampled locations on Area T-38. The results of the laboratory testing are provided in Table 3-21.

3.9.3 Site Assessment - Area T-38

Chemical screening and analysis of shallow soil samples obtained from high-probability sample locations at former training Area T-38 did not detect the presence of chemical agent or agent breakdown products at the sampled locations. Because of the uncertainty associated with the locations of former training pits and potentially buried drums of chemical agent at the site, additional investigation activities are warranted at this site. The EM geophysical survey at sampling point T38-S04 indicates a potential for subsurface disturbance in the inferred area of a former training pit. Because the estimated depth of the former pit is approximately 20 feet, additional more detailed geophysical surveys and deeper sampling activities are warranted to delineate and investigate the pit area. Soil sampling using hand-held sampling tools with MINICAMS screening also are warranted to investigate multiple inferred buried drum locations at the site. Analytical parameters for this site should include chloraceptophenone solution (CNB), consisting of chloraceptophenone in benzene and carbon tetrachloride, VOC, and SVOC compounds based on reports that CNB was used in the area in the early 1960's (G. Harvey, written communication, October 7, 1992).

3.10 SITE 7 - OLD TOXIC TRAINING AREA

Site 7 - Old Toxic Training Area consists of an approximately 500-square feet ditch area behind Building 3183 that was used for training exercises in the identification and detection of HD in the 1950's. The area is fenced, but accessible. Possible HD contamination at this site was investigated with two shallow soil borings.

3.10.1 Soil Sampling Results - Old Toxic Training Area

The USATEU collected four shallow soil samples at two locations within the Old Toxic Training Area (Figure 3-13). The samples were screened in the field for the presence of HD using a MINICAMS analyzer. The screening values were less than the 0.8 TWA threshold for

Table 3-21. Data Summary: Soil - Area T-38, Ft. McClellan, Anniston, Alabama

SAIC ID Number	T38-S01			T38-S01	T38-S02	T38-S02
Depth BLS	(1.0)			(5.0)	(1.0)	(5.0)
Collection Date	4/23/92			4/23/92	4/23/92	4/23/92
Associated Field QC Sample	FAS001			FAS001	FAS001	FAS001
Parameter	Units	CRL	UCR	FMP002	FMP002	FMP002
				RB-004	RB-004	RB-004
Method AAA9 (IMPA and MPA in Soil)						
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT	2.10 LT	2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT	2.00 LT	2.00 LT
Method LL03 (Organosulfur Compounds in Soil)						
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT	0.856 LT	0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT	2.37 LT	2.37 LT
Method 99 (Isopropylamine in Soil)						
Isopropylamine	µg/g	--	--	1.00 LT	1.27 LT	1.23 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)						
Thiodiglycol	µg/g	3.94	102.0	3.94 LT	3.94 LT	3.94 LT
Method TT9 (DIMP and DMMP in Soil)						
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT	0.114 LT	0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT	0.133 LT	0.133 LT

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

Table 3-21. Data Summary: Soil - Area T-38, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	T38-S03			T38-S03D			T38-S04			T38-S04		
Depth BLS	(1.0)			(1.0)			(1.0)			(5.0)		
Collection Date	4/23/92			4/23/92			4/23/92			4/23/92		
Associated Field QC Sample	FAS001			FAS001			FAS001			FAS001		
Parameter	FMP002			FMP002			FMP002			FMP002		
Units	UCR RB-004			RB-004			RB-005			RB-005		
CRL												
Method AAA9 (IMPA and MPA in Soil)												
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT			2.10 LT			2.10 LT		2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT			2.00 LT			2.00 LT		2.00 LT
Method LL03 (Organosulfur Compounds in Soil)												
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT			0.856 LT			0.856 LT		0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT			1.47 LT			1.47 LT		1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT			2.25 LT			2.25 LT		2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT			2.37 LT			2.37 LT		2.37 LT
Method 99 (Isopropylamine in Soil)												
Isopropylamine	µg/g	--	--	1.17 LT			1.09 LT			1.16 LT		1.24 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)												
Thiodiglycol	µg/g	3.94	102.0	3.94 LT			3.94 LT			3.94 LT		3.94 LT
Method TT9 (DIMP and DMMP in Soil)												
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT			0.114 LT			0.114 LT		0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT			0.133 LT			0.133 LT		0.133 LT

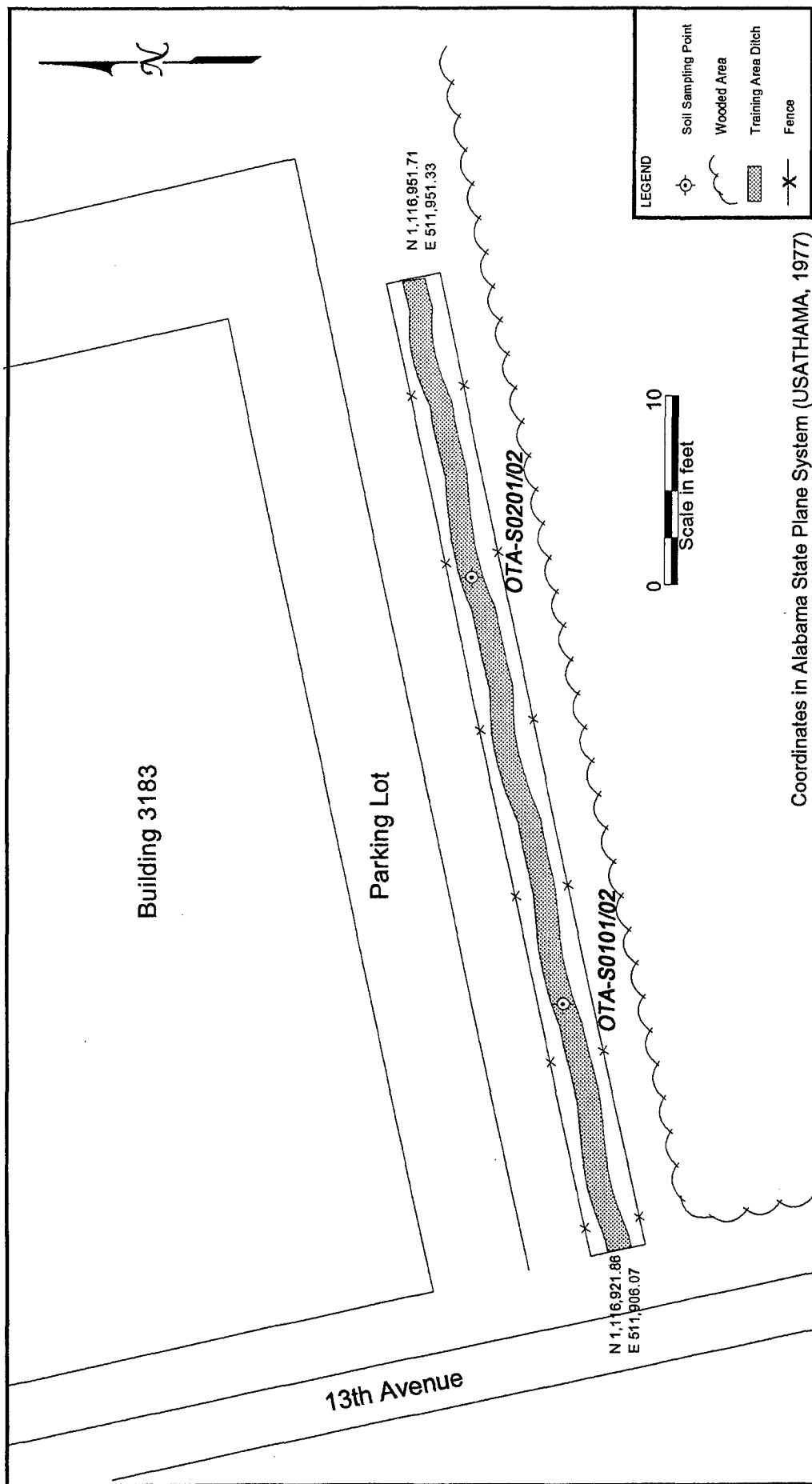
-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample



**OLD TOXIC TRAINING AREA - MAIN POST
FORT McCLELLAN, ALABAMA
SI SAMPLE LOCATIONS**

**Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland**



Figure 3-13

HD and detected values were below the detection limit for HD. The results of the field screening are shown in Table 3-22. Laboratory analysis of the soil samples for HD degradation products did not detect these compounds at the sampled locations. The results of the laboratory testing are shown in Table 3-23.

**Table 3-22. USATEU Results of MINICAMS Screening Area
Old Toxic Training Area**

Sample Number	Sample Depth	HD*
OTA-S0101	12 - 15"	0.00
OTA-S0102	58 - 60"	0.04
OTA-S0201	12 - 15"	0.03
OTA-S0202	62 - 64"	0.05

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU, 6/92).

3.10.2 Site Assessment - Old Toxic Training Area

Field screening and laboratory analysis do not indicate the presence of HD contamination at two sampled locations within the Old Toxic Training Area ditch. Additional environmental sampling for laboratory analysis does not appear warranted for this area.

3.11 SITE 8 - RANGE K

Site 8 - Range K is reportedly a 2-acre former chemical agent training area for which little information is available. A former shell tapping area was reportedly operated in this area from prior to 1961 to the summer of 1963. Chemical ordnance was opened and decontaminated in this area. Evidence of a former training area at this site was not observed during the October 1991 and April 1992 site visits. An approximately 5-foot diameter area of ponded drainage was noted in the site area. In addition, evidence of site usage as a bivouac area was observed. The site was investigated by reconnaissance geophysics and by collecting a sediment sample from the area of ponded drainage. Laboratory analysis (Table 3-24) of the sample did not detect the presence of chemical agent breakdown products at the sampled location.

Table 3-23. Data Summary: Soil - Old Toxic Training Area, Ft. McClellan, Anniston, Alabama

SAIC ID Number	OTA-S01	OTA-S01D	OTA-S01	OTA-S02	OTA-S02
Depth BLS	(1.0)	(1.0)	(5.0)	(1.0)	(5.0)
Collection Date	4/14/92	4/14/92	4/14/92	4/14/92	4/14/92
Associated Field QC Sample	FAS001	FAS001	FAS001	FAS001	FAS001
Parameter	FMP002	FMP002	FMP002	FMP002	FMP002
Units	RB-002	RB-002	RB-002	RB-002	RB-002
UCR	UCR				
CRL	CRL				
Method LL03 (Organosulfur Compounds in Soil)					
1,4-Oxathiane	17.1	0.856 LT	0.856 LT	0.856 LT	0.856 LT
1,4-Dithiane	11.3	1.47 LT	1.47 LT	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide	45.0	2.25 LT	2.25 LT	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone	47.4	2.37 LT	2.37 LT	2.37 LT	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)					
Thiodiglycol	102.0	3.94 LT	3.94 LT	3.94 LT	3.94 LT
µg/g	µg/g	3.94	3.94	3.94	3.94

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample

Table 3-24. Data Summary: Sediment -- Range K, Ft. McClellan, Anniston, Alabama

SAIC ID Number				RK-D01	RK-D01D
Depth BLS				(1.0)	(1.0)
Collection Date				4/27/92	4/27/92
Associated Field QC Sample				FAS001	FAS001
				FPR002	FPR002
Parameter	Units	CRL	UCR	RB-006	RB-006
Method AAA9 (IMPA and MPA in Soil)					
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT	2.10 LT D
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT	2.00 LT D
Method LL03 (Organosulfur Compounds in Soil)					
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT	0.856 LT D
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT	1.47 LT D
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT	2.25 LT D
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT	2.37 LT D
Method 99 (Isopropylamine in Soil)					
Isopropylamine	µg/g	--	--	1.00 LT	1.00 LT D
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)					
Thiodiglycol	µg/g	3.94	102.0	3.94 LT I	3.94 LT I,D
Method TT9 (DIMP and DMMP in Soil)					
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT	0.114 LT D
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT	0.133 LT D

-- The certification of these analytes will be submitted at a later date

CRL -- Certified Reporting Limit

UCR -- Upper Certified Range

LT -- less than the certified reporting limit

D -- duplicate sample

I -- out of control, data rejected due to low recoveries

3.11.1 Geophysical Results - Range K

The locations of transects and interpretation of EM data for sample location S1 at Range K are shown in Figure 3-14. Location P3 is disturbed at a distance of 22 to 54 feet (Figure B-9, Appendix B) in an area where several partially buried drums are located. The remainder of these profiles, including sampling location S1, appear undisturbed.

3.11.2 Site Assessment - Range K

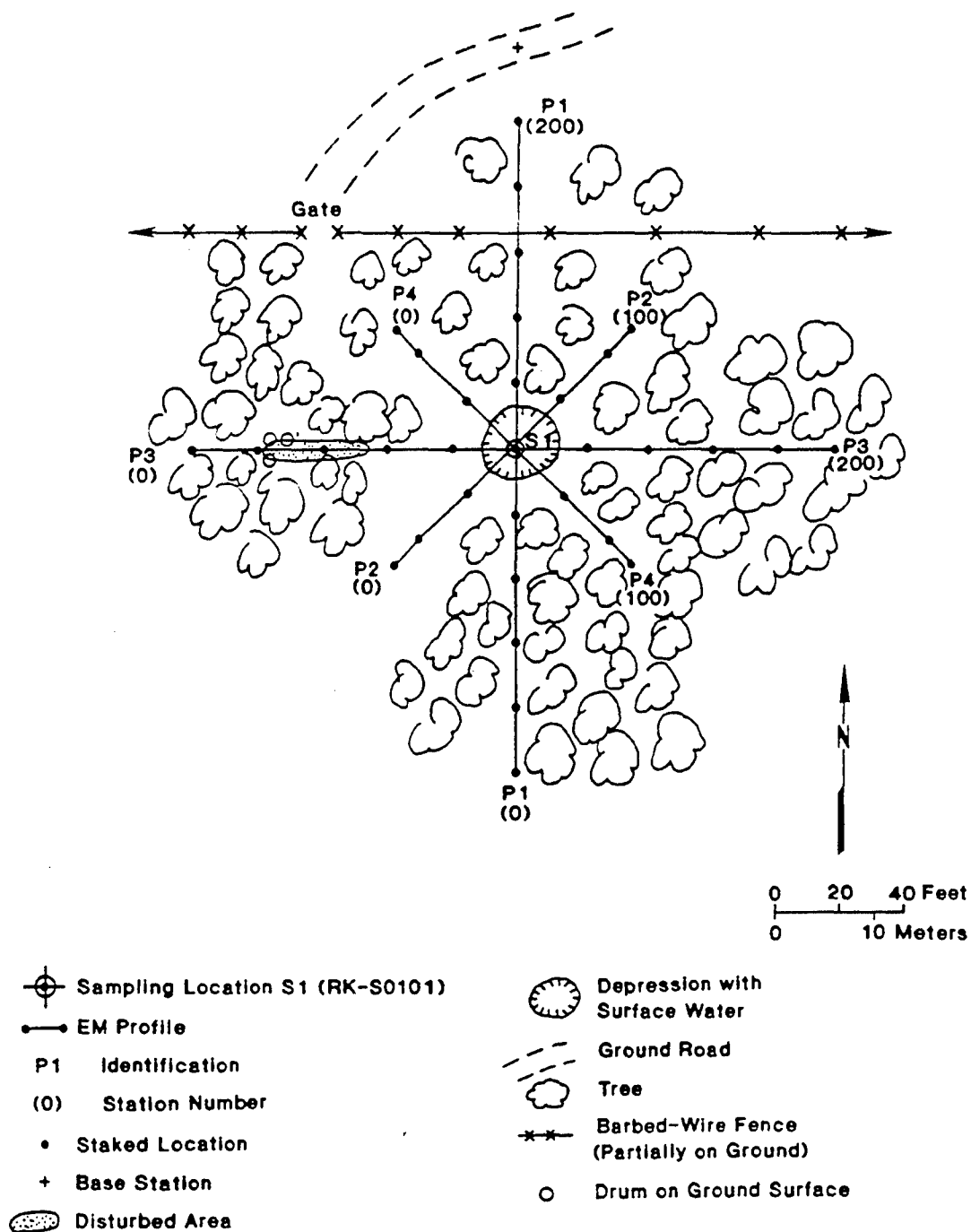
Geophysical and soil chemistry data for Range K indicate that the sampled location (RK-D01) is undisturbed and did not detect the presence of agent breakdown products. An independent site visit by USAEC (CETHA-TS-C) on November 16, 1992 identified DS-2 cans, HD, and GB rounds, and other ordnance in the southern portion of the site beyond the tree line. Based on this discovery, Range K should be evaluated in greater detail through surface reconnaissance, geophysical surveying, and soil sampling.

3.12 SITE 9 - RANGE I

Site 9 - Range I was a former agent shell tapping area used between 1963 to 1964. The 0.5 to 1-acre site has been physically rearranged; however, a concrete marker was observed during the October 1991 and April 1992 site visits. The agent is assumed to have been HD. The site was investigated by collecting, screening, and analyzing four shallow soil samples.

3.12.1 Soil Sampling Results - Range I

Four shallow soil samples were collected at Range I from two locations (Figure 3-15). The samples were screened in the field for HD, GB, and VX agents using a MINICAMS analyzer. The field screening did not detect the presence of chemical agent in the soil samples, since all of the values were below the TWA threshold of 0.8. The results of the field screening are provided in Table 3-25. Laboratory analysis for HD, GB, and VX degradation products did not detect the presence of these compounds in the site soils at the sampled locations. The results of the laboratory testing are provided in Table 3-26.



RANGE K LOCATION OF TRANSECTS AND
INTERPRETATION OF EM DATA FOR
SAMPLING LOCATION S1
FORT McCLELLAN, ALABAMA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 3-14

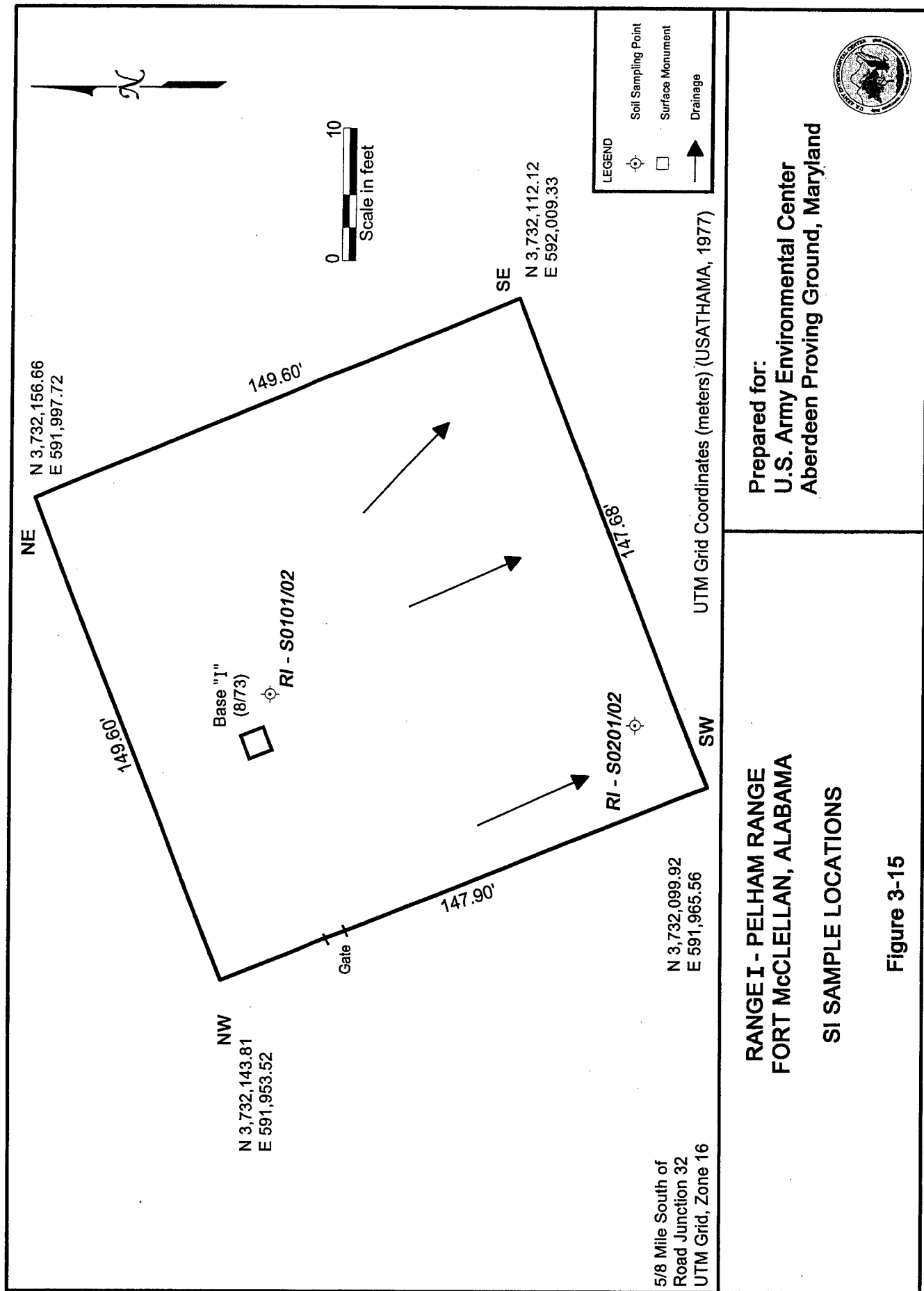


Table 3-25. USATEU Results of MINICAMS Screening - Range I

Sample Number	Sample Depth	HD*	GB*	VX*
RI-S0101	9 - 12"	0.00	0.00	0.00
RI-S0102	60 - 67"	0.00	0.00	0.00
RI-S0201	9 - 12"	0.00	0.01	0.00
RI-S0202	60 - 67"	0.00	0.00	0.00

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU, 6/92).

Table 3-26. Data Summary: Soil - Range I, Ft. McClellan, Anniston, Alabama

SAIC ID Number	RI-S01	RI-S01	RI-S01	RI-S02	RI-S02
Depth BLS	(1.0)	(5.0)	(1.0)	(5.0)	(5.0)
Collection Date	4/27/92	4/27/92	4/27/92	4/27/92	4/27/92
Associated Field QC Sample	FAS001	FAS001	FAS001	FAS001	FAS001
	FPR002	FPR002	FPR002	FPR002	FPR002
Parameter	Units	CRL	UCR	RB-006	RB-006
Method AAA9 (IMPA and MPA in Soil)					
Isopropylmethyl phosphonic acid	µg/g	2.10	40	2.10 LT	2.10 LT
Methyl phosphonic acid	µg/g	2.00	40	2.00 LT	2.00 LT
Method LL03 (Organosulfur Compounds in Soil)					
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT	0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)					
Thiodiglycol	µg/g	3.94	102.0	3.94 LT I	3.94 LT I
Method TT9 (DIMP and DMMP in Soil)					
Diisopropylmethylphosphonate	µg/g	0.114	4.57	0.114 LT	0.114 LT
Dimethylmethylphosphonate	µg/g	0.133	4.18	0.133 LT	0.133 LT

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

I - out of control, data rejected due to low recoveries

3.12.2 Site Assessment - Range I

Field and laboratory analysis of four soil samples at Range I does not indicate the presence of chemical agent (i.e., HD, GB, VX) or HD and GB breakdown products in the shallow site soils. The site was a tapping area where munitions were drilled (tapped) and drained. No records of munitions burial are ^{available} ~~present~~ for the site. The site should be removed from further consideration under the SI program.

3.13 SITE 10 - RANGE J

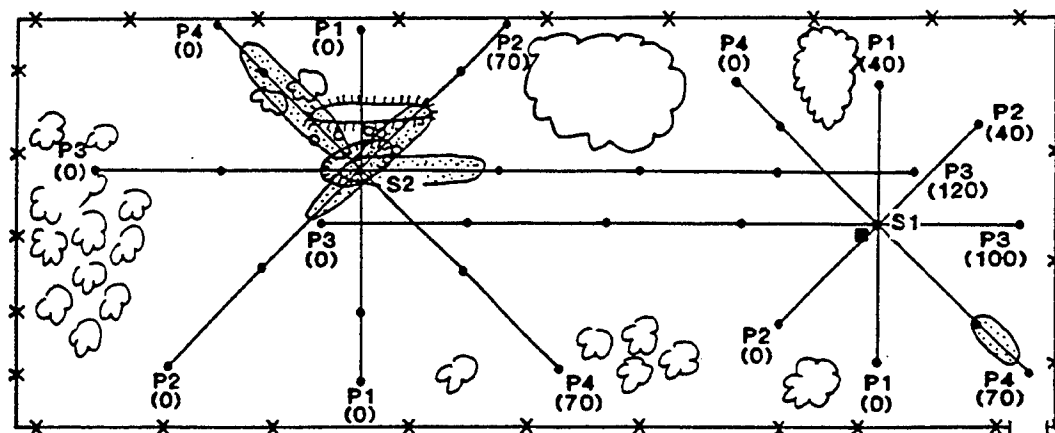
Site 10 - Range J is a former chemical agent training area contained within a 139- by 50-foot fenced area on Pelham Range. The site was used until 1963 as an agent training and disposal area. The site also was reportedly used to dispose of HD-contaminated soil that resulted from a 100-gallon spill on the Main Post in 1955. Evidence of drummed soil disposed of in a shallow pit was observed during the October 1991 and April 1992 site visits. A survey monument (dated August 1973) also was located within the fenced area. The site was investigated by reconnaissance geophysical surveys (electromagnetics and metal detection) and shallow soil sampling.

3.13.1 Geophysical Survey Results - Range J

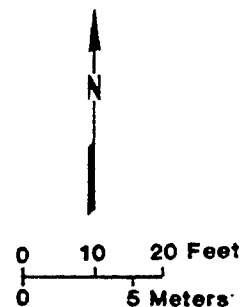
The locations of transects and interpretation of EM data for sampling locations S1 and S2 at Range J are shown in Figure 3-16. An in-phase anomaly (15 to 60 ppt) is present at P4 at 50 to 61 feet (Figure B-7, Appendix B). The remainder of the profiles for sampling location S1 appear undisturbed except near the edges, which is attributed to a fence. Several EM anomalies are observed for sample location S2. P2 is disturbed at 31 to 53 feet, P3 is disturbed at 36 to 58 feet, and P4 is disturbed at 7 to 27 feet.

3.13.2 Soil Sampling Results - Range J

Shallow soil sampling was conducted at four locations within Range J (Figure 3-17), including one sample (RJ-S0401) collected from a corroded drum exposed at the ground surface. Additional samples were collected in topographically downhill areas and near the identified surface monument. Seven samples were collected and screened in the field for the presence of



+ Base Station



- ⊕ Sampling Location
 - S1 (RJ-S0101/02)
 - S2 (RJ-S0201/02)
- EM Profile
- P1 Identification
- (0) Station Number
- Staked Location

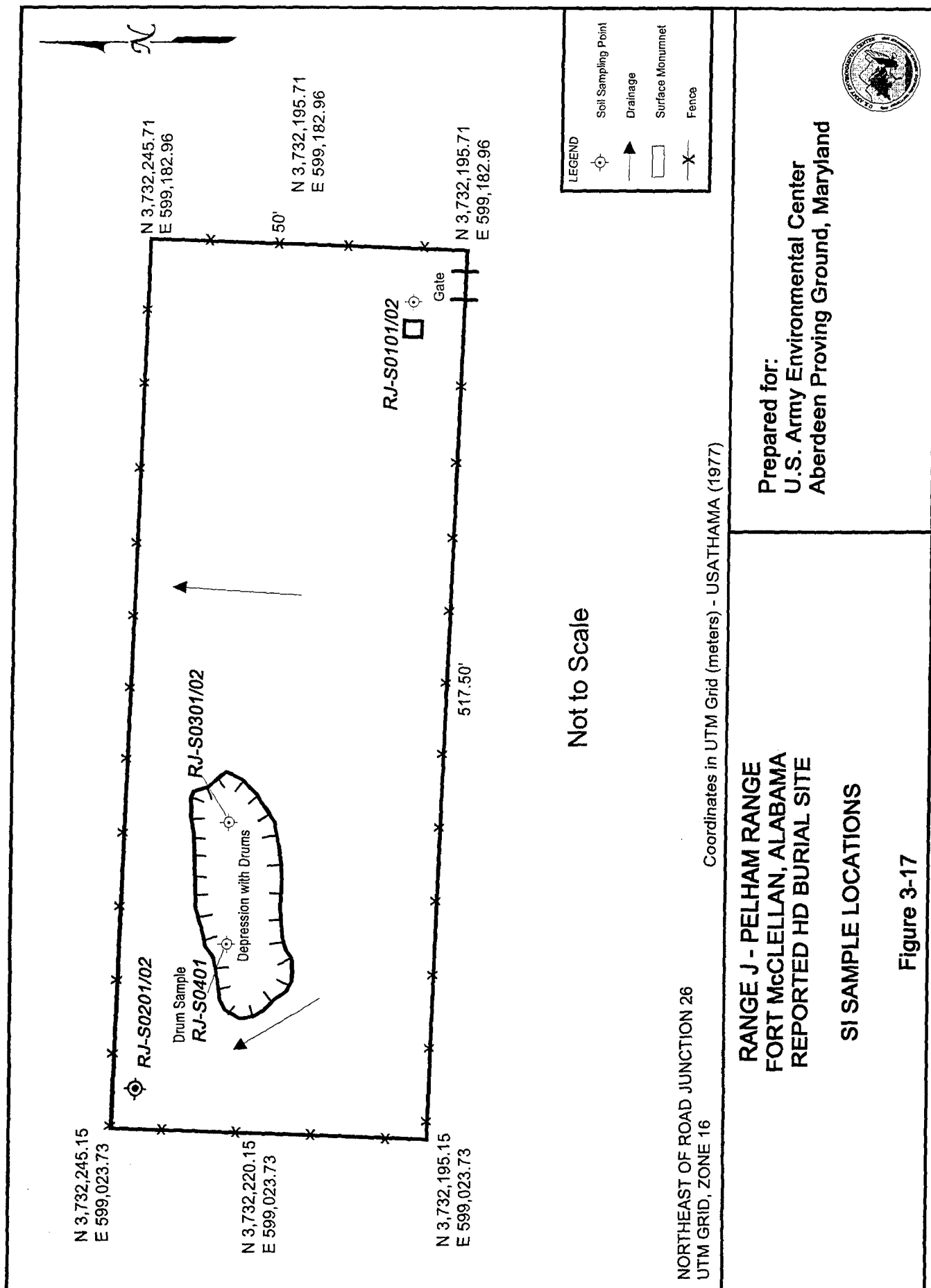
- Depression
- Mound
- Tree
- XX Chain-Link Fence
- Drum on Ground Surface
- Concrete Monument
- Disturbed Area

RANGE J LOCATION OF TRANSECTS AND
INTERPRETATION OF EM DATA FOR
SAMPLING LOCATIONS S1 AND S2
FORT McCLELLAN, ALABAMA

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 3-16



HD using a MINICAMS unit. The results of the field screening are shown in Table 3-27. Field screening values ranged from 0.0 to 0.35 TWA, below the value of 0.8 TWA. The result from sample RJ-S0401 (.35 TWA) emulated HD in the MINICAMS sampling gate, but USATEU personnel determined the sample was not agent due to the weathering of the drummed soil. Laboratory analyses of the screened samples for HD breakdown products did not detect the presence of these compounds in the shallow soils. Laboratory data are provided in Table 3-28.

Table 3-27. USATEU Results of MINICAMS Screening - Range J

Sample Number	Sample Depth	HD*
RJ-S0101	9 - 12"	0.00
RJ-S0102	63 - 69"	0.00
RJ-S0201	8 - 12"	0.13
RJ-S0202	60 - 67"	0.00
RJ-S0301	8 - 12"	0.00
RJ-S0302	58 - 64"	0.00
RJ-S0401	Drum	0.35

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU 1992).

3.13.3 Site Assessment - Range J

Soil sampling and analysis at Range J did not detect the presence of HD or HD breakdown products at the sampled locations. Electromagnetic surveying in the vicinity of sample location 2 indicates a broad area of subsurface disturbance in the vicinity of the shallow burial pit at the site. A more extensive geophysical survey consisting of electromagnetics and magnetometry is recommended for Range J to delineate areas of subsurface disturbance.

3.14 SITE 11 - RANGE L (LIMA POND)

Site 11 - Range L consists of a former chemical munitions disposal area on Pelham Range. The 0.5-acre site reportedly was used for the disposal of captured World War II munitions, including chemical ordnance. According to Post personnel, a shallow man-made pond was the dump site for the munitions. The pond is contained within a bermed area that is

Table 3-28. Data Summary: Soil - Range J, Ft. McClellan, Anniston, Alabama

SAIC ID Number	RJ-S01	RJ-S01	RJ-S01	RJ-S02	RJ-S02D	RJ-S02
Depth BLS	(1.0)	(5.0)	(1.0)	(1.0)	(5.0)	(5.0)
Collection Date	4/28/92	4/28/92	4/28/92	4/28/92	4/28/92	4/28/92
Associated Field QC Sample	FAS001	FAS001	FAS001	FAS001	FAS001	FAS001
Parameter	FPR002	FPR002	FPR002	FPR002	FPR002	FPR002
Units	RB-006	RB-006	RB-006	RB-006	RB-006	RB-006
Method LL03 (Organosulfur Compounds in Soil)						
1,4-Oxathiane	17.1	0.856 LT	0.856 LT	0.856 LT	0.856 LT	0.856 LT
1,4-Dithiane	11.3	1.47 LT	1.47 LT	1.47 LT	1.47 LT	1.47 LT
p-Chlorophenylmethylsulfoxide	45.0	2.25 LT	2.25 LT	2.25 LT	2.25 LT	2.25 LT
p-Chlorophenylmethylsulfone	47.4	2.37 LT	2.37 LT	2.37 LT	2.37 LT	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)						
Thiodiglycol	102.0	3.94 LT I	3.94 LT I	3.94 LT I	3.94 LT I	3.94 LT I
CRL - Certified Reporting Limit	3.94					
UCR - Upper Certified Range						
LT - less than the certified reporting limit						
D - duplicate sample						
I - out of control, data rejected due to low recoveries						

Table 3-28. Data Summary: Soil - Range J, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	RJ-S03	RJ-S03D	RJ-S03	RJ-S04
Depth BLS	(1.0)	(1.0)	(5.0)	(1.0)
Collection Date	4/28/92	4/28/92	4/24/92	4/24/92
Associated Field QC Sample	FAS001	FAS001	FAS001	FAS001
	FPR002	FPR002	FPR002	FPR002
Parameter	UCR	RB-006	RB-005	RB-005
Units	CRL			
Method LL03 (Organosulfur Compounds in Soil)				
1,4-Oxathiane	µg/g	0.856	17.1	0.856 LT
1,4-Dithiane	µg/g	1.47	11.3	1.47 LT
p-Chlorophenylmethylsulfoxide	µg/g	2.25	45.0	2.25 LT
p-Chlorophenylmethylsulfone	µg/g	2.37	47.4	2.37 LT
Method LW18 (Thiodiglycol and Chloroacetic Acid in Soil)				
Thiodiglycol	µg/g	3.94	102.0	3.94 LT I
				3.94 LT I

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample

I - out of control, data rejected due to low recoveries

topographically higher than the surrounding wooded terrain. The berm is estimated to be approximately 30 feet deep from the top of the slope to the existing pond bed. The depth of the pit below the pond bed is unknown. Few indicators of munitions dumping were evident at the site, although empty ammunition crates were observed along the pond berm. USATEU investigated Lima Pond using metal detection, but did not conduct additional soil and surface water sampling because of the elevated results obtained during the metal detection survey.

3.14.1 Geophysical Survey Results - Range L

Metal detection sweeps conducted by USATEU indicated a large concentration of metallic objects in Lima Pond. The qualitative results of the survey indicate that additional, more quantitative surveying is appropriate for the site. The total area within the base of the pond was reportedly surveyed from the pond shore by USATEU with magnetic readings taken 3 feet into the area from the base of the berm.

3.14.2 Site Assessment - Range L

Ordnance and chemical munitions potentially buried in Range L have not been extensively studied to determine the types of materials and their aerial distribution within the pond area. Previous undocumented surface soil sampling at Lima Pond did not indicate the presence of contamination, although the location of the sampling in the pond area is unknown. Additional quantitative geophysical surveys consisting of a combination of magnetometry, gravimetrics, and ground penetrating radar (GPR) are recommended for assessment of the materials beneath the pond floor and for estimating the depth of the excavation. Installation of six monitoring wells surrounding the pond area are recommended to assess the possible impacts of long-term munitions degradation on groundwater in the site area.

3.15 SITE 12 - DETECTION AND IDENTIFICATION AREA

The Detection and Identification Area is a 1.1-acre site that was used from the 1950's to 1972 for GB and possibly HD training. Agent simulants CK, GC, CX, and AC also may have been used in training. All training aids from this site and a building at Site T-4 were burned twice in a dug pit and buried at the Detection and Identification Area. The pit is

identified by stake F, which was located in the field during the October 1991 and April 1992 site visits. The site was investigated by collecting soil samples at two locations in the area.

3.15.1 Soil Sampling Results - Detection and Identification Area

Four soil samples were collected at two locations in the vicinity of stake F in the Detection and Identification Area (Figure 3-18). The samples were screened in the field for HD and GB using a MINICAMS analyzer. The results of the screening (Table 3-29) indicate that TWA values ranged between 0.0 to 0.03 TWA and are below the threshold limit of 0.8 TWA. HD and GB were not detected in the field screening samples. Laboratory analyses were conducted for HD and GB degradation products and metals. The results of these analyses show that agent breakdown compounds were not detected in the soil samples. Metals were detected in the soil samples. Detected results are presented in Table 3-30.

**Table 3-29. USATEU Results of MINICAMS Screening
Detection and Identification Area**

Sample Number	Sample Depth	HD*	GB*
DIA-S0101	12 - 18"	0.03	0.00
DIA-S0102	70 - 76"	0.03	0.00
DIA-S0201	12 - 15"	0.03	0.00
DIA-S0202	70 - 76"	0.03	0.00

* Reported values are below the 0.8 TWA for the MINICAMS and are not indicative of detected chemical warfare agent (USATEU, 6/92).

3.15.2 Site Assessment - Detection and Identification Area

Samples collected from two high-probability locations at the Detection and Identification Area do not indicate the presence of chemical warfare agent or agent breakdown products in the subsurface soils. Metals concentrations in the soils are naturally occurring and do not represent an environmental hazard. The location of a disposal pit in which training materials were burned is reportedly marked by a surface monument (stake F), which was located in the field. The dimensions of the pit are unreported and the position of stake F with respect to the pit boundary

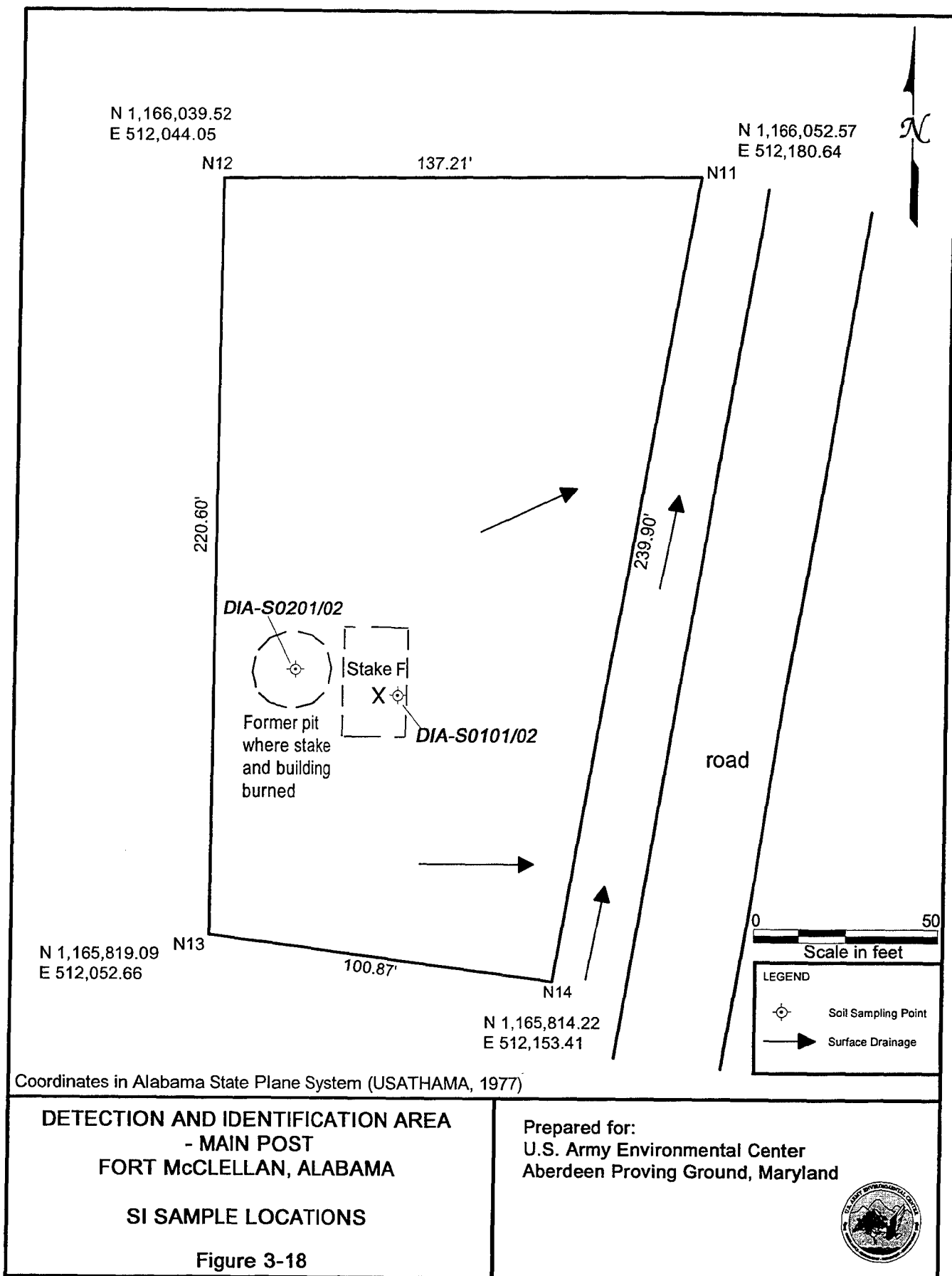


Table 3-30. Data Summary: Soil - Detection and Identification Area, Ft. McClellan, Anniston, Alabama

SAIC ID Number	DIA-S01	DIA-S01D	DIA-S01	DIA-S02	DIA-S02
Depth BLS	(1.0)	(1.0)	(5.0)	(1.0)	(5.0)
Collection Date	4/15/92	4/15/92	4/15/92	4/16/92	4/15/92
Associated Field QC Sample	TB-007	TB-007	TB-007	TB-007	TB-007
Parameter	FMP002, FAS001	FMP002, FAS001	FMP002, FAS001	FMP002, FAS001	FMP002, FAS001
Units	UCR	RB-003	RB-003	RB-003	RB-003
CRL	2.50	50.0	17.3	18.9	16.7
µg/g	2.50	50.0	17.3	18.9	16.7
21.9					
Method B9 (As in Soil)					
Arsenic	µg/g	2.50	50.0	17.3	18.9
Method JS12 (ICP Metals in Soil)					
Aluminum	µg/g	11.2	50,000	23900	21200
Barium	µg/g	3.29	1,000	60.5	58.7
Beryllium	µg/g	0.427	1,000	0.861	1.31
Boron	µg/g	6.64	1,000	6.64 LT	11.9
Calcium	µg/g	25.3	50,000	302	300
Chromium	µg/g	1.04	1,000	27.8	32.3
Cobalt	µg/g	2.50	1,000	10.4	16.8
Copper	µg/g	2.84	1,000	11.3	12.1
Iron	µg/g	6.66	50,000	45200	8150
Magnesium	µg/g	10.1	50,000	792	692
Manganese	µg/g	9.87	1,000	202	310
Nickel	µg/g	2.74	2,000	11	22.3
Potassium	µg/g	131	50,000	887	683
Tin	µg/g	7.43	2,000	7.43 LT	7.43 LT
Vanadium	µg/g	1.41	1,000	42.1	45.9
Zinc	µg/g	2.34	1,000	32.7	40.6
Lead	µg/g	7.44	1,000	13.8	24.6
27900					
70.9					
0.806					
6.64 LT					
87.9					
27.2					
4.57					
20.2					
48100					
1300					
53.7					
15.5					
1320					
7.43 LT					
41.2					
49.5					
12.8					

CRL - Certified Reporting Limit

UCR - Upper Certified Range

LT - less than the certified reporting limit

D - duplicate sample

is unknown. Based on the continuance of present land usage, no additional investigative activities are recommended for this site.

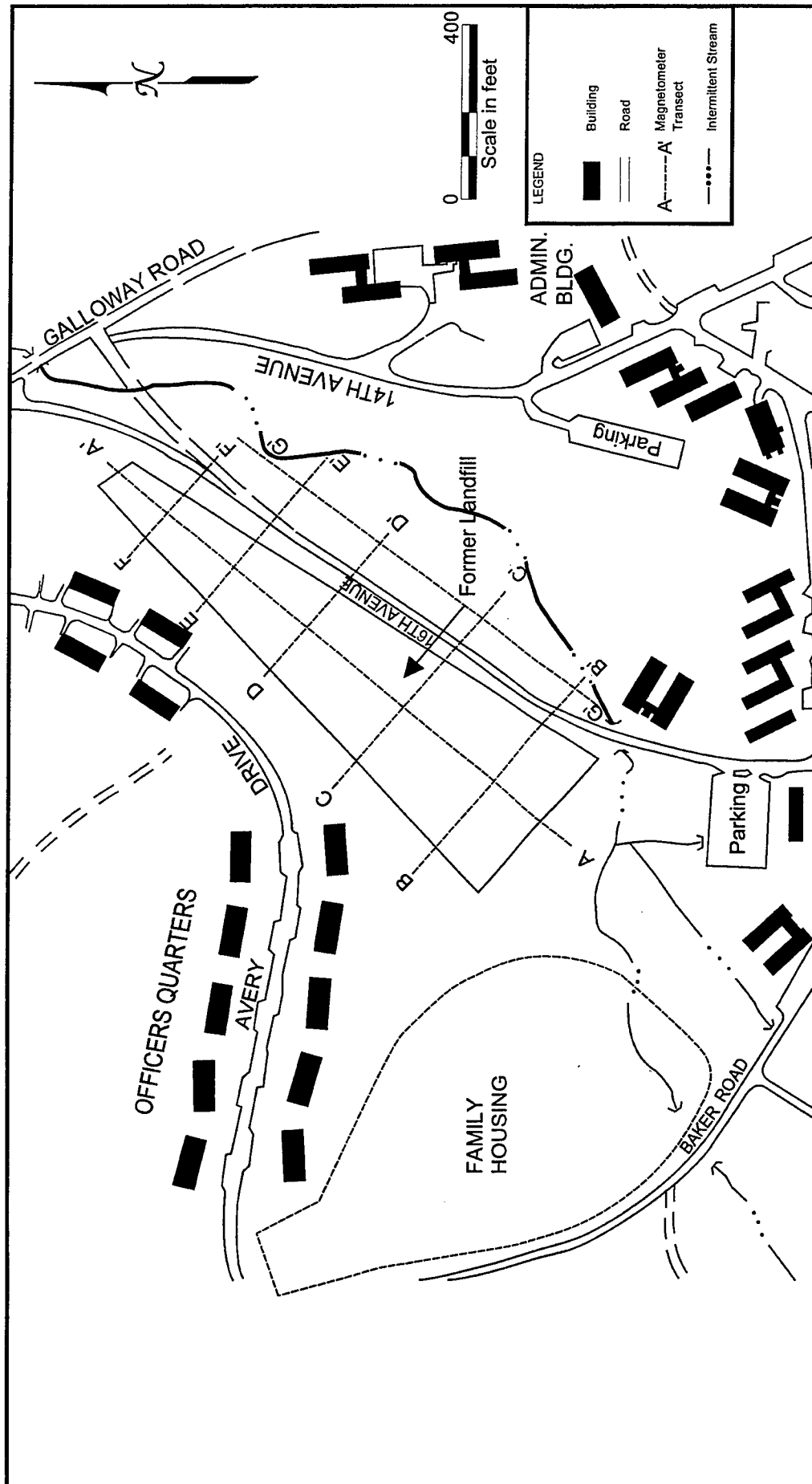
3.16 SITE 13 - FORMER LANDFILL #1

A sanitary landfill was reportedly operated at a 2-acre site located on the northwest side of 16th Avenue on the Main Post between Baker Road and Galloway Road. The landfill was operated between 1945 and 1947. Physical evidence of a landfiling operation was not readily visible on the ground surface during site visits in October 1991 and April 1992. The inferred site area was investigated by surface magnetometry (Figure 3-19).

3.16.1 Geophysical Survey Results - Former Landfill #1

Interpretations of magnetic data for Former Landfill #1 are summarized in Figure 3-20. Several small-scale magnetic anomalies are observed with surface expression of less than 100 feet. In general, the magnetic data do not vary significantly across the site from expected background values (52,131 nT average diurnal) except in a few isolated areas. The subsurface beneath some of these isolated areas appears to have been disturbed by man-made features.

Five distinct areas with magnetic anomalies are observed at the site (Anomalies 1 through 5). These areas are characterized by total-field and gradient magnetic anomalies, which indicate disturbed areas that may be associated with former landfill or dumping activities. Anomaly 1 exhibits total-field anomalies between 200 and 500 nT, and small-scale gradient magnetic anomalies of approximately 100 nT per meter (nT/m). Surface mapping in this area revealed a significant amount of scattered metal debris. Anomaly 2 exhibits a total-field anomaly of 400 nT. The dipolar nature (i.e., high-low character) of this anomaly indicates the presence of a ferromagnetic object, such as a buried pipe. Anomaly 3 exhibits a total-field anomaly of 200 nT. This anomaly is attributed in part to the presence of metal debris exposed at the surface. Anomaly 4 exhibits a small-scale total-field anomaly of 100 nT. Anomaly 5 exhibits gradient anomalies between 100 to 300 nT/m, with no significant total-field anomaly. This indicates the possible presence of buried utilities or cables in the area.



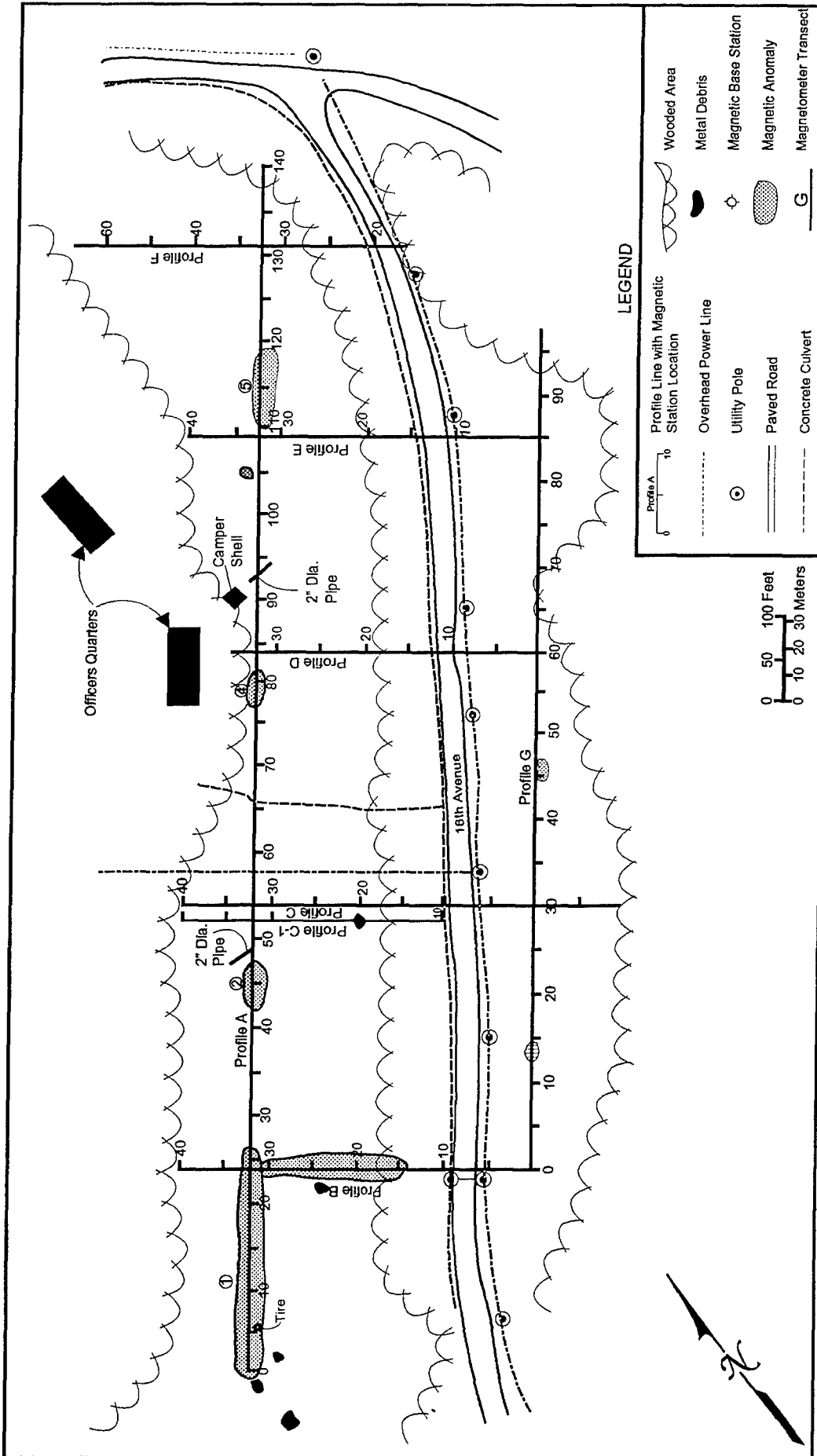
Prepared for:
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**FORMER LANDFILL 1 - MAIN POST
FORT MCCLELLAN, ALABAMA**

MAGNETOMETER TRANSECT LOCATIONS

Figure 3-19



**INTERPRETATION OF MAGNETIC DATA - LANDFILL 1
FORT MCCLELLAN, ALABAMA**

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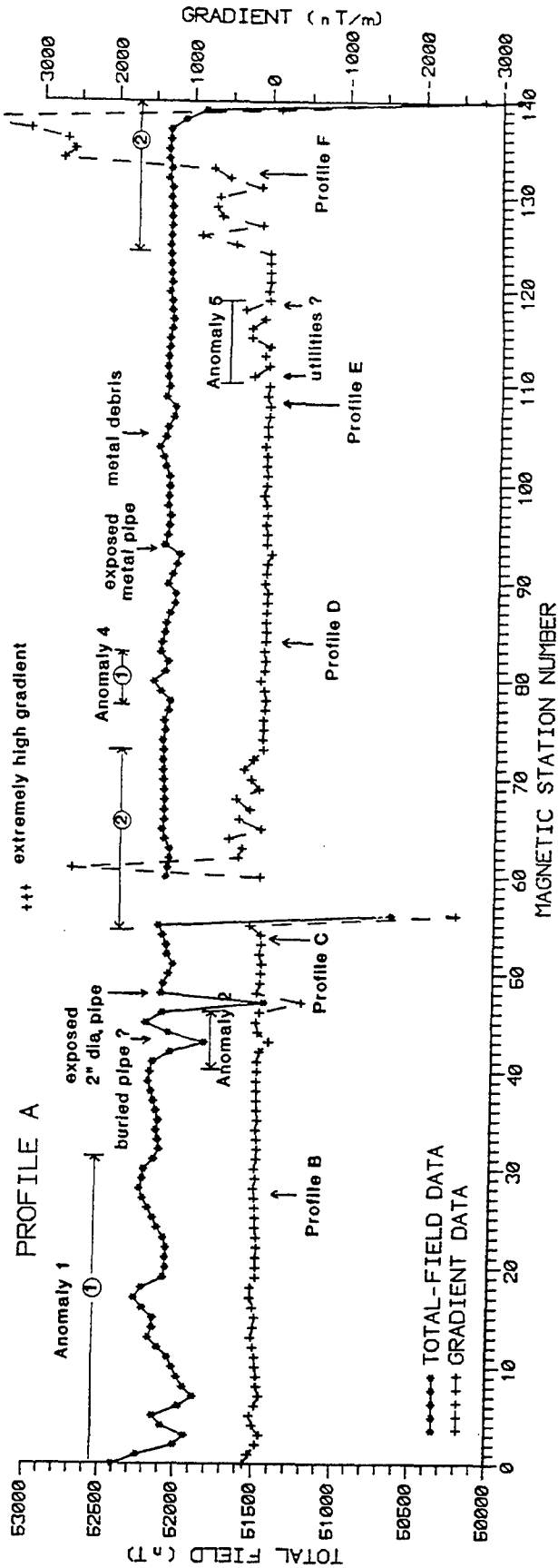
Figure 3-20

Profile A — Figure 3-21 depicts the magnetic data for Profile A. Portions of Profile A, between magnetic stations 0 to 32 and 77 to 83, are considered disturbed, possibly due to landfill activities. A total-field anomaly at station 43 may be related to a buried pipe (note that the anomaly at station 47 is due to an exposed 2-inch diameter metal pipe). Erratic and extremely high and low gradient magnetic readings are observed between stations 56 and 72, which are attributed to interference from a power line that crosses this profile at station 58. A small-scale total-field anomaly of 100 nT is observed at station 93 and is attributed to a 2-inch diameter metal pipe. Another small-scale total-field anomaly is present at station 106, which is attributed to metal debris exposed at the surface. Between stations 111 and 119, variations in gradient magnetic values with no observed change in total-field magnetic values indicate the presence of buried utilities or cables. Large magnitude (greater than 3,000 nT/m) gradient magnetic anomalies are observed between stations 124 and 140 and are attributed to interference from power lines in this area.

Profile B — Figure 3-22 depicts the magnetic data for Profile B. The beginning of this profile, stations 2 through 10, is disturbed due to interference from the power lines that intersect Profile B at station 5. Total-field magnetic anomalies on the order of 100 to 375 nT occur between stations 13 and 32, indicating the presence of ferromagnetic material. Exposed metal debris was observed at station 24.

Profile C — Figure 3-23 depicts the magnetic data for Profile C. Interference from the power line that crosses this profile at station 6 is observed in the magnetic values from stations 1 through 13. Past station 13, the majority of this profile appears undisturbed. Small-scale total-field magnetic anomalies occur between stations 15 through 42 and may be the result of interference from a power line that runs parallel to Profile C approximately 40 feet to the northeast.

Figure 3-24 depicts the magnetic data for Profile C-1. This profile was located approximately 20 feet to the southwest of Profile C in an attempt to reduce the effects of the power line parallel to these profiles. The magnetic data for Profile C-1 was collected on a 20-foot (6.1-meter) spacing. A total-field magnetic anomaly on the order of 300 nT occurs at



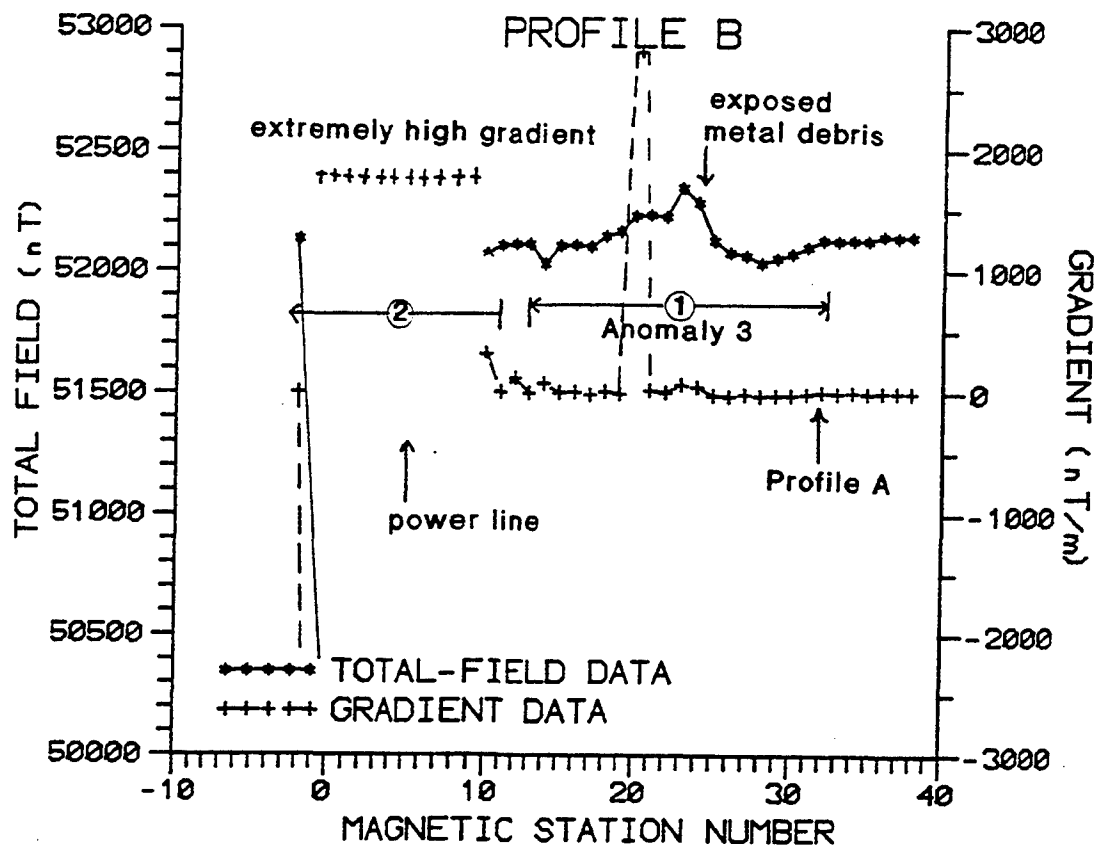
- ① disturbed area
- ② interference due to power line

LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE A

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Figure 3-21



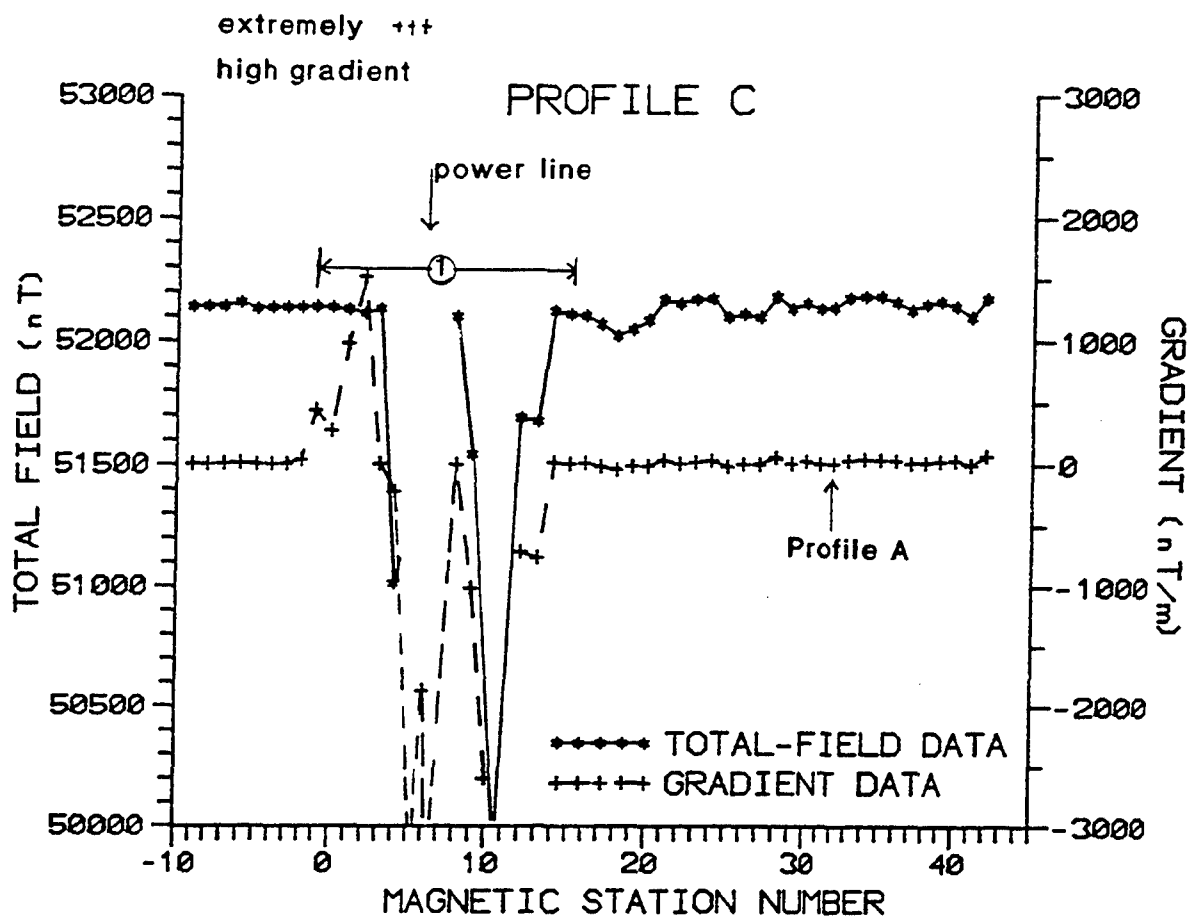
- ① disturbed area
- ② interference due to power line

LANDFILL 1
 FORT McCLELLAN, ALABAMA
 MAGNETOMETER DATA FOR PROFILE B

Prepared for:
 U.S. Army Environmental Center
 Aberdeen Proving Ground, Maryland



Figure 3-22



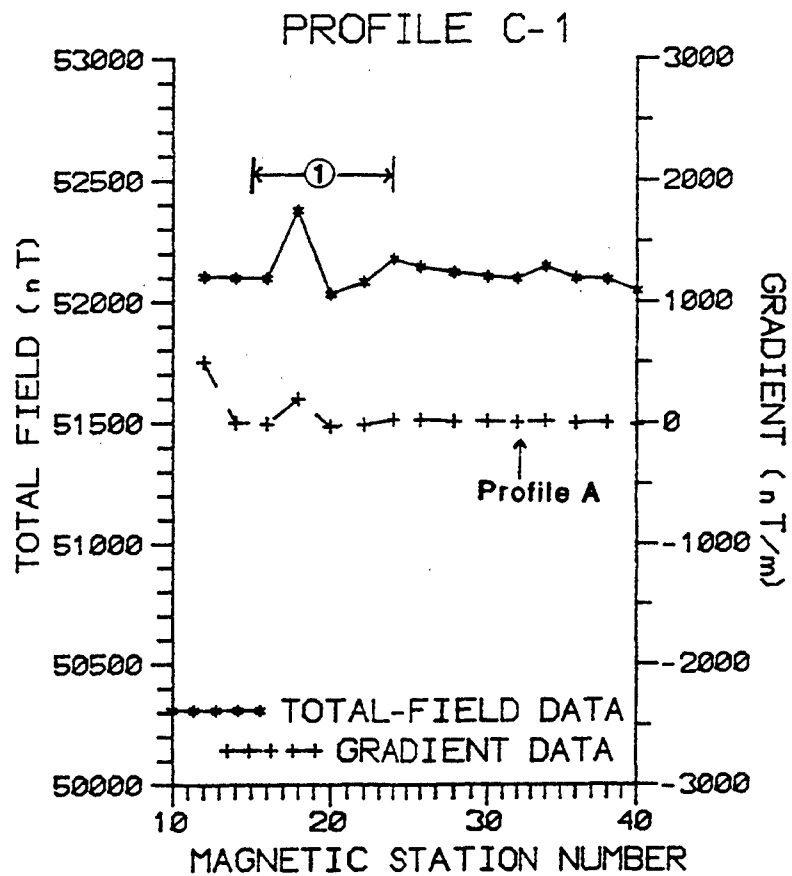
① interference due to power line

LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE C

Figure 3-23

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① disturbed area

LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE C-1

Figure 3-24

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Aberdeen Proving Ground, Maryland



station 18, which may indicate the presence of buried ferromagnetic debris. The remainder of this profile appears relatively undisturbed. The total-field magnetic readings appear more stable as compared to Profile C, indicating that the power line may have caused minor fluctuations in the readings for Profile C.

Profile D — Figure 3-25 depicts the magnetic data for Profile D. The beginning of this profile, stations 1 through 20, is disturbed due to the presence of the power line that crosses this profile at station 8. The small-scale total-field magnetic anomaly at stations 32 through 35 may be related to cultural effects associated with the nearby officers quarters.

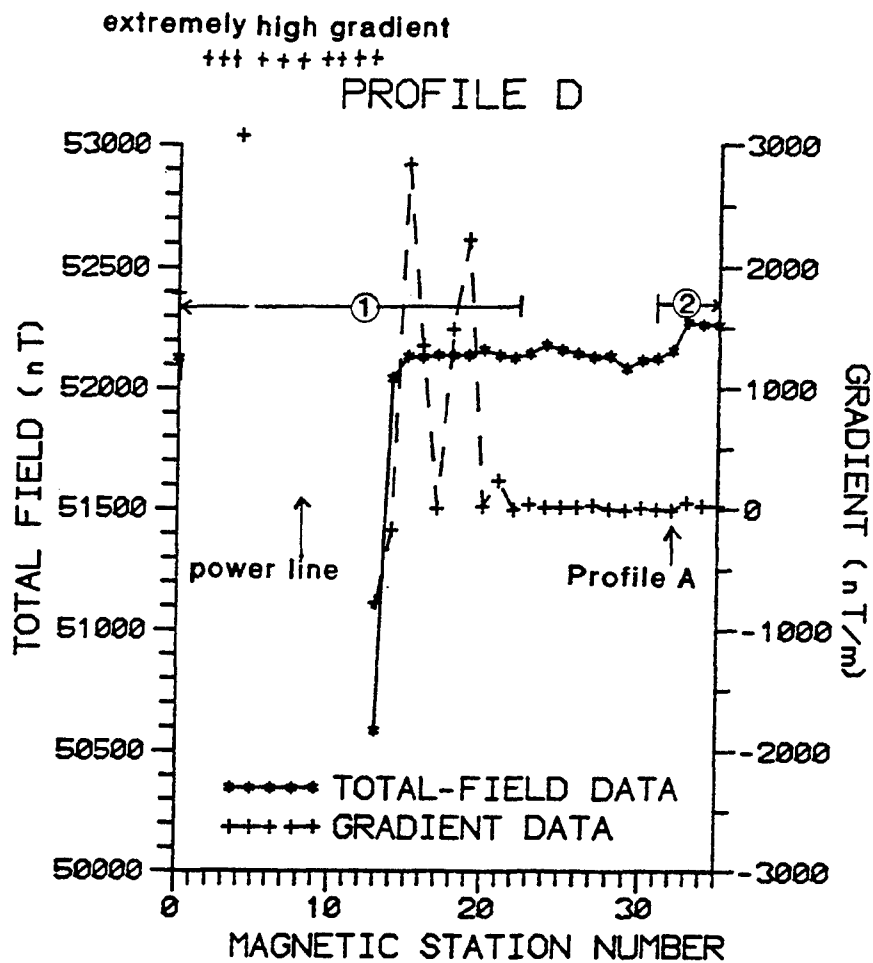
Profile E — Figure 3-26 depicts the magnetic data for Profile E. The beginning of this profile, stations 5 through 20, is disturbed due to the power line that crosses this profile at station 10. Past station 20, the profile appears relatively undisturbed.

Profile F — Figure 3-27 depicts the magnetic data for Profile F. The beginning of this profile, stations 16 through 32, is disturbed due to the power line located at station 16. Past station 26, the total-field profile appears undisturbed. A small-scale total-field anomaly occurs at station 47, which may indicate the presence of buried ferromagnetic debris.

Profile G — Figure 3-28 depicts the magnetic data for Profile G. The fluctuations in the gradient magnetic values are attributed to the power line located parallel to this profile and approximately 50 to 100 feet to the northwest. The majority of the total-field profile appears undisturbed. Two small-scale total-field magnetic anomalies occur at stations 12 to 19 and 43 to 48, indicating the presence of buried ferromagnetic debris in these areas.

3.16.2 Site Assessment - Former Landfill #1

Magnetometer data obtained along seven transects at Former Landfill #1 does not indicate large-scale landfilling over the surveyed area. The initial geophysical survey using magnetometry identified several anomalous areas indicative of buried metallic objects. In many instances these anomalies could be attributed to near surface phenomena associated with uncontrolled dumping as opposed to large-scale landfilling. More extensive magnetometer

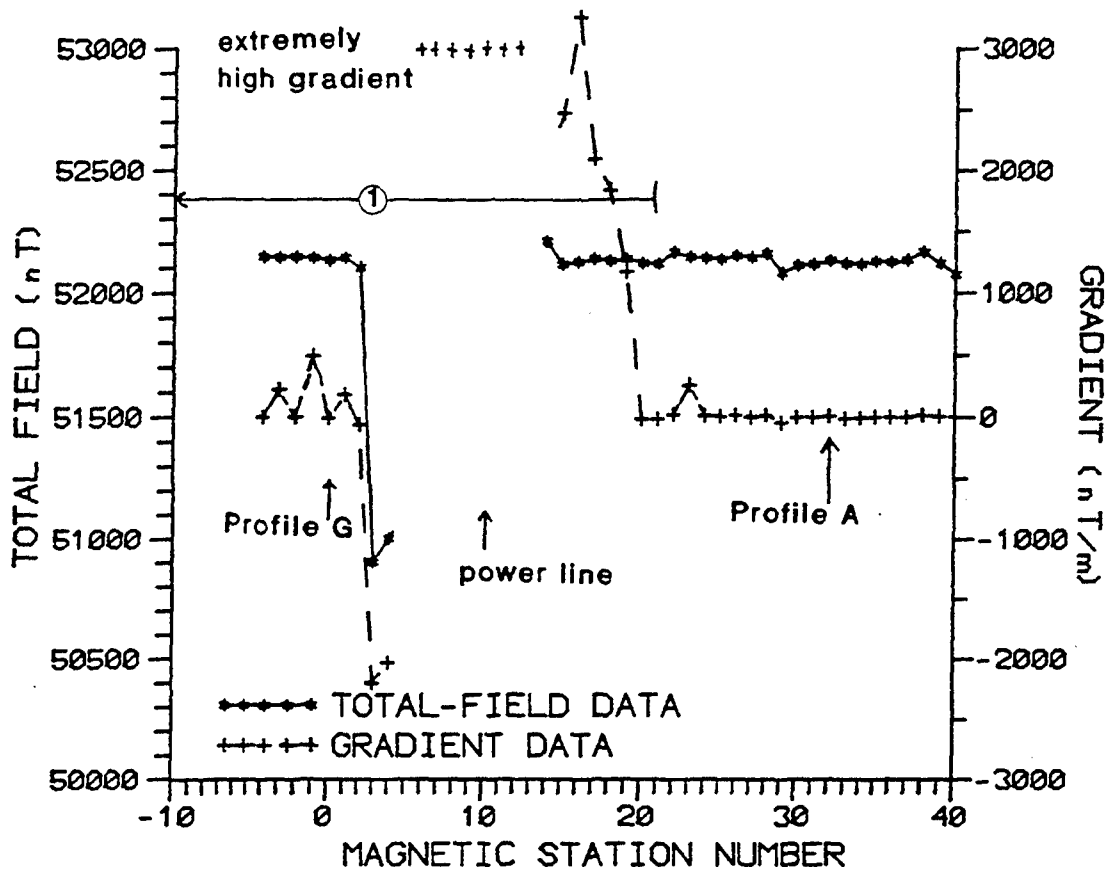


LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE D

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 3-25

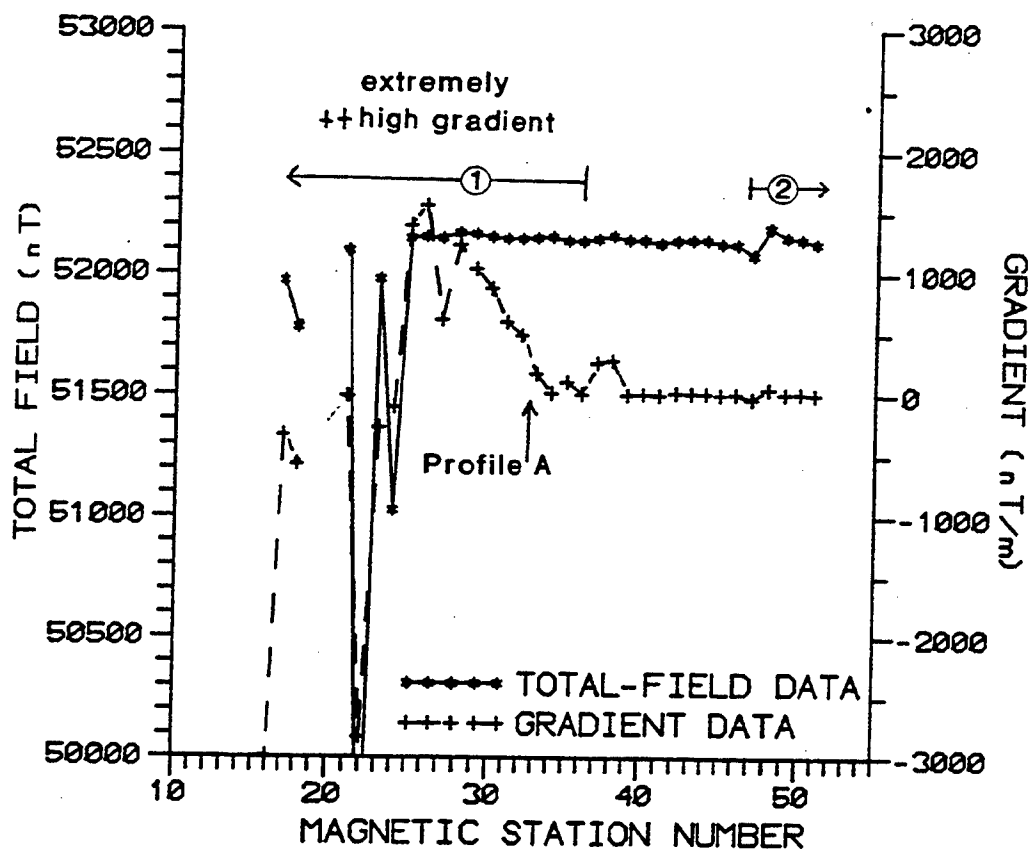


LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE E

Figure 3-26

Prepared for:
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Aberdeen Proving Ground, Maryland





① interference due to power line

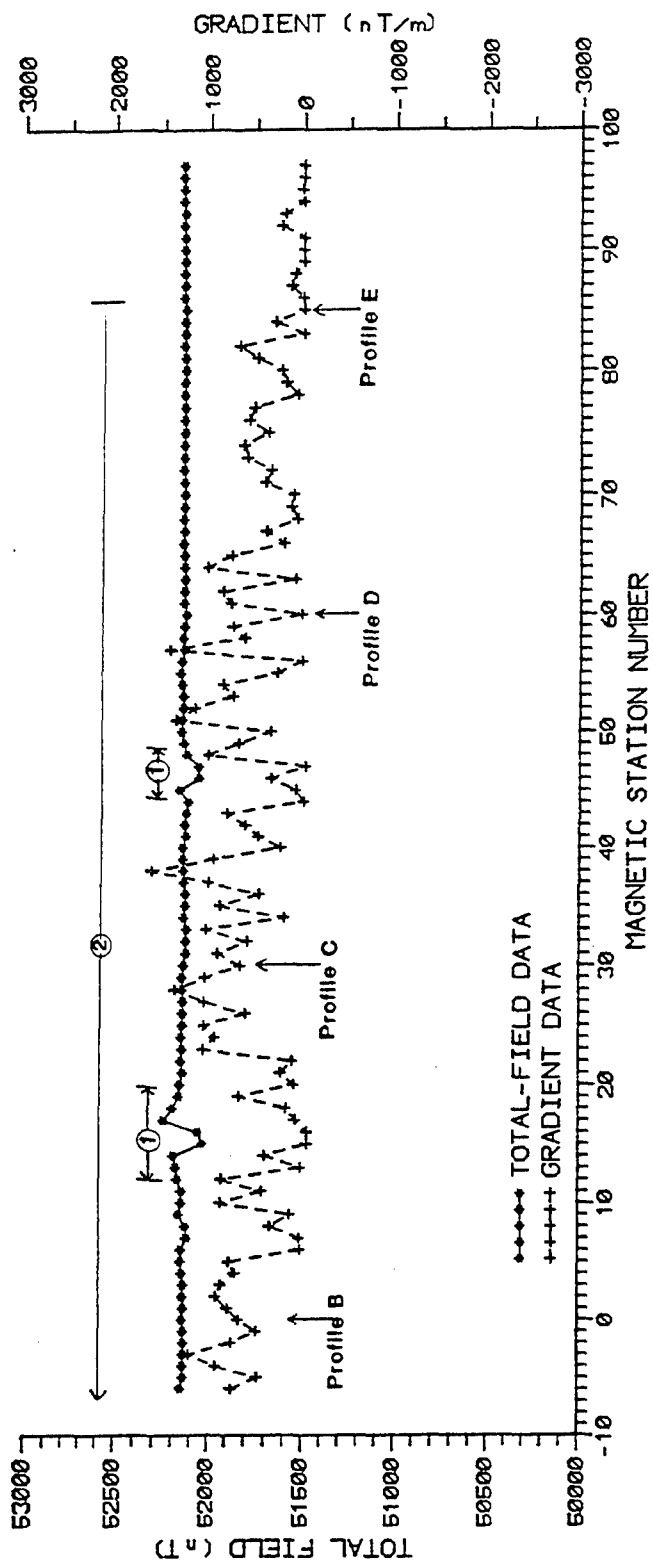
② disturbed area

LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE F

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 3-27



① disturbed area

② interference due to power line

LANDFILL 1
FORT McCLELLAN, ALABAMA
MAGNETOMETER DATA FOR PROFILE G

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Figure 3-28

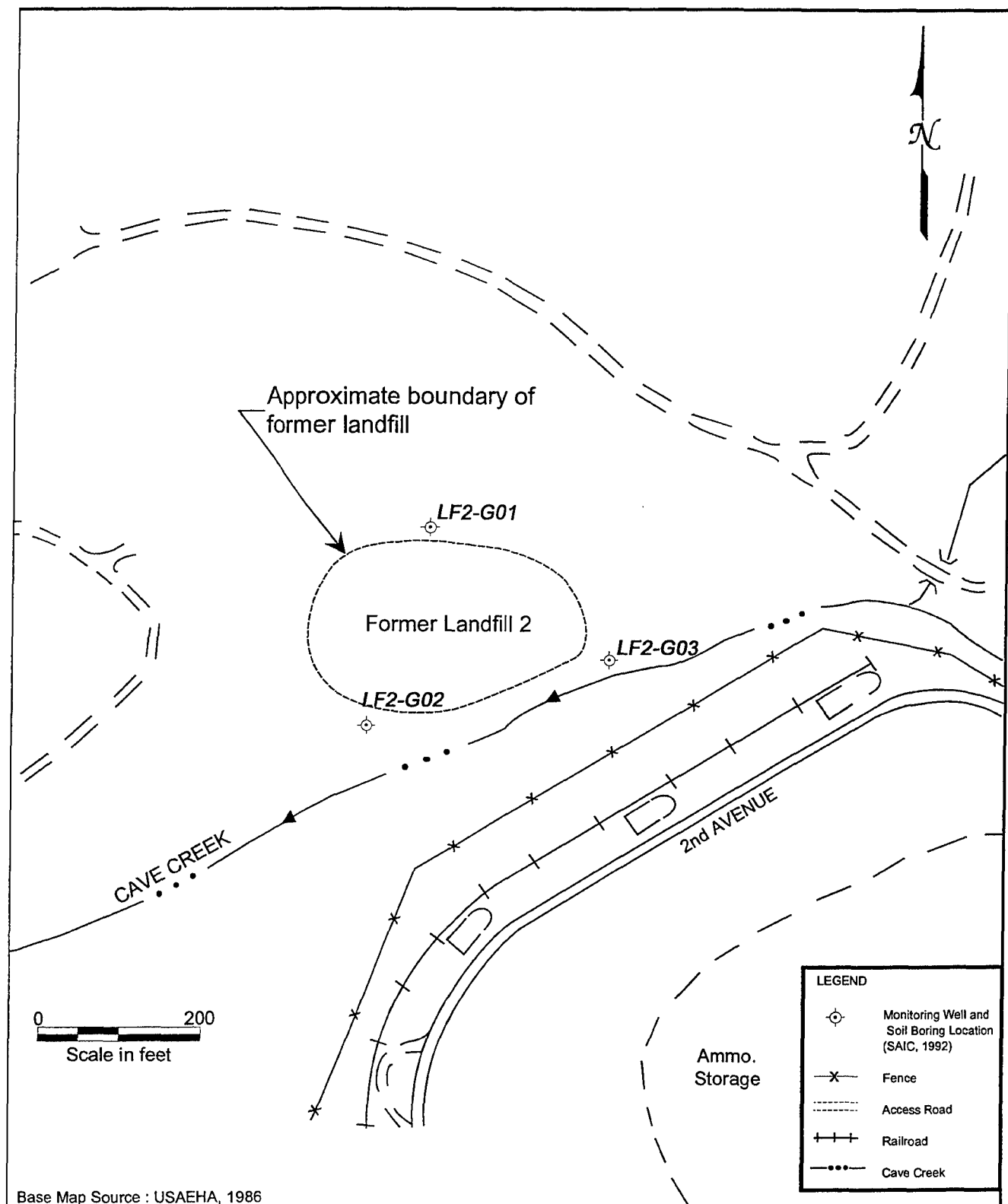
anomalies were observed in the southern portion of the investigated area and more surface debris was observed at the surface in this area. The entire site area should be resurveyed using electromagnetics, and the area of investigation should be expanded to the southwest along 16th Avenue, with more detailed geophysical surveys conducted over the larger scale anomalous areas in the southern portion of the site. Based on the additional geophysical data, groundwater monitoring wells may need to be established in this area.

3.17 SITE 14 - FORMER LANDFILL #2

Site 14 - Former Landfill #2 was the Post sanitary landfill after the closure of Former Landfill #1 and was active from 1947 to an unknown date. The landfill covers approximately 4 acres and is located west of the southern tip of Cemetery Hill, between 2nd Avenue and 10th Street (Figure 3-29). The landfill was used for the disposal of waste during deactivation of the installation. Rusty drums, metal, small containers, assorted building materials, and machinery parts were observed onsite during SI site visits. Considerable debris was unearthed at the landfill during access road construction during the SI.

3.17.1 Groundwater Sampling Results - Former Landfill #2

Groundwater samples were obtained from installed monitoring wells (LF2-1, 2, and 3) at Former Landfill #2. Laboratory analyses for VOCs, SVOCs, pesticides/PCBs, agent breakdown products, and explosives did not indicate the existence of pervasive groundwater contamination associated with the site. Detected organic compounds (Table 3-31) include acetone (100 $\mu\text{g/L}$) and nontarget compounds, including a tentative identification of isopropanol (6,000 $\mu\text{g/L}$). These compounds are attributed to decontamination protocols in the analytical laboratory and during the field sampling. Pesticide concentrations in the site wells were detected at levels comparable to observed concentrations in the field blanks. The detected pesticides included δ -BHC, isodrin, and lindane. The detected concentrations were below the maximum contaminant levels (MCLs) for those compounds with regulatory limits. Groundwater pH values ranged between 6.24 and 7.58 units and specific conductivity ranged between 681 and 910 μS . Detected inorganics concentrations are within the ranges of naturally occurring levels. Lead was detected at a concentration of 46.9 $\mu\text{g/L}$ in well LF2-3. A duplicate sample (LF2-G03D) was collected and only analyzed for agent breakdown products. Complete results are shown in



**FORMER LANDFILL 2 - MAIN POST
FORT McCLELLAN, ALABAMA**

GROUNDWATER SAMPLE LOCATIONS

Figure 3-29

Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland



Table 3-31. Data Summary: Groundwater - Former Landfill #2, Ft. McClellan, Anniston, Alabama

SAIC ID Number	LF2-G01	LF2-G02	LF2-G03
Depth BLS	(17.89)	(3.93)	(4.70)
Collection Date	6/11/92	6/11/92	6/11/92
Associated Field QC Sample	TB-0016	TB-0016	TB-0016
Parameter	FMP003	FMP003	FMP003
	RB-009	RB-009	RB-009
Units	CRL	UCR	
Method SS12 (ICP Metals in Water)			
Aluminum	µg/L	112	125,000
Barium	µg/L	2.82	12,000
Boron	µg/L	230	10,000
Calcium	µg/L	105	200,000
Iron	µg/L	77.5	500,000
Magnesium	µg/L	135	250,000
Manganese	µg/L	9.67	10,000
Potassium	µg/L	1240	250,000
Sodium	µg/L	279	50,000
Zinc	µg/L	18.0	10,000
Lead	µg/L	43.4	10,000
Method UM21 (VOCs in Water)			
Acetone	µg/L	8	100
Unknown	µg/L	--	--
Method UH20 (Organochlorine Pesticides in Water)			
delta-BHC	µg/L	0.0034	0.500
Isodrin	µg/L	0.0025	0.500
Lindane	µg/L	0.0025	0.500

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

C - analysis is confirmed

GT - greater than the upper certified range

LT - less than the certified reporting limit

U - analysis is unconfirmed

Unknown - The following tentatively identified compounds were identified for sample:

LF2-G01 - UNK036 1000 S µg/L

LF2-G02 - UNK037 6000 S µg/L

LF2-G03 - UNK035 400 S µg/L

Appendix E. Chemical agent breakdown compounds, SVOCs, and explosives-related compounds were not detected in the groundwater at Former Landfill #2.

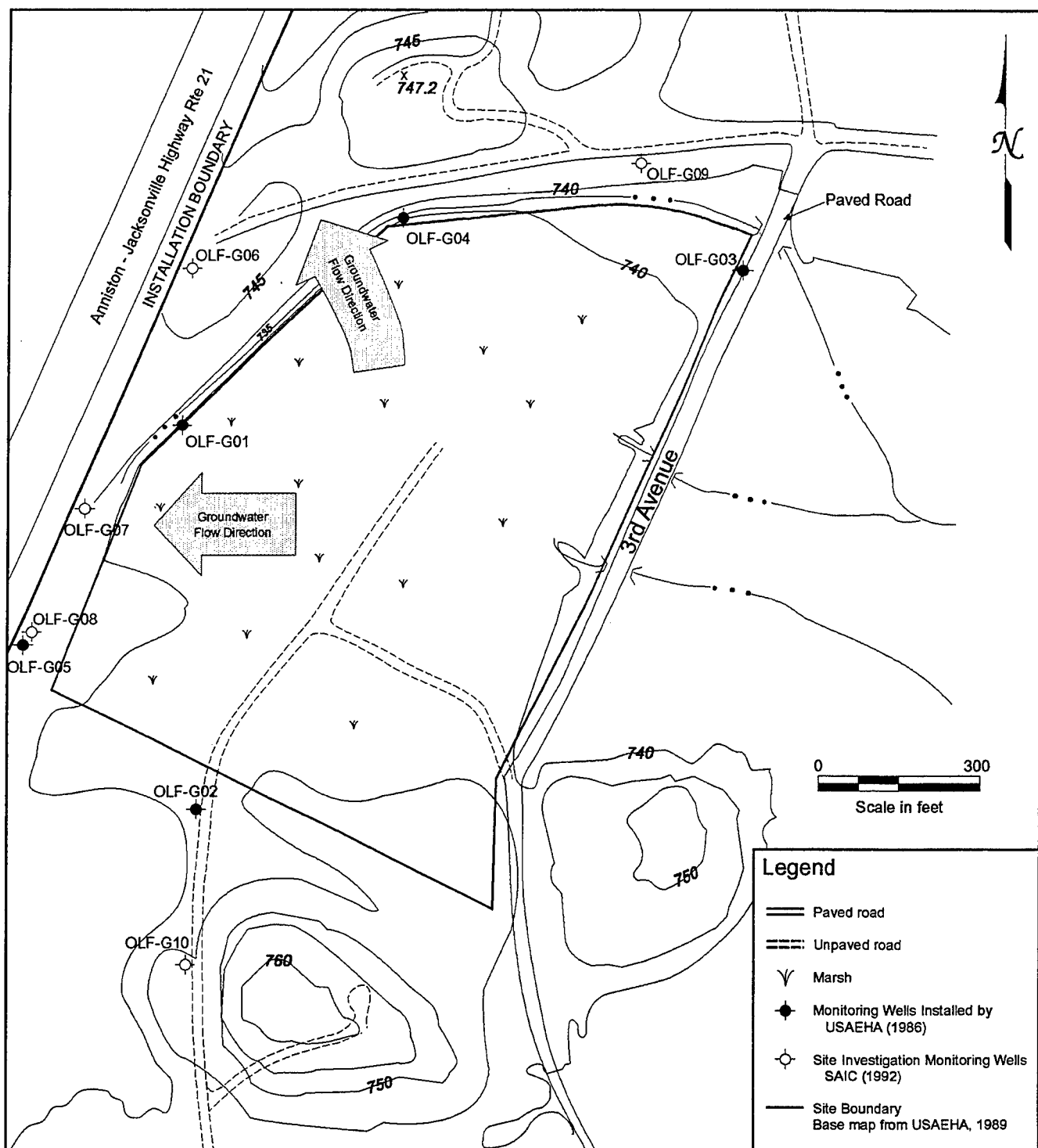
3.17.2 Site Assessment - Former Landfill #2

Based on the results of groundwater sampling at Former Landfill #2, pervasive environmental contamination was not detected in groundwater at this site. Installed monitoring wells were located in the field with one well upgradient and two wells located downgradient of the landfill site as expressed by site topography. Landfill wastes were encountered by well LF2-3 because debris was redistributed to this location during construction of an access road across the top of the landfill to the well site.

The western and southern boundaries of the site are distinctive based on topographic expression and are generally confirmed by the locations of wells LF2-2 and LF2-3. Well LF2-1 did not encounter waste materials and may define a northern boundary to the landfill; however, the topographic expression of the landfill in this area is not evident. In addition, a second confirmatory round of groundwater samples should be obtained from the site and analyzed for the same parameters investigated during the initial sampling. A surface water and sediment sample should be collected downstream from Former Landfill #2 to assess the water quality in Cane Creek. Potential soil contamination at the landfill has not been assessed and will require shallow soil borings, sampling, and analysis.

3.18 SITE 15 - FORMER LANDFILL #3

Site 15 - Former Landfill #3 was the Post sanitary landfill between 1946 and 1967. The landfill was operated using the trench and fill method with trenches trending northwest to southeast. The landfill covers approximately 22 wooded acres and is located in a marshy area east of State Route 21 and north of Cane Creek. VOCs, including tetrachloroethene, methylene chloride, 1,1-dichloroethene, trans-1,2-dichloroethene, benzene, and bis(2-ethylhexyl) phthalate have been previously detected in wells from Former Landfill #3 in concentrations ranging from 4 to 110 $\mu\text{g/L}$ (USATHAMA 1990). The landfill site (Figure 3-30) was investigated by installing and sampling five groundwater monitoring wells (OLF-6 to OLF-10) and sampling five



**FORMER LANDFILL 3
FORT McCLELLAN, ALABAMA**

SI SAMPLE LOCATIONS

Figure 3-30

Prepared for:
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Aberdeen Proving Ground, Maryland



existing monitoring wells (OLF-1 to OLF-5). Surface water and sediment samples were collected from Cane Creek where it leaves the Post southwest of Former Landfill #3.

3.18.1 Groundwater Sampling Results - Former Landfill #3

Groundwater samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, explosives, and chemical agent (HD, GB, VX) breakdown products. The laboratory results for detected compounds are shown in Table 3-32. Organic compounds detected in the wells included trichloroethylene, 1,1-dichloroethene, 1,1,2,2-trichloroethane, benzene, methyl isobutyl ketone, bis-2-ethylhexyl phthalate, tetrachloroethene, and a variety of pesticides. Organic compounds exceeding established EPA (November 1991) MCLs include 1,1-dichloroethane (OLF-G04) and TCE (OLF-G07). Detected pesticides include α -BHC, δ -BHC, isodrin, lindane, DDD, DDE, DDT, α -Endosulfan, β -Endosulfan, aldrin, dieldrin, endrin, heptachlor, and heptachlor epoxide. The detected concentrations were below the MCLs for those compounds with regulatory limits. Evaluation of the unregulated compounds would require a risk assessment. The explosives-related compounds 1,3,5-trinitrobenzene ($1.7 \mu\text{g/L}$) and 2,4-dinitrotoluene ($.773 \mu\text{g/L}$) were detected in well OLF-10 at Former Landfill #3. Chemical agent breakdown products were not detected in the groundwater samples collected at Former Landfill #3.

Metals concentrations in excess of MCLs were detected at wells OLF-2 (total chromium, nickel, lead, beryllium, and thallium) and OLF-G03 (beryllium). Mercury concentrations were detected at wells OLF-1, OLF-2, OLF-3, OLF-4, and OLF-8; however, the levels are below the $2 \mu\text{g/L}$ MCL for mercury. In addition, the method detection limits for beryllium, cadmium, lead, and thallium all exceed the MCLs or action levels for these compounds in drinking water. Aluminum concentrations range from 318 to $240,000 \mu\text{g/L}$ with the highest values occurring at wells OLF-2 ($240,000$), OLF-3 ($18,300 \mu\text{g/L}$), and OLF-10 ($23,600 \mu\text{g/L}$). MCLs are not available for naturally occurring metals, such as calcium, sodium, potassium, manganese, magnesium, and iron. Groundwater pH values ranged between 5.88 and 6.65 units and specific conductivity ranged between 398 and $1,940 \mu\text{S}$.

Table 3-32. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama

SAIC ID Number	OLF-G01			OLF-G02			OLF-G03			OLF-G03D		
Depth BLS	(15.10)			(12.20)			(11.70)			(11.70)		
Collection Date	6/09/92			6/10/92			6/10/92			6/10/92		
Associated Field QC Sample	TB-0013,14			TB-0015			TB-0015			TB-0015		
Parameter	Units	CRL	UCR	FMP003			FMP003			FMP003		
				RB-008			RB-009			RB-009		
Method AX8 (As in Water)												
Arsenic	µg/L	2.35	121	2.35 LT			2.35 LT			7.87 D		
Method CC8 (Hg in Water)												
Mercury	µg/L	0.100	2.00	0.309			1.02			1.14 D		
Method SS12 (ICP Metals in Water)												
Aluminum	µg/L	112	125,000	7040			240000			7320 D		
Barium	µg/L	2.82	12,000	42.1			775			172 D		
Calcium	µg/L	105	200,000	916			250000			19100 D		
Chromium	µg/L	16.8	1,000	16.8 LT			271			16.8 LT D		
Cobalt	µg/L	25.0	10,000	25 LT			120			25 LT D		
Copper	µg/L	18.8	10,000	18.8 LT			252			88.5 D		
Iron	µg/L	77.5	500,000	5320			271000			17400 D		
Magnesium	µg/L	135	250,000	2700			280000			12700 D		
Manganese	µg/L	9.67	10,000	210			3820			686 D		
Nickel	µg/L	32.1	20,000	32.1 LT			239			47.8 D		
Silver	µg/L	10.0	2,000	10 LT			10 LT			10 LT D		
Vanadium	µg/L	27.6	10,000	27.6 LT			390			27.6 LT D		
Zinc	µg/L	18.0	10,000	27.6			576			91.8 D		
Lead	µg/L	43.4	10,000	43.4 LT			1470			43.4 LT D		
Method UM21 (VOCs in Water)												
1,1-Dichloroethane	µg/L	1	150	1 LT			1 LT			1 LT D		
Benzene	µg/L	1	150	1 LT			1 LT			1 LT D		
Methylisobutylketone	µg/L	1.4	100	1.4 LT			1.4 LT			1.4 LT D		
1,1,2,2-Tetrachloroethane	µg/L	1.5	150	1.5 LT			1.5 LT			1.5 LT D		
Tetrachloroethene	µg/L	1	150	1 LT			1 LT			1.7 D		
Trichloroethene	µg/L	1	150	1 LT			1 LT			1 LT D		
Unknown	µg/L	--	--	0(0)			100(1)			0(0) 20(1)		

Table 3-32. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	OLF-G01	OLF-G02	OLF-G03	OLF-G03D
Depth BLS	(15.10)	(12.20)	(11.70)	(11.70)
Collection Date	6/09/92	6/10/92	6/10/92	6/10/92
Associated Field QC Sample	TB-0013,14	TB-0015	TB-0015	TB-0015
Parameter	FMP003 RB-008	FMP003 RB-009	FMP003 RB-009	FMP003 RB-009
Units	CRL	UCR		
Method UM25 (SVOCs in Water)				
bis(2-Ethylhexyl)phthalate	7.7	200		
Unknown	μg/L	--		
Method UW25 (Explosives in Water)				
1,3,5-Trinitrobenzene	0.210	20		
2,4-Dinitrotoluene	0.397	20		
Method UIH20 (Organochlorine Pesticides in Water)				
alpha-Hexachlorocyclohexane	0.0025	0.500		
Endosulfan I	0.0025	0.500		
Aldrin	0.0074	0.500		
Endosulfan II	0.0077	0.500		
delta-BHC	0.0034	0.500		
Dieldrin	0.0074	0.500		
Endrin	0.0176	0.500		
Heptachlor	0.0025	0.250		
Heptachlor epoxide	0.0063	0.184		
Isodrin	0.0025	0.500		
Lindane	0.0025	0.500		
p,p'-DDD	0.0081	0.572		
p,p'-DDE	0.0039	0.537		
p,p'-DDT	0.0025	0.250		
--	The certification of these analytes will be submitted at a later date			
CRL	Certified Reporting Limit			
UCR	Upper Certified Range			
C	analysis is confirmed			
D	duplicate sample			
G	reported results are affected by interferences or high background			
LT	less than the certified reporting limit			
U	analysis is unconfirmed			
Unknown	The following tentatively identified compounds were identified for sample:			
	OLF-G02 -- UNK037 100 S μg/L			
	OLF-G03D -- UNK147 20 S μg/L			

Table 3-32. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

Table 2. Data Summary: Groundwater									
SAIC ID Number	OLF-G04			OLF-G05			OLF-G06		
Depth BLS	(39.40)			(30.70)			(64.40)		
Collection Date	6/10/92			6/07/92			6/09/92		
Associated Field QC Sample	TB-0015			TB-0010			TB-0013,14		
Parameter	Units	CRL	UCR	FMP003			FMP003		
				RB-009			RB-008		
Method AX8 (As in Water)									
Arsenic	µg/L	2.35	121	2.35 LT			2.35 LT		
Method CC8 (Hg in Water)									
Mercury	µg/L	0.100	2.00	1.49 D			0.1 LT D		
Method SS12 (ICP Metals in Water)									
Aluminum	µg/L	112	125,000	1570			2310		
Barium	µg/L	2.82	12,000	84.8			1730		
Calcium	µg/L	105	200,000	1000			12.9		
Chromium	µg/L	16.8	1,000	16.8 LT			614		
Cobalt	µg/L	25.0	10,000	25 LT			16.8 LT		
Copper	µg/L	18.8	10,000	18.8 LT			25 LT		
Iron	µg/L	77.5	500,000	1620			18.8 LT		
Magnesium	µg/L	135	250,000	6420			1940		
Manganese	µg/L	9.67	10,000	354			499		
Nickel	µg/L	32.1	20,000	32.1 LT			39.5		
Silver	µg/L	10.0	2,000	10 LT			32.1 LT		
Vanadium	µg/L	27.6	10,000	27.6 LT			10 LT		
Zinc	µg/L	18.0	10,000	18 LT			27.6 LT		
Lead	µg/L	43.4	10,000	43.4 LT			18 LT		
Method UM21 (VOCs in Water)									
1,1-Dichloroethane	µg/L	1	150	9.6			43.4 LT		
Benzene	µg/L	1	150	1.9			1 LT		
Methylisobutylketone	µg/L	1.4	100	1.4 LT			1 LT		
1,1,2,2-Tetrachloroethane	µg/L	1.5	150	1.5 LT			1.4 LT		
Tetrachloroethene	µg/L	1	150	1 LT			1.5 LT		
Trichloroethene	µg/L	1	150	1 LT			1 LT		
Unknown	µg/L	--	--	300 (1)			1 LT		
				0 (0)			0 (0)		

Table 3-32. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	Depth BLS	Collection Date	Associated Field QC Sample	Parameter	Units	CRL	UCR	OLF-G04 (39.40) 6/10/92 TB-0015 FMP003 RB-009	OLF-G05 (30.70) 6/07/92 TB-0010 FMP003 RB-008	OLF-G06 (64.40) 6/09/92 TB-0013,14 FMP003 RB-008	OLF-G07 (41.30) 6/07/92 TB-0010 FMP003 RB-008
Method UM25 (SVOCs in Water) (Continued)											
bis(2-Ethylhexyl)phthalate	µg/L	7.7	200					7.7 LT	17	7.7 LT	17
Unknown	µg/L	--	--					20 (1)	0 (0)	0 (0)	0 (0)
Method UW25 (Explosives in Water)											
1,3,5-Trinitrobenzene	µg/L	0.210	20					0.249 LT	0.21 LT	0.21 LT	0.804 LT
2,4-Dinitrotoluene	µg/L	0.397	20					0.397 LT	0.397 LT	0.397 LT	0.397 LT
Method UH20 (Organochlorine Pesticides in Water)											
alpha-Hexachlorocyclohexane	µg/L	0.0025	0.500					0.222	0.0025 LT	0.0026	0.0025 LT
Endosulfan I	µg/L	0.0025	0.500					0.0177	0.0025 LT	0.0025 LT	0.0025 LT
Aldrin	µg/L	0.0074	0.500					0.0074 LT	0.0074 LT	0.0074 LT	0.0074 LT
Endosulfan II	µg/L	0.0077	0.500					0.0195	0.0077 LT	0.0077 LT	0.0077 LT
delta-BHC	µg/L	0.0034	0.500					0.0034 LT	0.0034 LT	0.0034 LT	0.0034 LT
Dieldrin	µg/L	0.0074	0.500					0.0074 LT	0.0074 LT	0.0074 LT	0.0074 LT
Endrin	µg/L	0.0176	0.500					0.169	0.0176 LT	0.0176 LT	0.0176 LT
Heptachlor	µg/L	0.0025	0.250					0.126	0.0025 LT	0.0025 LT	0.0025 LT
Heptachlor epoxide	µg/L	0.0063	0.184					0.0253	0.0063 LT	0.0063 LT	0.0063 LT
Isodrin	µg/L	0.0025	0.500					0.00785	0.0131	0.0184	0.00611
Lindane	µg/L	0.0025	0.500					0.0025 LT	0.0025 LT	0.0025 LT	0.0025 LT
p,p'-DDD	µg/L	0.0081	0.572					0.0307	0.0081 LT	0.0081 LT	0.0081 LT
p,p'-DDE	µg/L	0.0039	0.537					0.0752	0.00489	0.0039 LT	0.0039 LT
p,p'-DDT	µg/L	0.0025	0.250					0.00309	0.0025 LT	0.0025 LT	0.00392

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

C - analysis is confirmed

D - duplicate sample

G - reported results are affected by interferences or high background

LT - less than the certified reporting limit

U - analysis is unconfirmed

Unknown - The following tentatively identified compounds were identified for sample:

OLF-G04 - UNK037 300 S µg/L, UNK588 20 S µg/L

OLF-G05 - UNK037 300 S µg/L

Table 3-32. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	OLF-G07D (41.30) 6/07/92			OLF-G08 (29.34) 6/07/92			OLF-G09 (20.10) 6/08/92			OLF-G10 (16.42) 6/11/92		
Depth BLS												
Collection Date												
Associated Field QC Sample												
Parameter	Units	CRL	UCR	TB-0010 FMP003 RB-008			TB-0010 FMP003 RB-008			TB-0015 FMP003 RB-009		
Method AX8 (As in Water)												
Arsenic	µg/L	2.35	121	2.35 LT	D	2.35 LT	2.35 LT		2.35 LT		2.35 LT	
Method CC8 (Hg in Water)												
Mercury	µg/L	0.100	2.00	0.1 LT	D	0.191	0.1 LT		0.1 LT		0.1 LT	
Method SS12 (ICP Metals in Water)												
Aluminum	µg/L	112	125,000	1430	D	566	318			23600		
Barium	µg/L	2.82	12,000	55.1	D	25.7	9.8			122		
Calcium	µg/L	105	200,000	9740	D	8080	564			4950		
Chromium	µg/L	16.8	1,000	16.8 LT	D	16.8 LT	16.8 LT			16.8 LT		
Cobalt	µg/L	25.0	10,000	25 LT	D	25 LT	25 LT			25 LT		
Copper	µg/L	18.8	10,000	18.8 LT	D	18.8 LT	18.8 LT			18.8 LT		
Iron	µg/L	77.5	500,000	919	D	1390	849			18300		
Magnesium	µg/L	135	250,000	4980	D	4440	823			8260		
Manganese	µg/L	9.67	10,000	305	D	53.7	12.3			354		
Nickel	µg/L	32.1	20,000	32.1	D	32.1 LT	32.1 LT			32.1 LT		
Silver	µg/L	10.0	2,000	10 LT	D	10 LT	10 LT			10 LT		
Vanadium	µg/L	27.6	10,000	27.6 LT	D	27.6 LT	27.6 LT			27.6 LT		
Zinc	µg/L	18.0	10,000	32	D	35.5	19.6			93.5		
Lead	µg/L	43.4	10,000	43.4 LT	D	43.4 LT	43.4 LT			43.4 LT		
Method UM21 (VOCs in Water)												
1,1-Dichloroethane	µg/L	1	150	1 LT	D	1 LT	1 LT			1 LT		
Benzene	µg/L	1	150	1 LT	D	1 LT	1 LT			1 LT		
Methylisobutylketone	µg/L	1.4	100	1.4 LT	D	1.4 LT	1.4 LT			1.4 LT		
1,1,2,2-Tetrachloroethane	µg/L	1.5	150	22.1	D	1.5 LT	1.5 LT			1.5 LT		
Tetrachloroethene	µg/L	1	150	1 LT	D	1 LT	1 LT			1 LT		
Trichloroethene	µg/L	1	150	6.3	D	1 LT	1 LT			1 LT		
Unknown	µg/L	--	--	0 (0)	D	0 (0)	30 (1)			50 (1)		

Table 3-32. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	OLF-G07D (41.30)	OLF-G08 (29.34)	OLF-G09 (20.10)	OLF-G10 (16.42)
Depth BLS	6/07/92	6/07/92	6/08/92	6/11/92
Collection Date	TB-0010	TB-0010	TB-0010	TB-0015
Associated Field QC Sample	FMP003	FMP003	FMP003	FMP003
Parameter	RB-008	RB-008	RB-008	RB-009
Units	CRL	UCR		
Method UM25 (SVOCs in Water) (Continued)				
bis(2-Ethylhexyl)phthalate	7.7	200		
Unknown	μg/L	μg/L		
	--	--		
Method UW25 (Explosives in Water)				
1,3,5-Trinitrobenzene	0.210	20		
2,4-Dinitrotoluene	0.397	20		
	μg/L	μg/L		
	--	--		
Method UH20 (Organochlorine Pesticides in Water)				
alpha-Hexachlorocyclohexane	0.0025	0.500		
Endosulfan I	0.0025	0.500		
Aldrin	0.0074	0.500		
Endosulfan II	0.0077	0.500		
delta-BHC	0.0034	0.500		
Dieldrin	0.0074	0.500		
Endrin	0.0176	0.500		
Heptachlor	0.0025	0.250		
Heptachlor epoxide	0.0063	0.184		
Isodrin	0.0025	0.500		
Lindane	0.0025	0.500		
p,p'-DDD	0.0081	0.572		
p,p'-DDE	0.0039	0.537		
p,p'-DDT	0.0025	0.250		
	μg/L	μg/L		
-- The certification of these analytes will be submitted at a later date				
CRL - Certified Reporting Limit				
UCR - Upper Certified Range				
C - analysis is confirmed				
D - duplicate sample				
G - reported results are affected by interferences or high background				
LT - less than the certified reporting limit				
U - analysis is unconfirmed				
Unknown - The following tentatively identified compounds were identified for sample:				
OLF-G09 - UNK038 30 S μg/L				
OLF-G010 - UNK036 50 S μg/L				

3.18.2 Surface Water/Sediment Sampling Results - Former Landfill #3

Surface water and sediment samples were collected from Cane Creek where the stream leaves Fort McClellan southwest of Former Landfill #3. The samples were analyzed in the laboratory for VOCs, SVOCs, metals, pesticides/PCBs, chemical agent breakdown products, and explosives. The analyses (Tables 3-33 and 3-34) did not indicate the presence of environmental contamination in the samples, with the exception of α -BHC (.00498 $\mu\text{g/L}$) and isodrin (.0163 $\mu\text{g/L}$) pesticide concentrations in the surface water sample (OLF-S01). These compounds were identified in comparable concentrations in the field blank samples.

3.18.3 Site Assessment - Former Landfill #3

Groundwater sampling at Former Landfill #3 indicates the presence of VOCs, SVOCs, pesticides, metals, and explosive compounds. The site formerly was used as a municipal landfill. A comprehensive listing of specific wastes disposed of in the landfill is not available. In addition, the trench boundaries are imprecisely known and the vertical extent of the landfill trenches is unknown. The source(s) for the large variety of pesticides identified in the groundwater is similarly unknown. USATHAMA (1977) indicated that surplus pesticides were expended into treatment areas and empty pesticide containers were triple rinsed and disposed of in a sanitary landfill. Burial of solid wastes in trenches containing standing water also was reported and resulted in the construction of the drainage ditches around the landfill to divert the surface runoff (USATHAMA 1977). Explosive compounds detected in groundwater are likely to have originated from burned ammunition crates or pallets on which ammunition was stored. Munitions disposal was routinely documented at a site of burial.

Based on the results of previous sampling and the SI sampling, Former Landfill #3 was selected for HRS scoring as the most contaminated SI site. The detection of chemical constituents in the site groundwater, including VOCs, SVOCs, pesticides, metals, and explosive-related compounds, indicates that uncontrolled leakage from the site is occurring. The extent of the aquifer contamination resulting from the uncontrolled leakage is unknown. The concentrations of compounds detected during the SI are substantially lower than reported in previous studies. This may be attributable to the intermittent release of contaminants from the landfill with subsequent non-uniform transport in groundwater flowing through the variably

Table 3-33. Data Summary: Surface Water - Former Landfill #3, Ft. McClellan, Anniston, Alabama

SAIC ID Number	OLF-W01		
Depth BLS	(1.0)		
Collection Date	6/09/92		
Associated Field QC Sample	TB-0013,14		
Parameter	Units	CRL	UCR
Method SS12 (ICP Metals in Water)			
Aluminum	µg/L	112	125,000
Barium	µg/L	2.82	12,000
Boron	µg/L	230	10,000
Calcium	µg/L	105	200,000
Iron	µg/L	77.5	500,000
Magnesium	µg/L	135	250,000
Manganese	µg/L	9.67	10,000
Potassium	µg/L	1240	250,000
Sodium	µg/L	279	50,000
Zinc	µg/L	18.0	10,000
Method UH20 (Organochlorine Pesticides in Water)			
alpha-Hexachlorocyclohexane	µg/L	0.0025	0.500
Isodrin	µg/L	0.0025	0.500
CRL - Certified Reporting Limit			
UCR - Upper Certified Range			
C - analysis is confirmed			
U - analysis is unconfirmed			

Table 3-34. Data Summary: Sediment - Former Landfill #3, Ft. McClellan, Anniston, Alabama

SAIC ID Number	OLF-D01		
Depth BLS	(1.0)		
Collection Date	6/09/92		
Associated Field QC Sample	TB-0013,14		
Parameter	Units	CRL	UCR

FMP003
RB-008

Method JS12 (ICP Metals in Soil)

Aluminum	μg/g	11.2	50,000	2630
Barium	μg/g	3.29	1,000	12.5
Calcium	μg/g	25.3	50,000	473
Chromium	μg/g	1.04	1,000	11.8
Copper	μg/g	2.84	1,000	9.89
Iron	μg/g	6.66	50,000	11600
Magnesium	μg/g	10.1	50,000	766
Manganese	μg/g	9.87	1,000	73
Nickel	μg/g	2.74	2,000	4.91
Vanadium	μg/g	1.41	1,000	9.68
Zinc	μg/g	2.34	1,000	25.7

Method LM25 (SVOCs in Soil)

Unknown	μg/g	--	--	1 (1)
---------	------	----	----	-------

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

Unknown - The following tentatively identified compounds were identified for sample:

OLF-D01 - UNK535 1 S μg/g

weathered and fractured aquifer underlying the landfill. The previously existing data set also is rather sparse with respect to contaminant analyses. Additional groundwater sampling of the wells installed at Former Landfill #3 is recommended to confirm the results of the previous investigations. Existing aerial photographs (11/20/69) show the locations of linear trench boundaries extending in parallel across the landfill site from the southwest to the northeast. The trenches are aligned in a northwest to southeast orientation. Ponded water is visible in some trenches. Additional monitoring wells are recommended to enhance the hydrogeologic interpretations at the site.

3.19 SITE 16 - HD SPILL/DISPOSAL SITES

Unsubstantiated reports of HD spill and burial sites at several locations on the Main Post could not be confirmed during the SI planning. Approximate locations for the reported occurrences have been paved or otherwise developed and did not warrant environmental sampling. The sites should be removed from the SI program.

3.20 SITE 17 - OLD WATER HOLE

Site 17 - Old Water Hole is a site that may have been used as a disposal location for munitions and chemical agents. A rectangular, shallow depression approximately 85 by 35 feet was located by Fort McClellan Department of Environmental Management (DEM) personnel in the approximate area between the New Mt. Sellers Cemetery and a former prisoner of war (POW) camp. An additional circular depression was located near the main depression in this area. The depressions periodically fill with water from precipitation. The Old Water Hole site was investigated by USATEU personnel using metal detection.

3.20.1 Geophysical Survey Results - Old Water Hole

Metal detection sweeps conducted by USATEU indicated a large concentration of metallic objects in the Old Water Hole site. The qualitative results of the survey indicate that additional, more quantitative surveying is appropriate for the site.

3.20.2 Site Assessment - Old Water Hole

Based on the results of the qualitative geophysical survey conducted by USATEU at the Old Water Hole, the investigation of the site should be expanded to include quantitative geophysical assessment of the site area using electromagnetics and magnetometry. The geophysical surveys should be conducted on closely spaced grid patterns that encompass the inferred disposal areas (depressions) and overlap to a portion of the area outside of the depressions. Groundwater monitoring wells should be installed in the site area to determine groundwater flow directions, hydraulic gradients, and groundwater quality. Soil sampling and analysis is recommended during monitoring well installation. Groundwater analyses for explosives and chemical warfare agent degradation products are recommended.

4. HAZARD RANKING SYSTEM

This section presents the results of the Hazard Ranking System (HRS) scoring for Former Landfill #3 at Fort McClellan. A background discussion of the scoring system methodology and a summary of the assumptions and limitations inherent to the scoring is provided in Sections 4.1 through 4.3. The results of the HRS scoring are presented in Section 4.4 and Appendix G.

4.1 HAZARD RANKING SYSTEM SUMMARY

The primary objective of the HRS is to accurately assess the relative degree of risk to human health and the environment posed by uncontrolled hazardous waste sites and facilities under review through the migration pathways of groundwater, surface water, soil, and air. The HRS score is the primary criterion that the U.S. Environmental Protection Agency (EPA) uses to determine whether a site should be placed on the National Priorities List (NPL). While not as indepth as a risk assessment, the HRS provides a measure of relative risk among the potential NPL sites and is used as a screening tool to identify those sites that represent the highest priority for further investigation and possible cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The HRS is a numeric scoring system that uses site information from available preliminary assessment (PA) reports, initial site investigations (SIs), and field investigation activities conducted at the site. The system evaluates four separate pathways: air migration, groundwater migration, surface water migration, and soil exposure. Each pathway evaluates three factor categories: the likelihood of release of hazardous substances, waste characteristics, and receptor targets. These categories are used multiplicatively to generate a pathway score. Each factor category has a maximum score of 100, which is generated by the individual pathway scores calculated from site information. Scores are first calculated for the individual pathways and then combined for the site using the root-mean-square of all pathway scores to determine the overall HRS site score, which ranges from 0 to 100.

The groundwater migration pathway evaluates threats to the nearest well, population, natural resources, and wellhead protection areas. The surface water migration pathway evaluates

three threats: drinking water, human food chain, and environment by considering the overland/flow component and groundwater to surface water components. The likelihood of release of both hazardous gases and particulates is evaluated in the air migration pathway. The soil exposure pathway surveys both resident population and nearby population threats.

EPA has established an overall score of 28.5 to use as a management tool for screening sites that are candidates for the NPL (40 CFR Part 300, December 1990). Because the HRS is intended to be a screening system, the cutoff score is not considered a significant indicator of a specific level of risk from a site, nor is the cutoff intended to reflect a point below which no risk exists.

The original HRS, adopted in 1982, evaluated the relative threat of a site over five pathways, including groundwater, surface water, air, direct contact, and fire/explosion. The revised HRS (HRS2) (USEPA 1991) retains the same structure, cutoff score, and basic approach as the original HRS, but incorporates Superfund Amendments and Reauthorization Act (SARA) requirements as well as improvements identified as necessary by EPA and the public. HRS2 retains the groundwater, surface water, and air pathways, deletes the direct contact and fire/explosion pathways, and adds soil exposure as the fourth pathway.

HRS2 is more comprehensive than the original HRS because it:

- Evaluates new exposure pathways to assess direct contact of people with contaminated soils, and contamination of the aquatic food chain
- Expands the toxicity evaluation, considering not only acute health effects, but both carcinogenic and chronic noncarcinogenic effects
- Increases the sensitive environments by giving greater weight in all pathways to those exposed to documented contamination from the site than those potentially exposed and to those exposed to contamination above health-based benchmarks or ecologically based benchmarks
- Increases the number of sensitive environments evaluated and the weights given to them in the surface water, air, and soil exposure pathways
- Evaluates the potential for air to be contaminated and for contaminated groundwater to enter surface water.

Other revisions of HRS2 include:

- Using concentration data to determine the quantity of waste at a site
- Assigning higher scores when the population is exposed to contamination versus potential exposure
- Assigning higher scores to potentially exposed populations and sensitive environments closest to a site, with scores decreasing with distance from a site.

To assist with HRS scoring and report documentation, EPA has developed an automated scoring system, the Preliminary Ranking Evaluation score (PREscore). This automated system provides an accurate, efficient, and convenient means of scoring sites using the HRS. PREscore performs HRS calculations from raw data, calculates values from hazardous substance information, and calculates site scores. The program generates HRS scoresheets, an HRS documentation record, and EPA's NPL Characteristics Data Collection Form. This information is presented in Appendix G.

4.2 HRS2 SCORING OVERVIEW - FORMER LANDFILL #3

Former Landfill #3 was identified from the 17 investigated SI sites to pose the greatest threat to human health and the environment and was selected for evaluation using HRS2 and PREscore. Former Landfill #3 was operated as the installation sanitary landfill from 1946 to 1967 using the trench and fill method. The landfill covers approximately 22 acres and is located adjacent to the currently operating landfill on the Main Post. Ponding of surface water was noted during the field investigation activities and a segment of the landfill is within an identified wetland. Ten monitoring wells are currently in place at Former Landfill #3. Five wells, OLF-1 through OLF-5, were installed by the U.S. Army Environmental Hygiene Agency (USAEHA) in 1986, and the remaining five wells, OLF-6 through OLF-10, were installed by Science Applications International Corporation (SAIC) in 1992. Sampling data for these wells are provided in Section 3. Water level measurements indicate that the groundwater flow direction is to the west and northwest to areas outside Fort McClellan and the landfill. Unnamed tributaries run through the landfill and flow westward into Cave Creek, which eventually flows off Post into Cane Creek.

The HRS2 score for Former Landfill #3 was calculated from available site records, including the *Preliminary Site Inspection Report of Fort McClellan Military Reservation* prepared by Advanced Sciences, Inc. (ASI 1991), and the *Enhanced Preliminary Assessment, Fort McClellan, Alabama* prepared by Roy F. Weston, Inc., in 1990. Information regarding facility characteristics, regulatory history, process and waste disposal history, and remedial/removal actions was incorporated from these documents into the HRS2 NPL Characteristics Data Collection Form (Appendix G). Population and migration pathway data and, in some instances, source to target distance data, were calculated using 7.5 minute U.S. Geological Survey (USGS) topographic maps of Anniston, Alabama. Other site-related information, including sampling data, waste quantities, and waste characteristics, was compiled after SI activities had been completed at Fort McClellan and incorporated into the four pathways of the HRS2 (air, groundwater, surface water, and soil).

4.2.1 Groundwater Migration Pathway

An evaluation of the groundwater pathway at Fort McClellan yielded a score of 32.16 out of 100, as shown in Table 4-1. The pathway consists of evaluating the likelihood of release of hazardous substances into the groundwater, the waste characteristics of potential contaminants, and the potential human and environmental targets within a 4-mile radius of the source.

Source and waste characterization was the first category evaluated for the HRS2 score of Former Landfill #3. A source is defined as any area where hazardous substances have been deposited, stored, disposed of, or placed, in addition to those soils that have become contaminated from migration of a hazardous substance (U.S. EPA 1990). Sources do not include those volumes of air, groundwater, surface water, or surface water sediments that have become contaminated by migration, except in cases of groundwater plumes or contaminated surface water and sediments for which a source has not been identified. In these instances, the plume or contaminated sediments may be considered a source. Based on laboratory analyses, Former Landfill #3 was characterized as a source of contamination.

The likelihood of release at the site is evaluated as either "Observed Release" or "Potential to Release" for the groundwater, surface water, soil exposure, and air migration

**Table 4-1. HRS Pathway Summary Scoresheet for Former Landfill #3,
Fort McClellan, Anniston, Alabama**

PATHWAY SUMMARY SCORESHEET	
Groundwater Migration Pathway Score (S_{gw})	32.16
Surface Water Migration Pathway Score (S_{sw})	0.6
Soil Exposure Pathway Score (S_s)	0
Air Migration Pathway Score (S_a)	0
$(S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2) =$	593
$(S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2)/4 =$	148
$[(S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2)/4]^{0.5} =$	16.08

pathways. Using previously collected groundwater data and information obtained during the SI at Former Landfill #3, observed contaminant releases into groundwater were found at the site. The aquifer directly underlying the site of the observed release is the water table aquifer in the Cambrian Rome Formation. Previous sampling data indicated a release of tetrachloroethene (PCE) to the groundwater at levels above the EPA Maximum Contaminant Level (MCL) of 5 µg/L for drinking water standards (well OLF-5, 110 µg/L; well OLF-4, 12 µg/L; well OLF-3, 50 µg/L). Five additional organic compounds were detected by this analysis, including methylene chloride (9 µg/L), 1,1-dichloroethane (18 µg/L), trans-1,2-dichloroethene (24 µg/L), and benzene (4 µg/L) at OLF-4; and bis(2-ethylhexyl) phthalate at wells OLF-1 (20 µg/L), OLF-2 (40 µg/L), and OLF-3 (10 µg/L). Current sampling data indicated additional contaminant releases into the groundwater. These results, which produced an observed release of 550, are presented in Table 4-2.

Evaluation of the potential targets is based on four factors: the nearest drinking water well, population, recreational and/or irrigation resources, and the presence of a wellhead protection area. Residents on the installation at Fort McClellan receive water from the public water system of the city of Anniston. The city of Weaver receives its water supply from two water supply wells located approximately 1.68 miles (No. 2) and 2.06 miles (No. 3) northwest of former Landfill #3. These wells supply an approximate population of 6,650 (City of Weaver, personal communication). In addition, individuals visiting the camping area at Lake Reilly

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama

SAIC ID Number																			
Depth BLS																			
Collection Date																			
Associated Field QC Sample																			
Parameter	Units	CRL	UCR	OLF-G01 (15.10) 6/09/92 TB-0013,14 FMP003 RB-008				OLF-G02 (12.20) 6/10/92 TB-0015 FMP003 RB-009				OLF-G03 (11.70) 6/10/92 TB-0015 FMP003 RB-009				OLF-G03D (11.70) 6/10/92 TB-0015 FMP003 RB-009			
Method AX8 (As in Water)																			
Arsenic	µg/L	2.35	121	**				**				2.79				7.87			
Method CC8 (Hg in Water)																			
Mercury	µg/L	0.100	2.00	0.309				1.02				0.842				1.14			
Method SS12 (ICP Metals in Water)																			
Aluminum	µg/L	112	125,000	7040				240000				7320				18300			
Barium	µg/L	2.82	12,000	42.1				775				172				196			
Calcium	µg/L	105	200,000	916				250000				19100				20500			
Chromium	µg/L	16.8	1,000	**				271				**				26.6			
Cobalt	µg/L	25.0	10,000	**				120				**				**			
Copper	µg/L	18.8	10,000	**				252				88.5				162			
Iron	µg/L	77.5	500,000	5320				271000				17400				48400			
Magnesium	µg/L	135	250,000	2700				280000				12700				20800			
Manganese	µg/L	9.67	10,000	210				3820				686				831			
Nickel	µg/L	32.1	20,000	**				239				47.8				65.4			
Silver	µg/L	10.0	2,000	**				390				**				**			
Vanadium	µg/L	27.6	10,000	**				576				91.8				32			
Zinc	µg/L	18.0	10,000	27.6				1470				**				139			
Lead	µg/L	43.4	10,000	**								**				**			
Method UM21 (VOCs in Water)																			
1,1-Dichloroethane	µg/L	1	150	**				**				**				**			
Benzene	µg/L	1	150	**				**				**				**			
Methylisobutylketone	µg/L	1.4	100	**				**				**				**			
1,1,2,2-Tetrachloroethane	µg/L	1.5	150	**				**				**				**			
Tetrachloroethene	µg/L	1	150	**				**				1.7				4.3			
Trichloroethene	µg/L	1	150	**				**				**				**			
Unknown	µg/L	--	--	0 (0)				100 (1)				0 (0)				20 (1)			

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	Depth BLS	Collection Date	Associated Field QC Sample	Parameter	Units	CRL	UCR	OLF-G01 (15.10) 6/09/92 TB-0013,14 FMP003 RB-008	OLF-G02 (12.20) 6/10/92 TB-0015 FMP003 RB-009	OLF-G03 (11.70) 6/10/92 TB-0015 FMP003 RB-009	OLF-G03D (11.70) 6/10/92 TB-0015 FMP003 RB-009
Method UM25 (SVOCs in Water)											
bis(2-Ethylhexyl)phthalate	µg/L	7.7	200					**	**	**	**
Unknown	µg/L	--	--					**	**	**	**
Method UW25 (Explosives in Water)											
1,3,5-Trinitrobenzene	µg/L	0.210	20					**	**	**	**
2,4-Dinitrotoluene	µg/L	0.397	20					**	**	**	**
Method UI120 (Organochlorine Pesticides in Water)											
alpha-Hexachlorocyclohexane	µg/L	0.0025	0.500					**	0.0128	**	**
Endosulfan I	µg/L	0.0025	0.500					**	**	**	**
Aldrin	µg/L	0.0074	0.500					**	0.0344	**	**
Endosulfan II	µg/L	0.0077	0.500					**	0.00996	**	**
delta-BHC	µg/L	0.0034	0.500					**	0.0117	**	**
Dieldrin	µg/L	0.0074	0.500					**	0.0271	**	**
Endrin	µg/L	0.0176	0.500					**	0.0356	**	**
Heptachlor	µg/L	0.0025	0.250					**	0.00546	**	**
Heptachlor epoxide	µg/L	0.0063	0.184					0.00692	**	**	**
Isodrin	µg/L	0.0025	0.500					0.00967	0.0183	0.00778	0.0145
Lindane	µg/L	0.0025	0.500					**	**	**	0.00318
p,p'-DDD	µg/L	0.0081	0.572					**	0.0312	**	**
p,p'-DDE	µg/L	0.0039	0.537					**	**	**	0.0057
p,p'-DDT	µg/L	0.0025	0.250					**	**	**	**

-- The certification of these analytes will be submitted at a later date

CRL - Certified Reporting Limit

UCR - Upper Certified Range

** indicates non-detected analytes

C - analysis is confirmed

U - analysis is unconfirmed

Unknown - The following tentatively identified compounds were identified for sample:

OLF-G02 - UNK037 100 S µg/L

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)												
SAIC ID Number	OLF-G04			OLF-G05			OLF-G06			OLF-G07		
Depth BLS	(39.40)			(30.70)			(64.40)			(41.30)		
Collection Date	6/10/92			6/07/92			6/09/92			6/07/92		
Associated Field QC Sample	TB-0015			TB-0010			TB-0013,14			TB-0010		
Parameter	Units	CRL	UCR	FMP003			FMP003			FMP003		
				RB-009			RB-008			RB-008		
Method AX8 (As in Water)												
Arsenic	µg/L	2.35	121	**				**				**
Method CC8 (Hg in Water)												
Mercury	µg/L	0.100	2.00	1.49	D			**				**
Method SS12 (ICP Metals in Water)												
Aluminum	µg/L	112	125,000	1570				2310				1350
Barium	µg/L	2.82	12,000	84.8				36.1				55.4
Calcium	µg/L	105	200,000	1000				4920				13100
Chromium	µg/L	16.8	1,000	**				18.3				**
Cobalt	µg/L	25.0	10,000	**				**				**
Copper	µg/L	18.8	10,000	**				**				**
Iron	µg/L	77.5	500,000	1620				5870				**
Magnesium	µg/L	135	250,000	6420				3390				1030
Manganese	µg/L	9.67	10,000	354				257				7050
Nickel	µg/L	32.1	20,000	**				**				414
Silver	µg/L	10.0	2,000	**				**				**
Vanadium	µg/L	27.6	10,000	**				**				**
Zinc	µg/L	18.0	10,000	**				35.8				**
Lead	µg/L	43.4	10,000	**				**				**
Method UM21 (VOCs in Water)												
1,1-Dichloroethane	µg/L	1	150	9.6				**				**
Benzene	µg/L	1	150	1.9				**				**
Methylisobutylketone	µg/L	1.4	100	**				3				**
1,1,2,2-Tetrachloroethane	µg/L	1.5	150	**				**				**
Tetrachloroethene	µg/L	1	150	**				**				17
Trichloroethene	µg/L	1	150	**				**				**
Unknown	µg/L	--	--	300 (1)				300 (1)				3.8
												**

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	OLF-G04	OLF-G05	OLF-G06	OLF-G07
Depth BLS	(39.40)	(30.70)	(64.40)	(41.30)
Collection Date	6/10/92	6/07/92	6/09/92	6/07/92
Associated Field QC Sample	TB-0015	TB-0010	TB-0013,14	TB-0010
Parameter	FMP003 RB-009	FMP003 RB-008	FMP003 RB-008	FMP003 RB-008
Method UM25 (SVOCs in Water) (Continued)				
bis(2-Ethylhexyl)phthalate	200	17	**	17
Unknown	--	0 (0)	**	**
Method UW25 (Explosives in Water)				
1,3,5-Trinitrobenzene	20	**	**	**
2,4-Dinitrotoluene	20	**	**	**
Method UH20 (Organochlorine Pesticides in Water)				
alpha-Hexachlorocyclohexane	0.500	C	0.0026	**
Endosulfan I	0.500	U	**	**
Aldrin	0.500	**	**	**
Endosulfan II	0.500	C	**	**
delta-BHC	0.500	**	**	**
Dieldrin	0.500	**	**	**
Endrin	0.500	C	**	**
Heptachlor	0.250	U	**	**
Heptachlor epoxide	0.184	U	**	**
Isodrin	0.500	U	0.0131	0.00611
Lindane	0.500	**	**	**
p,p'-DDD	0.572	C	**	**
p,p'-DDE	0.537	U	0.00489	**
p,p'-DDT	0.250	U	**	0.00392

-- The certification of these analytes will be submitted at a later date

CRL -- Certified Reporting Limit

UCR -- Upper Certified Range

** indicates non-detected analytes

C -- analysis is confirmed

D -- duplicate sample

U -- analysis is unconfirmed

Unknown -- The following tentatively identified compounds were identified for sample:

OLF-G04 -- UNK037 300 S µg/L, UNK588 20 S µg/L

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number Depth BLS Collection Date Associated Field QC Sample												
Former Landfill #3, F. McClellan, Anniston, Alabama (Continued)												
Parameter	Units	CRL	UCR	OLF-G07D (41.30) 6/07/92 TB-0010 FMP003 RB-008	OLF-G08 (29.34) 6/07/92 TB-0010 FMP003 RB-008	OLF-G09 (20.10) 6/08/92 TB-0011 FMP003 RB-008	OLF-G10 (16.42) 6/11/92 TB-0015 FMP003 RB-009					
Method AX8 (As in Water)												
Arsenic	µg/L	2.35	121	**	**	**	**					
Method CC8 (Hg in Water)												
Mercury	µg/L	0.100	2.00	**	0.191	**	**					
Method SS12 (ICP Metals in Water)												
Aluminum	µg/L	112	125,000	1430	D	566	23600					
Barium	µg/L	2.82	12,000	55.1	D	25.7	122					
Calcium	µg/L	105	200,000	9740	D	8080	4950					
Chromium	µg/L	16.8	1,000	**	**	**	**					
Cobalt	µg/L	25.0	10,000	**	**	**	**					
Copper	µg/L	18.8	10,000	**	**	**	**					
Iron	µg/L	77.5	500,000	919	D	1390	18300					
Magnesium	µg/L	135	250,000	4980	D	4440	8260					
Manganese	µg/L	9.67	10,000	305	D	53.7	354					
Nickel	µg/L	32.1	20,000	32.1	D	**	**					
Silver	µg/L	10.0	2,000	**	**	**	**					
Vanadium	µg/L	27.6	10,000	**	**	**	**					
Zinc	µg/L	18.0	10,000	32	D	35.5	93.5					
Lead	µg/L	43.4	10,000	**	**	**	**					
Method UM21 (VOCs in Water)												
1,1,1-Dichloroethane	µg/L	1	150	**	**	**	**					
Benzene	µg/L	1	150	**	**	**	**					
Methylisobutylketone	µg/L	1.4	100	**	**	**	**					
1,1,1,2,2-Tetrachloroethane	µg/L	1.5	150	22.1	D	**	**					
Tetrachloroethene	µg/L	1	150	**	**	**	**					
Trichloroethene	µg/L	1	150	6.3	D	**	**					
Unknown	µg/L	--	--	**	**	30 (1)	50 (1)					

Table 4-2. Data Summary: Groundwater - Former Landfill #3, Ft. McClellan, Anniston, Alabama (Continued)

SAIC ID Number	OLF - G07D (41.30) 6/07/92	OLF - G08 (29.34) 6/07/92	OLF - G09 (20.10) 6/08/92	OLF - G10 (16.42) 6/11/92
Depth BLS				
Collection Date				
Associated Field QC Sample	TB-0010 FMP003 RB-008	TB-0010 FMP003 RB-008	TB-0011 FMP003 RB-008	TB-0015 FMP003 RB-009
Parameter	Units	CRL	UCR	
Method UM25 (SVOCs in Water) (Continued)				
bis(2-Ethylhexyl)phthalate	µg/L	7.7	200	
Unknown	µg/L	--	--	
Method UW25 (Explosives in Water)				
1,3,5-Trinitrobenzene	µg/L	0.210	20	
2,4-Dinitrotoluene	µg/L	0.397	20	
Method UH20 (Organochlorine Pesticides in Water)				
alpha-Hexachlorocyclohexane	µg/L	0.0025	0.500	
Endosulfan I	µg/L	0.0025	0.500	
Aldrin	µg/L	0.0074	0.500	
Endosulfan II	µg/L	0.0077	0.500	
delta-BHC	µg/L	0.0034	0.500	
Dieldrin	µg/L	0.0074	0.500	
Endrin	µg/L	0.0176	0.500	
Heptachlor	µg/L	0.0025	0.250	
Heptachlor epoxide	µg/L	0.0063	0.184	
Isodrin	µg/L	0.0025	0.500	
Lindane	µg/L	0.0025	0.500	
p,p'-DDD	µg/L	0.0081	0.572	
p,p'-DDE	µg/L	0.0039	0.537	
p,p'-DDT	µg/L	0.0025	0.250	
--	The certification of these analytes will be submitted at a later date			
CRL	Certified Reporting Limit			
UCR	Upper Certified Range			
**	indicates non-detected analytes			
C	analysis is confirmed			
D	duplicate sample			
U	analysis is unconfirmed			
Unknown	The following tentatively identified compounds were identified for sample:			
	OLF - G09 - UNK038 30 S µg/L			

U -- The certification of these analytes will be submitted at a later date

CRL -- Certified Reporting Limit

UCR -- Upper Certified Range

** indicates non-detected analytes

C -- analysis is confirmed

D -- duplicate sample

U -- analysis is unconfirmed

Unknown -- The following tentatively identified compounds were identified for sample:

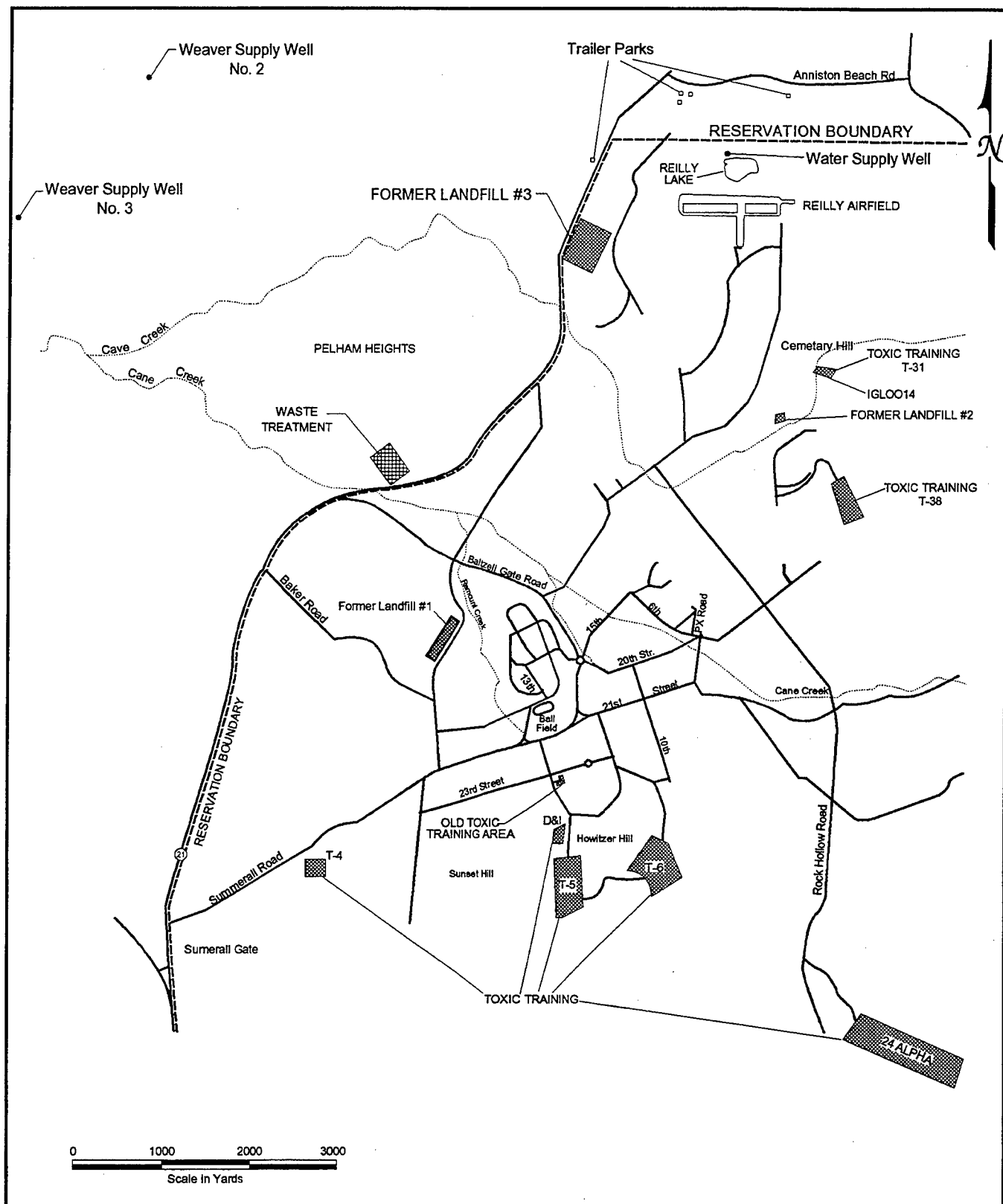
OLF - G09 - UNK038 30 S µg/L

obtain water from a drinking water well located approximately 2,370 feet from Well OLF-3 at Former Landfill #3. The Weaver Supply Wells (No. 2 and 3) and the drinking well at Lake Reilly are shown in Figure 4-1. The wells supplying the City of Weaver (No. 2 and 3) are tested for organics on a three-year cycle and no detections have been recorded (City of Weaver, personal communication). In addition, both wells are greater than 100 feet below land surface. Well No. 2 is approximately 413 feet in depth and Well No. 3 is approximately 125 feet in depth. Recent (March 26, 1992) inorganics data provided by the city of Weaver for wells 2 and 3 did not indicate the presence of deleterious metals concentrations in the groundwater. The Weaver data is provided in Appendix L. Although contamination has not been detected in either well, the HRS score is based on the proximity of the wells to the source of contamination and the population that receives the drinking water. The population factor received a value of 254 for the potential exposure of the population to contaminants released from the landfill. The score is based on available data regarding the surrounding public water systems and the target populations at 1/4, 1/2, 1, 2, 3, and 4 mile radial intervals surrounding Former Landfill #3. The resource category received a score of 5.0 because Lake Reilly was identified as a resource. Wellhead protection areas were not identified in the influence area of the landfill. The targets category received a resulting score of 268.

Based on the observed release and assessment of hazardous substances, a PREscore of 45.84 out of 100 was calculated for the toxicity/mobility/hazardous waste quantity and targets.

4.2.2 Surface Water Migration Pathway

The surface water migration pathway was evaluated because observations of ponding were noted during the SI field activities at Former Landfill #3. Unnamed tributaries of Cave Creek located on the landfill also were identified. The tributaries flow into Cave Creek, which leaves the installation on the western boundary south of the identified landfill area. Surface water within the study area is used for recreational activities, including swimming and fishing. Lake Reilly is the nearest surface water body to the landfill (approximately .4 miles northeast of Well OLF-3) used for these activities. Residents of the study area also receive potable water from groundwater and surface water sources located within the target population area (4 miles)



**GROUNDWATER SUPPLY WELLS
IN VICINITY OF MAIN POST
FORT McCLELLAN, ALABAMA**

Figure 4-1

**Prepared for:
U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland**



(ASI 1991). The population served by Lake Reilly (approximately 200) was used in determining the HRS target factor (5.00) for surface water (Appendix G).

Contaminant releases were identified in the surface water from sampling data obtained during the SI field investigation activities at Former Landfill #3. One surface water sample (OLF-W01) was collected from an unnamed tributary at the southern end of Former Landfill #3. These results are presented in Table 4-3. A score of 0.6 out of 100 was calculated for the surface water migration pathway (Table 4-1).

4.3 HRS2 SCORING LIMITATIONS

As noted previously, HRS2 assigns higher scores to potentially exposed populations and sensitive environments that are nearest to a site, with scores decreasing with distance from a site. Source to target distance data for the population and migration distance of groundwater and surface water was calculated using a compass and 7.5 minute USGS topographic maps of Anniston, Alabama (1972). Population was determined by measuring 1/4, 1/2, 1, 2, and 3 to 4 mile radial target distance limits from the center of Former Landfill #3. In estimating residential population, the value was based on the number of residences multiplied by the average number of persons per residence for the county in which the residence is located (3.8 persons per dwelling, EPA 1990). A trailer park was observed northwest of Former Landfill #3 during the SI field activities. Other trailer parks also were noted on a 7.5 minute topographic map (see Figure 4-1). It was estimated that 20 trailers reside in each park. This estimation also was included in the target population value calculation. The population of the city of Anniston is 26,623 (1990 census) based on the 1990 census (Calhoun County, personal communication). However, the majority of this population is outside the 4-mile radius of Former Landfill #3.

The groundwater migration pathway of the HRS does not take into consideration groundwater flow direction; therefore, the population was calculated from the 4-mile radius surrounding Former Landfill #3 and not in the area of the northwesterly groundwater flow. Soil and air pathways were not evaluated because of a lack of data for these media. The air pathway is not estimated to have a significant impact on the site scoring.

Table 4-3. Data Summary: Surface Water - Former Landfill #3, Ft. McClellan, Anniston, Alabama

SAIC ID Number	OLF-W01		
Depth BLS	(1.0)		
Collection Date	6/09/92		
Associated Field QC Sample	TB-0013,14		
Parameter	Units	CRL	UCR

FMP003
RB-008

Method SS12 (ICP Metals in Water)

Aluminum	µg/L	112	125,000	1420
Barium	µg/L	2.82	12,000	30.3
Boron	µg/L	230	10,000	250
Calcium	µg/L	105	200,000	19300
Iron	µg/L	77.5	500,000	1720
Magnesium	µg/L	135	250,000	7250
Manganese	µg/L	9.67	10,000	36
Potassium	µg/L	1240	250,000	2080
Sodium	µg/L	279	50,000	4320
Zinc	µg/L	18.0	10,000	19

Method UH20 (Organochlorine Pesticides in Water)

alpha-Hexachlorocyclohexane	µg/L	0.0025	0.500	0.00498	C
Isodrin	µg/L	0.0025	0.500	0.163	U

CRL - Certified Reporting Limit

UCR - Upper Certified Range

C - analysis is confirmed

U - analysis is unconfirmed

The surface water migration pathway data information was limited due to low sample quantities. One surface water sample was collected at a southern point of the Former Landfill #3 boundary (OLF-W01).

During the HRS evaluation the following metals were identified as not being provided in the HRS database: calcium, magnesium, potassium, and vanadium. In addition, three organic compounds (isodrin, α -BHC, and Δ -BHC) were not provided in the database. These metals and organics were identified as contaminants, but could not be evaluated by the HRS.

4.4 SUMMARY AND CONCLUSIONS

The HRS2 evaluation of Former Landfill #3 resulted in a score of 16.08, which is less than the 28.5 minimum required for consideration on the NPL. This evaluation was based solely on the calculation of the groundwater and surface water pathways. An evaluation of the soil exposure pathway and the air migration pathway was not presented at this time due to insufficient data.

Additional surface water and sediment samples should be taken for further evaluation in the HRS scoring. More detailed geologic and hydrogeologic characterization of the subsurface formation is also recommended to more clearly define the risk of contaminant migration.

Based on the SI field activities and water level monitoring of the installed wells, the direction of groundwater flow beneath Former Landfill #3 is northwesterly. The water supply wells for the town of Weaver are located within the 4-mile radius study area northwest of Former Landfill #3 (ASI 1992). It is recommended that these wells be monitored for contaminants of concern.

In addition, further investigation into the current census of the population surrounding Former Landfill #3 at 1/4, 1/2, 1, 2, and 3 to 4 mile radii should be conducted to more accurately evaluate the HRS2 scoring of the groundwater migration pathway.

5. CONCLUSIONS AND RECOMMENDATIONS

Site investigation (SI) activities have been conducted at 17 sites on the Fort McClellan Army Installation. The identified sites for investigation include 12 former chemical agent training areas located on the Main Post and Pelham Range, 2 former munitions disposal areas, and 3 former sanitary landfills. This section summarizes Science Applications International Corporation's (SAIC's) conclusions and recommendations based on the findings of the SI activities conducted by SAIC and the U.S. Army Technical Escort Unit (USATEU) at the Post.

5.1 SITE CONDITIONS

Existing conditions and supplemental investigation activities that may be necessary to further characterize unknown conditions at the investigated sites are summarized below. Existing conditions include geologic and hydrogeologic conditions, surficial site conditions, and environmental conditions.

5.1.1 Geologic and Hydrogeologic Conditions

Complete geologic and hydrogeologic characterization of the sites considered under the SI was not a primary goal of the field program. Information was obtained regarding the site soils at the agent training areas to describe the samples; however, characterization of available transport pathways was not a focus of the sampling at these sites. Similarly, investigations at the former munitions disposal areas (Range L and Old Water Hole) and Former Landfill #1 consisted solely of reconnaissance geophysical activities with no intrusive sampling. The most detailed geologic characterizations were completed at Former Landfills #2 and #3 and consisted of drilling and lithologic logging of 8 boreholes and geotechnical analysis of 13 soil samples. Hydrogeologic characterization at Former Landfills #1 and #2 consisted of measuring groundwater elevations in the site wells, and determining hydraulic gradients and groundwater flow directions. Hydrologic characterization has not been conducted at the remaining SI sites. Contamination resulting from former usage of chemical warfare agents or the degradation products of previously used agents at the training sites was not detected during the SI program. Therefore, detailed geologic or hydrogeologic characterization of these sites is not warranted at this time. Additional geologic and hydrogeologic characterization is warranted at Former

Landfills #1, #2, and #3, Range L, and the Old Water Hole, since these areas indicate a potential for release of contaminants to the environment or represent an environmental hazard. Additional characterization at these sites should include combinations of quantitative geophysics, drilling and monitoring well installations, soil sampling and analysis, water level measurements, and slug testing.

5.1.2 Site Boundaries

The locations of areas used as disposal or burn pits on several of the training sites and the locations of existing survey monuments with respect to the pit boundaries are unknown. Investigated sites that warrant additional quantitative geophysical surveys to delineate pit or site boundaries, landfilled areas, or buried munitions or drums include Sites T-24A and T-38, Range L, the Old Water Hole, and Former Landfill #1. Geophysical surveys consisting of combinations of electromagnetics, magnetics, and ground penetrating radar (GPR) should be obtained on grid patterns that extend beyond the expected targets of the surveys.

Identification of overall site boundaries is of concern at Range L, the Old Water Hole, and Landfill #1. Some of these areas were heavily overgrown during the site visits and field work, and other areas were not well-defined by previous investigators at the sites. Resolution of site boundaries at Former Landfill #3 can be effected through analysis of aerial photographs, field reconnaissance, and global positioning surveying (GPS) to provide quantitative location information. Determination of site boundaries at the Old Water Hole is recommended using electromagnetic terrain conductivity and magnetometer surveying. Additional GPR surveys should be obtained at the Old Water Hole to attempt to image the disposition of waste materials buried at the site. Geophysical surveys at Range L are recommended to quantitatively locate concentrations of buried munitions and attempt to determine the depth of the burial pit. Coordinated surveys, including EM, magnetometer, and GPR, are recommended for further investigations within the burial pit. Intrusive sampling within the pit area is not recommended for safety reasons.

Delineation of burial pit boundaries is recommended at sites T-24A and T-38. Quantitative magnetometer and EM surveying should be conducted on grid patterns to attempt

to accurately locate the former burial pits for comparison to recently sampled locations and for permanent location of the areas in the event future remediation is required. Additional geophysical surveys also are warranted at Landfill #1 to further investigate the geophysical anomalies identified during the SI study.

5.1.3 Environmental Conditions

Known environmental conditions at the SI sites are based on environmental sampling at locations determined to have a high probability for containing the materials known to have been used or disposed of at each site. Sampling at the 12 former chemical agent training areas did not indicate the presence of chemical agent or chemical agent breakdown products in the shallow soils, surface water, or sediments at these sites. The disposition of the remaining sites would be determined based on the other supplemental activities recommended at each site. Recommended geophysical surveys at these sites are discussed in Section 3. Monitoring well installations are recommended at the Old Water Hole and Range L.

Former training sites that are recommended for minimal or no additional investigative activities include Areas T-5, T-6, T-31, Old Toxic Training Area, Decontamination and Identification Area, Range I, Range J, and the HD Spill/Burial Sites. Area T-5 and Range J should be assessed for the presence of ordnance, and once cleared, should be removed from consideration under the SI program. Additional investigative activities to locate Area T-4 and to investigate CWA ordnance at Range K are recommended.

Environmental contamination has not been assessed at Former Landfill #1. The results of reconnaissance geophysical surveying indicate a potential for subsurface disturbance in the southern portion of the inferred former landfill area. Additional geophysical surveying (EM and magnetometer) is recommended at Former Landfill #1 with the installation of groundwater monitoring wells in the event that the surveys delineate anomalous areas of concern. Soil sampling and analysis is warranted during well installation. A second round of groundwater sampling is recommended at Former Landfills #2 and #3 to confirm the results of the initial sampling rounds. Soil sampling and analysis is recommended at each of these sites. Additional well or piezometer placements are warranted at Former Landfill #3 to investigate groundwater

quality around the landfill and to provide additional data locations to further delineate groundwater flow directions.

Extensive additional investigation activities are recommended for Range L and the Old Water Hole sites to determine the extent of munitions burial and the potential environmental impacts of disposal at these locations. Integrated, multi-component geophysical surveys and monitoring well drilling, installation, and sampling is recommended for these sites. Additional investigations also are recommended for Areas T-24A and T-38 to delineate pit boundaries and to complete additional soil sampling and analysis. The conclusions determined from the SI study and recommendations for additional investigations at the SI sites are provided in Table 5-1.

**Table 5-1. Summary of Site Investigation Findings and Recommendations
Fort McClellan, Alabama**

Site No.	Site Name	Field and Laboratory Results	Recommended Activities
1	Area T-4	• Unable to locate site	Research site location and perform additional field reconnaissance of site. Collect soil samples for analysis.
2	Area T-5	• HD, GB, VX chemical agent, agent breakdown products not detected at 5 locations	Assess site for ordnance. If negative, no further investigation is warranted for present land use
3	Area T-6	• HD chemical agent, agent breakdown products not detected at 3 locations	No further investigation is warranted for present land use
4	Area T-24A	• HD, GB chemical agent, agent breakdown products not detected at 3 locations	Delineate pit boundaries and possible ordnance geophysically; possible additional soil sampling
5	Area T-31	• HD, GB chemical agent, agent breakdown products not detected at 5 locations	No further investigation is warranted for present land use
6	Area T-38	• HD, GB VX chemical agent, agent breakdown products not detected at 4 locations	Delineate pit boundaries and locate possible buried drums; assess site area for possible chemical agent using MINICAMS field screening; drill soil boring in pit area.
7	Old Toxic Training Area	• HD chemical agent, agent breakdown products not detected at 2 locations	No further investigation is warranted for present land use.
8	Range K	• HD, GB, VX chemical agent, agent breakdown products not detected at 1 location	Additional site reconnaissance reported CWA ordnance at site; additional soil sampling; if CWA is not detected, then no further investigation is warranted for present land use.
9	Range I	• HD, GB chemical agent, agent breakdown products not detected at 2 locations	Remove site from SI
10	Range J	• HD chemical agent, agent breakdown products not detected at 4 locations	Assess site geophysically for possible burials, potentially remove from SI.

**Table 5-1. Summary of Site Investigation Findings and Recommendations
Fort McClellan, Alabama (continued)**

Site No.	Site Name	Field and Laboratory Results	Recommended Activities
11	Range L	• Samples not collected; metal detection indicates possible munitions burials at site	Install 6 monitoring wells; investigate pond area geophysically
12	Detection and Identification Area	• HD, GB chemical agent, agent breakdown products not detected at 2 locations	No further investigation is warranted for present land use
13	Former Landfill 1	• Magnetometer survey indicates potential ground disturbance	Additional geophysical surveying in southern portion of site; possible monitoring well installations
14	Former Landfill 2 (LF2)	• Organics, inorganics, agent breakdown products not detected in groundwater	Confirmatory groundwater and surface water/sediment sampling
15	Former Landfill 3 (OLF)	• Organic and inorganic contamination detected in groundwater at site; explosive compounds detected in groundwater	Delineate extent of groundwater contamination; hydrogeology; confirmatory groundwater and surface water/sediment sampling.
16	HD Spill/Burial Sites	• No sampling activities	In absence of verifiable information, the sites should be removed from the SI
17	Old Water Hole	• Magnetometer survey indicates substantial quantities of buried material	Investigate site using quantitative geophysics; install three perimeter groundwater monitoring wells; assess soil contamination

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