LAW
ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

REVISED FINAL WORK PLAN

FOR

PREDESIGN INVESTIGATION AT HUNTER ARMY AIRFIELD SAVANNAH, GEORGIA

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

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PREDESIGN INVESTIGATION
REVISED FINAL WORK PLAN

HUNTER ARMY AIRFIELD FIRE TRAINING AREA
SAVANNAH, GEORGIA

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JULY 1995

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LIST OF ACRONYMS

AA	Atomic Absorption
ACGIH	American Council on Governmental and Industrial Hygienists
AFCEE	Air Force Center for Environmental Excellence
ARARs	Applicable or Relevant and Appropriate Requirements
ANSI	American National Standards Institute
ATSDR	Agency for Toxic Substances and Disease Registry
ASTM	American Society for Testing and Materials
ATV	All Terrain Vehicle
bls	below land surface
BPM	beats per minute
CCV	Continuing Calibration Validation
CEMRK	U.S. Army Corps of Engineers, Kansas City District
CESAS	U. S. Army Corps of Engineers, Savannah District
CDAP	Chemical Data Acquisition Plan
CFR	Code of Federal Regulations
CHRIS	Chemical Hazard Response Information System
COE	U.S. Army Corps of Engineers
COC	Chain of Custody
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination Reduction Zone
DER	Department of Environmental Regulation
DOT	United States Department of Transportation
DQO	Data Quality Objectives
EA	Environmental Assessment Report
EMT	Emergency Medical Team
EPA	Environmental Protection Agency
ESE	Environmental Science & Engineering, Inc.

LIST OF ACRONYMS
(Continued)

F	Fahrenheit
FDHRS	Florida Department of Health & Rehabilitative Services
FID	Flame Ionization Detector
FNSI	Findings of No Significant Impact
FTA	Fire Training Area
GC	Gas Chromatography
gpm	Gallons per minute
GSHP	General Safety and Health Plan
HAA	Hunter Army Airfield
HEPA	High Efficiency Particulate Air Filter
HPLC	High Performance Liquid Chromatography
HSRA	Georgia Hazardous Site Response Act
HSI	Hazardous Site Inventory
HSO	Health and Safety Officer
HSP	Health and Safety Plan
HTW	Hazardous and Toxic Wastes
ICP	Inductively Coupled Plasma
ICV	Initial Calibration Validation
I.D.	Inside Diameter
IDL	Instrument Detection Limit
IDLH	Immediately Dangerous to Life and Health
IDW	Investigation Derived Waste
IP	Ionization Potential
JP-4	Jet Fuel
LAW	Law Environmental, Inc.
LEL	Lower Explosive Limit
MCLs	Maximum Contaminant Levels
MS	Matrix Spike

LIST OF ACRONYMS
(Continued)

MSA	Method of Standard Additions
MSD	Matrix Spike Duplicate
msl	mean sea level
MW	Monitoring Well
NFPA	National Fire Prevention Association
NIOSH	National Institute of Occupational Safety & Health
NOI	Notice of Interest
NRC	National Response Center
NSC	National Safety Council
NTUs	Nephelometric Turbidity Units
O.D.	Outside Diameter
OSHA	Occupational Safety & Health Act
PAH	Polynuclear Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCTs	Preliminary Cleanup Targets
PEL	Permissible Exposure Limit
PID	Photoionization Detector
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PQL	Practical Quantitation Limit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
REC	Record of Environmental Consideration
RD	Remedial Design Plan
RF	Response Factor

LIST OF ACRONYMS
(Continued)

RPD	Relative Percent Difference
SCBA	Self-Contained Breathing Apparatus
SOPs	Standard Operating Procedures
SSHP	Site Safety & Health Plan
SSSHP	Site-Specific Safety & Health Plan
SSO	Site Safety Officer
STEL	Short-Term Exposure Limit
TLV	Threshold Limit Value
TSDF	Treatment, Storage, and Disposal Facility
TWA	Time-Weighted Average
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USAEHA	United States Army Environmental Hygiene Agency
USDHHS	United States Department of Health and Human Services
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
WBGT	Wet Bulb Globe Temperature

1.0 BACKGROUND

1.1 INTRODUCTION

This Predesign Investigation Work Plan title "Revised Work Plan" was prepared for Source Removal Design at the Hunter Army Airfield (HAAF) Fire Training Area (FTA), Savannah, Georgia. This document has been prepared to comply with the requirements of the scope of work issued by the U.S. Army Corps of Engineers, Savannah District (CESAS), dated April 25, 1995.

1.2 PURPOSE

The purpose of this investigation is to gather field data to further define the extent of soil and ground-water contamination at the FTA. This information will be used to prepare design and construction documents (plans, specifications, and construction cost estimate) for remediation and closure of the site.

1.3 SITE DESCRIPTION

The following subsections are summarized from the Environmental Science and Engineering (ESE, 1993a and 1993b) reports.

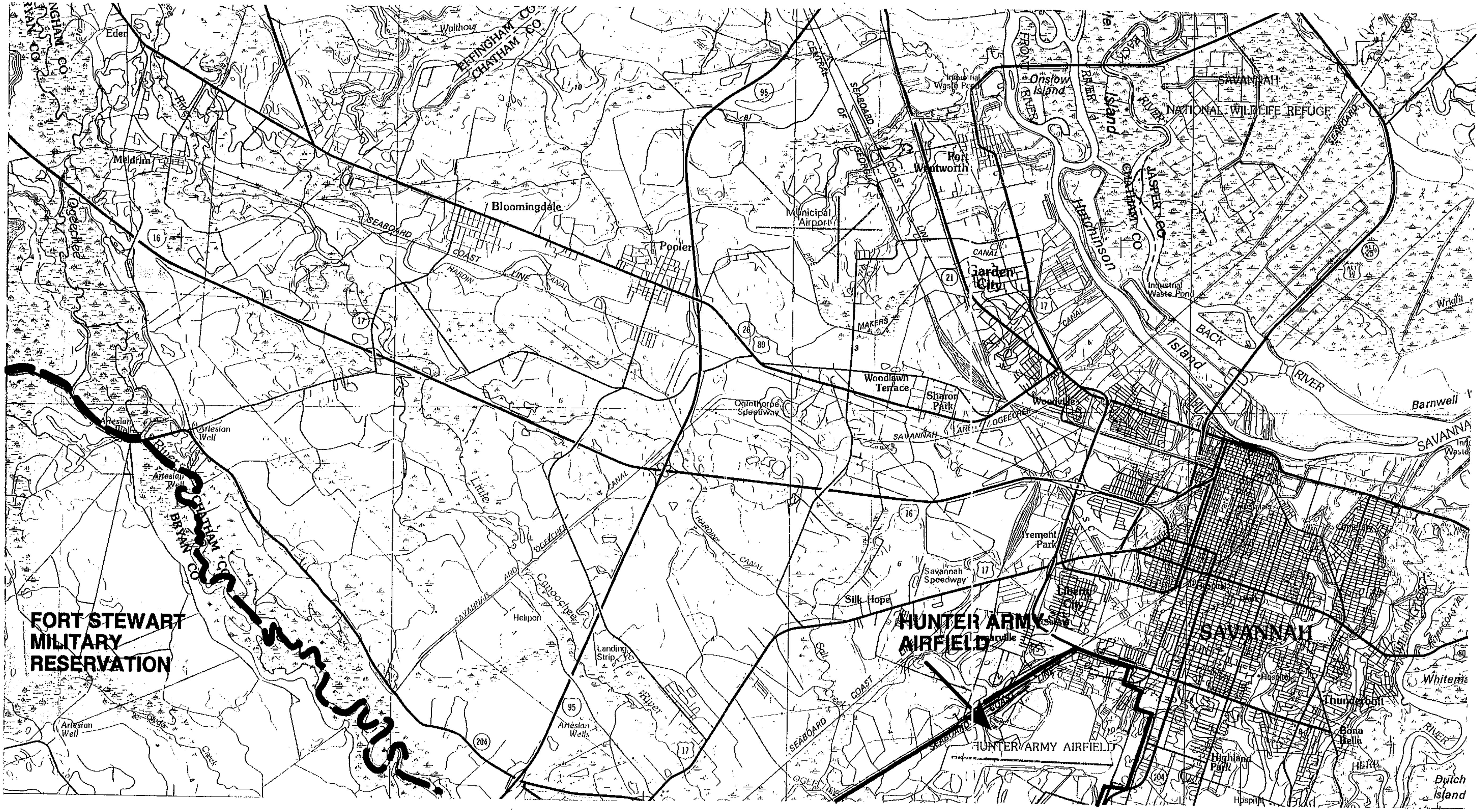
1.3.1 Site Location and History

HAAF is located in Chatham County, Georgia, within the southwest portion of Savannah (Figures 1-1 and 1-2). The installation is bounded to the north by the city of Savannah, to the south and east by residential and light commercial areas, and to the west by the Little Ogeechee

FIGURE 1-1

LOCATION MAP

HUNTER ARMY AIRFIELD, GEORGIA



LEGEND

▬ ▬ ▬ FT. STEWART INSTALLATION BOUNDARY (APPROXIMATE)

Source: U.S. Geological Survey, Savannah 1:100,000 Topographic Map, 1981. Georgia Bicentennial Highway Map, 1976.

NOTE: HUNTER ARMY AIRFIELD BOUNDARY EXTENDS BEYOND THE SOUTHERN LIMIT OF MAP.

CP

REPLACE THIS PAGE WITH SCANNED MAP!

River. The installation currently serves as an aircraft support base for Fort Stewart, and the U.S. Coast Guard.

Fort Stewart was established in June 1940 as an antiaircraft artillery training center. The installation was named in honor of Revolutionary War General Daniel Stewart. During World War II, the Fort Stewart served for a short period time as a prisoner of war camp, and housed two Italian units. The installation was deactivated at the end of the war. Fort Stewart was reactivated in 1950 to serve as a training post for antiaircraft artillery units in the Korean Conflict. The post's mission was expanded in 1953 to include armor training. In 1956, Fort Stewart was designated a permanent Army installation.

HAAF was acquired from the U.S. Air Force in 1967 following the designation of Fort Stewart as a flight training center. This was in response to the increased need for helicopter pilot training during the Vietnam Conflict. Aviation training was discontinued at Fort Stewart in 1973. Fort Stewart became a training and maneuver area upon activation of the 1st Battalion, 75th Infantry on January 21, 1974. Support and training for weapons systems including tank, field artillery, helicopter gunnery, and small arms was carried out for regular Army and National Guard units. The 24th Infantry Division was permanently stationed at Fort Stewart in 1975, and was active in the Persian Gulf war crisis of 1991. Aircraft based at HAAF include a variety of combat and transport helicopters. The airfield was also used for mobilization of troops and weapons during recent U.S. military operations in the Persian Gulf and Somalia.

The FTA is located on the northwestern portion of the airfield approximately 800 feet from the control tower on a grassy cleared area measuring approximately 400 feet by 200 feet. The fire training area features a 6,400 ft^2 diked, gravel-covered concrete pad upon which a simulated aircraft was constructed from a steel storage tank (ESE, 1993b). Fuels used in training exercises at the FTA were stored in an aboveground, steel storage tank with a capacity of approximately 10,000 gallons. The tank measures approximately 27 feet by 9 feet, and is installed with the long axis oriented horizontally. The tank rests on three concrete supports, and is located approximately 112 feet due north of the fire training pad. The tank is surrounded on all sides by an approximately 2.5-foot high earthen berm. Fuel used in fire training exercises was pumped through an underground line directly to the simulated aircraft on the fire training pad. The fuel line measures approximately 142 feet in length, and is of unknown diameter. Approximately 30 feet to the northeast of the steel tank is a horizontally-oriented, cylindrical, tank-like metallic object measuring approximately 12 feet by 4 feet. The function of this object, and its past use at the FTA, is not known.

The site is bounded on the northwest and south by drainage ditches, by the airfield pavement on the east, and by wooded land on the southwest (Figure 1-3). Topography at the site slopes predominantly to the west at a moderate gradient. Topographic relief in the vicinity of the site is approximately 21 feet. Elevations at the site range from 35 feet above mean sea level (msl) at the fire training pad to 14 feet msl in the northern drainage ditch (ESE, 1993).

The FTA was used until 1991 for training of fire fighters based at HAAF. Fuel utilized for training exercises included mostly water-contaminated jet fuel (JP-4) and diesel fuels. Although solvents also were reported to have been used at the site [personal communication, U.S. Army Environmental Hygiene Agency (USAEHA), 1993], no evidence or documentation exists that solvents were used. During the training exercises, the fuel was pumped on the surfaces of the simulated aircraft and ignited. The fire was extinguished with water or foam (ESE, 1993b). The pad was constructed with concrete curbs to contain the water and foam generated during fire fighting exercises. These curbs were not entirely effective in containing the fluids, which would occasionally spill over the curbs and flow onto the surrounding soil (ESE, 1993b).

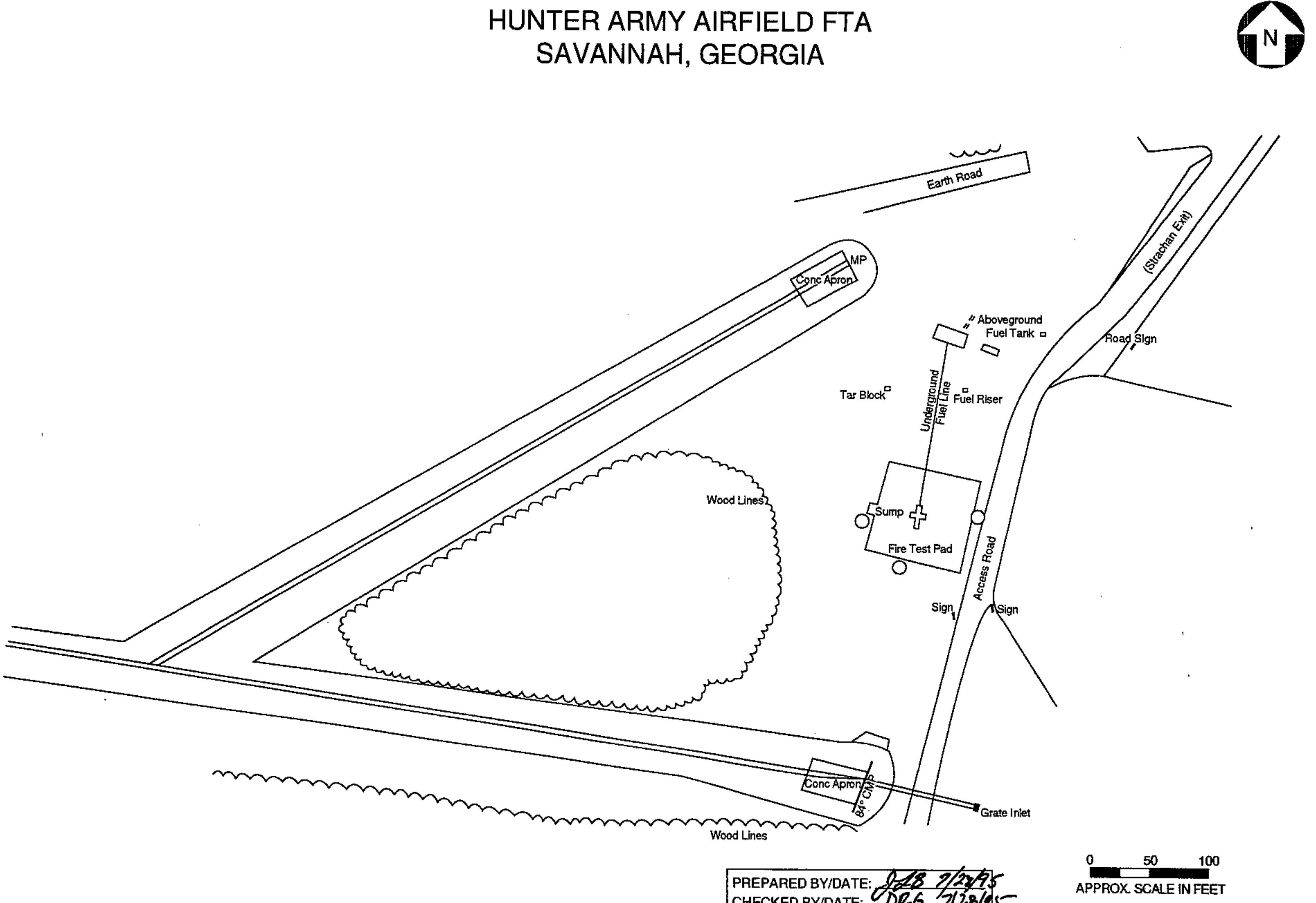
1.3.2 Environmental Setting

Hunter Army Airfield is geographically separated from the main Fort Stewart complex by a distance of approximately 50 miles. The topography of the FTA averages approximately 30 feet

FIGURE 1-3

SITE LAYOUT

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



PREPARED BY/DATE: JLB 7/27/95
CHECKED BY/DATE: DRG 7/28/95
REVIEWED BY/DATE:

(BASE MAP MODIFIED FROM ESE, 1993b)

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above mean sea level, and slopes gently west toward the Springfield canal. The canal trends southwest before emptying into the Little Ogeechee River floodplain.

1.3.2.1 Geology - The Atlantic Coastal Plain consists of a thick wedge of variably consolidated sediments ranging in age from Recent to Cretaceous. The sedimentary wedge thickens and slopes eastward at dips of less than 1 degree. Basement rocks underlying the coastal plain in the Savannah area consist of consolidated metamorphic and sedimentary rocks of Triassic to Precambrian age, and crystalline igneous rocks of the Precambrian Piedmont Formation. The depth to the Precambrian basement rocks in the Savannah area is approximately 4,200 feet (Cramer and Arden, 1980).

Sediments comprising the principal artesian and surficial aquifers at the site extend to a depth of approximately 850 feet. The units consist principally of sands and limestones of Eocene to Recent age. Figure 1-4 shows a composite geologic column representing the Savannah area.

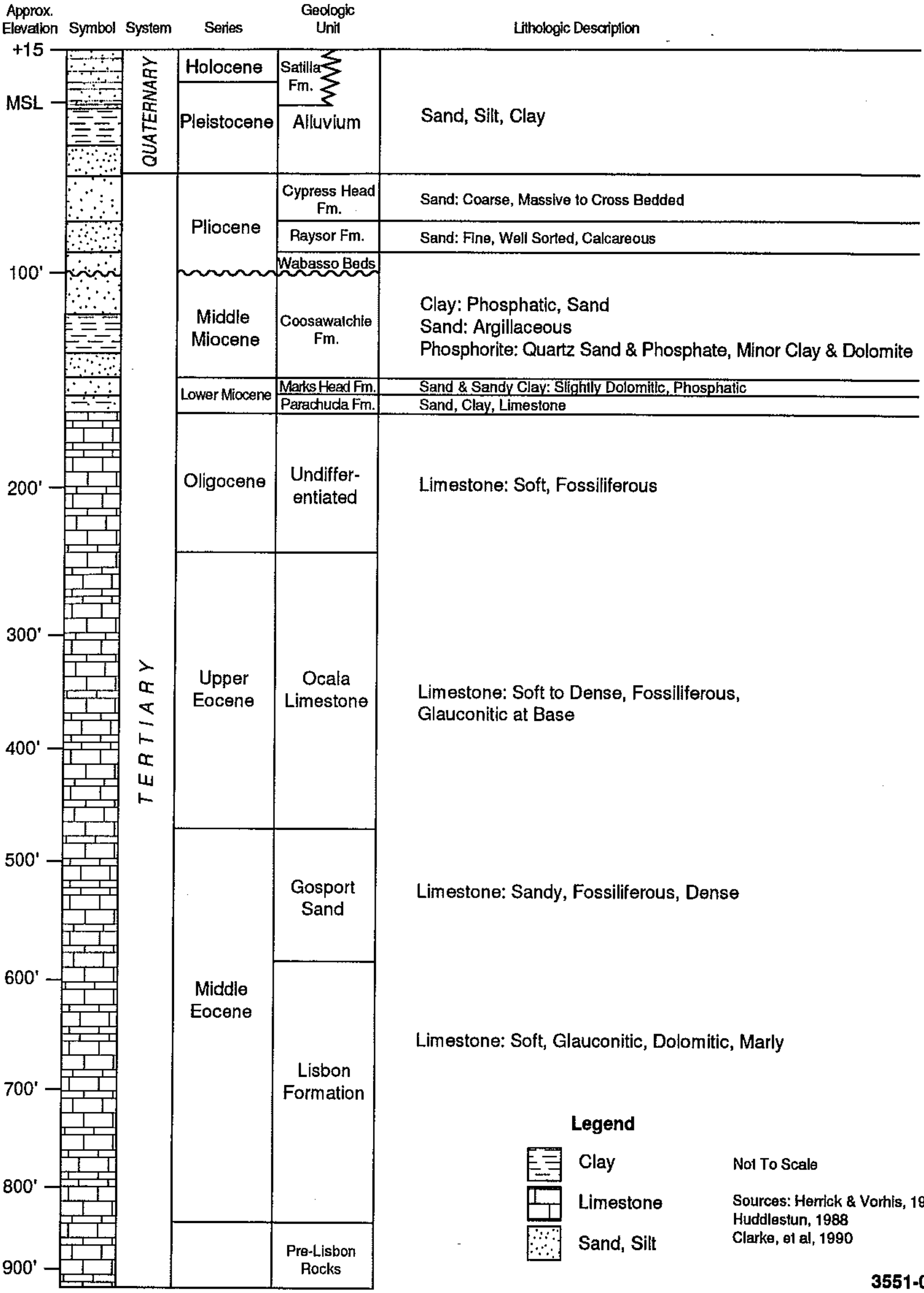
Previous investigations conducted at or near FTA (ESE, 1982; USAEHA, 1987) indicate that the geologic section consists predominantly of sand, silty sand, and lesser clayey sand deposits to a depth of at least 100 feet below ground surface (bgs). Shallow borings performed during previous investigations (USAEHA, 1987 and ESE, 1990) at the FTA indicate the surficial deposits to consist of predominantly fine grained sand to depths of at least 10 feet.

1.3.2.2 Hydrogeology - The two principal aquifer systems of the Georgia Coastal Plain are the surficial (or water table) aquifer and the Floridan aquifer. The Floridan aquifer system is comprised of Middle to Upper Eocene limestones of the Ocala Group, and undifferentiated Oligocene include sandy clay units and possibly comprises a part of the Floridan aquifer. In the Savannah area, the top of the Floridan aquifer system occurs at approximately 200 feet bgs.

FIGURE 1-4

COMPOSITE GEOLOGIC COLUMN OF SAVANNAH AREA

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



System	Series	Geologic Unit	Lithologic Description
QUATERNARY	Holocene	Satilla Fm.	Sand, Silt, Clay
	Pleistocene	Alluvium	
TERTIARY	Pliocene	Cypress Head Fm.	Sand: Coarse, Massive to Cross Bedded
		Raysor Fm.	Sand: Fine, Well Sorted, Calcareous
		Wabasso Beds	
	Middle Miocene	Coosawatchie Fm.	Clay: Phosphatic, Sand Sand: Argillaceous Phosphorite: Quartz Sand & Phosphate, Minor Clay & Dolomite
	Lower Miocene	Marks Head Fm.	Sand & Sandy Clay: Slightly Dolomitic, Phosphatic
		Parachucla Fm.	Sand, Clay, Limestone
	Oligocene	Undifferentiated	Limestone: Soft, Fossiliferous
	Upper Eocene	Ocala Limestone	Limestone: Soft to Dense, Fossiliferous, Glauconitic at Base
	Middle Eocene	Gosport Sand	Limestone: Sandy, Fossiliferous, Dense
		Lisbon Formation	Limestone: Soft, Glauconitic, Dolomitic, Marly
		Pre-Lisbon Rocks	

Not To Scale

Sources: Herrick & Vorhis, 1963,
Huddlestun, 1988
Clarke, et al, 1990

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The upper confining unit of the Floridan aquifer is comprised of the Middle and Upper Miocene Hawthorn Group and Duplin Marl. These units are comprised of clay with occasional limestone beds and provide hydraulic separation between the Floridan aquifer system and the overlying surficial aquifer.

The Pleistocene to Recent deposits overlying the Miocene units consist of complexly distributed beds of sand, silt, and clay. Development of the surficial aquifer occurs in beds and lenses of sand within these deposits. The typical water table depth in the Savannah area is approximately 3 to 10 feet bgs.

Borings performed at FTA encountered the surficial aquifer water table at 8 feet bgs. The surficial aquifer's vertical extent has yet to be determined; however, Kundell (1978) reports that the surficial aquifer may be up to 120 feet thick in the study area.

The Floridan aquifer system is the major ground-water source for the coastal plain of Georgia and adjacent states. The Floridan aquifer in Georgia provides the majority of water for industrial and domestic use (500 million gallons per day statewide in 1978). No records exist to demonstrate that extended usage of the surficial aquifer has occurred in the study area. However, on Skidaway Island east of Savannah, withdrawals from the surficial aquifer for irrigation and ground-water heat pumps range from 120,000 to 855,000 gallons per day (Clarke, Hacke, and Peck, 1990).

1.3.2.3 Climate - The climate in the vicinity of Hunter Army Airfield is moist and temperate year round. Average temperatures are typically in the range from about 52 degrees Fahrenheit in winter to 80 degrees Fahrenheit in summer. Annual rainfall averages approximately 48 inches, 60 percent of which usually falls during the period from April through September. The study area rarely is subjected to prolonged droughts.

1.3.3 Nature and Extent of Contamination

The following discussion of the nature and extent of contamination at the FTA was summarized from ESE (1993b).

1.3.3.1 Previous Investigations - In March 1987, a preliminary contamination assessment was preformed by the USAEHA. This Hazardous Waste Study was performed to evaluate the existence of contamination in the soils and pit residues at three fire training areas and 4 Explosive Ordnance Disposal sites at Fort Stewart and HAAF. During February 1990, ESE performed the first phase of a contamination evaluation at the Hunter FTA. From July to December 1992, ESE conducted tests at the FTA to determine the significance of the contamination.

The ESE investigations included drilling of soil borings, installation of monitoring wells, and sampling and analyses of sediments, soil, and ground water. Figure 1-5 shows the location of the samples collected during the 1987, 1990, and 1992 investigations. As required under Resource Conservation and Recovery Act (RCRA) regulations, ESE (1993) used the analytical results from the 1987, 1990, and 1992 investigations to develop carcinogenic and systemic preliminary cleanup targets (PCTs) for the site. Contaminant classes for which PCTs were developed included metals, volatile organic compounds, polynuclear aromatic compounds, and semi-volatile organic compounds.

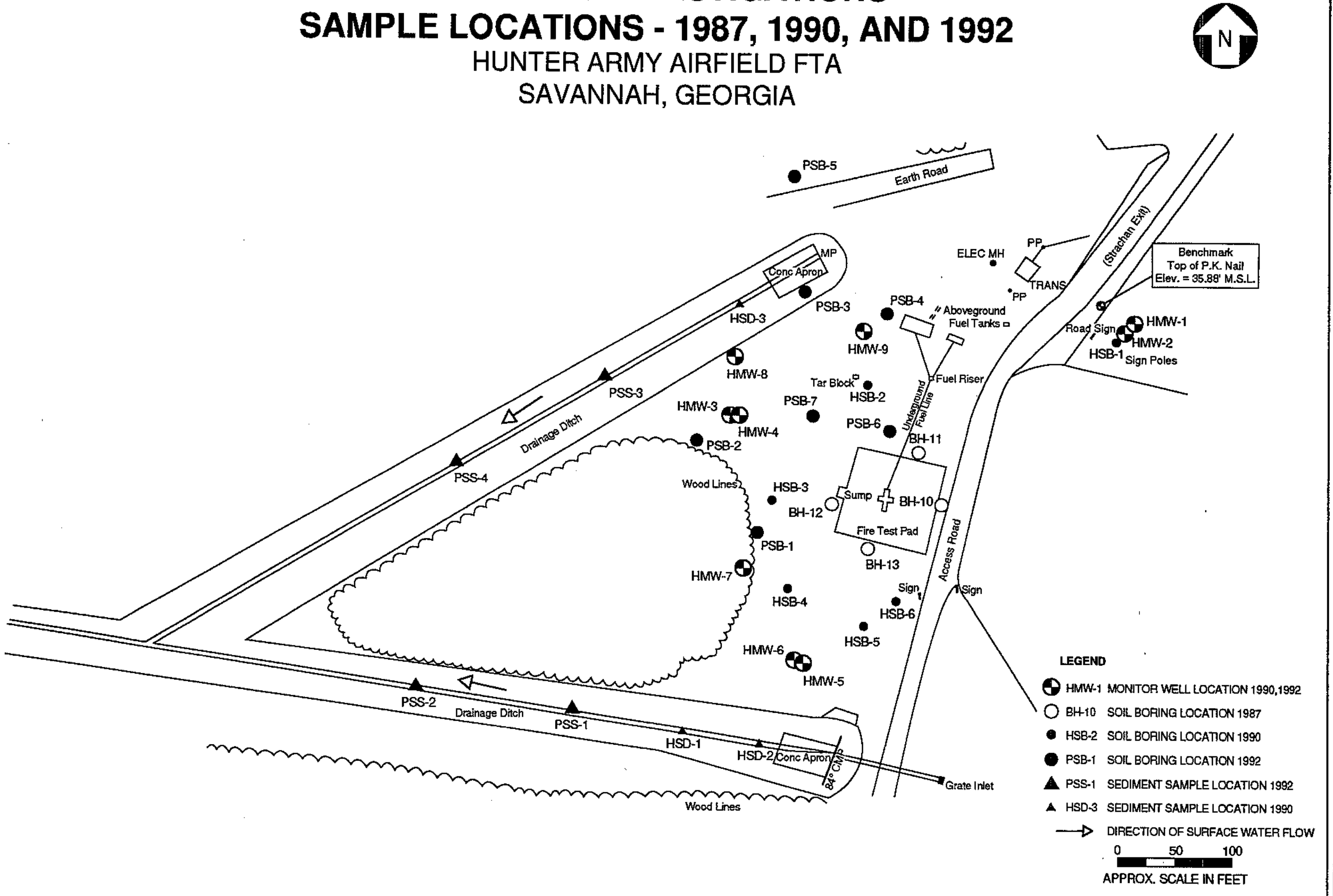
The ground-water analyses performed included hydraulic conductivity (slug) testing, ground-water level monitoring, and PCT analysis. Ground-water levels were checked in monitoring wells at the site over a six-month period using an electronic hydrologic monitor. Water level measurements were recorded hourly with the monitor, while manual measurements were taken once monthly.

Hydraulic conductivity (slug) testing was performed in two monitoring wells at the site during the 1992 investigation. Wells tested included HMW-3, completed in the deep portion of the

FIGURE 1-5

PREVIOUS INVESTIGATIONS SAMPLE LOCATIONS - 1987, 1990, AND 1992

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



(BASE MAP MODIFIED FROM ESE, 1993b)

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surficial aquifer; and HMW-4, completed in the upper portion of the surficial aquifer. Results of testing indicated the surficial aquifer hydraulic conductivity in the vicinity of wells HMW-3 and HMW-4 to be 1.8 x 10^{-3} feet per minute (ft/min) and 1.3 x 10^{-3} ft/min, respectively. Figures 1-6 and 1-7 depict the configuration of the potentiometric surface in the shallow and deep portions of the surficial aquifer, respectively.

1.3.3.2 Soil Contamination - Soil sampling was performed during the previous investigations conducted at the site. Soil sampling locations are shown in Figure 1-5. The results of chemical analysis of the soil samples are shown in Tables 1-1 through 1-3 for the 1992, 1990, and 1987 sampling events, respectively.

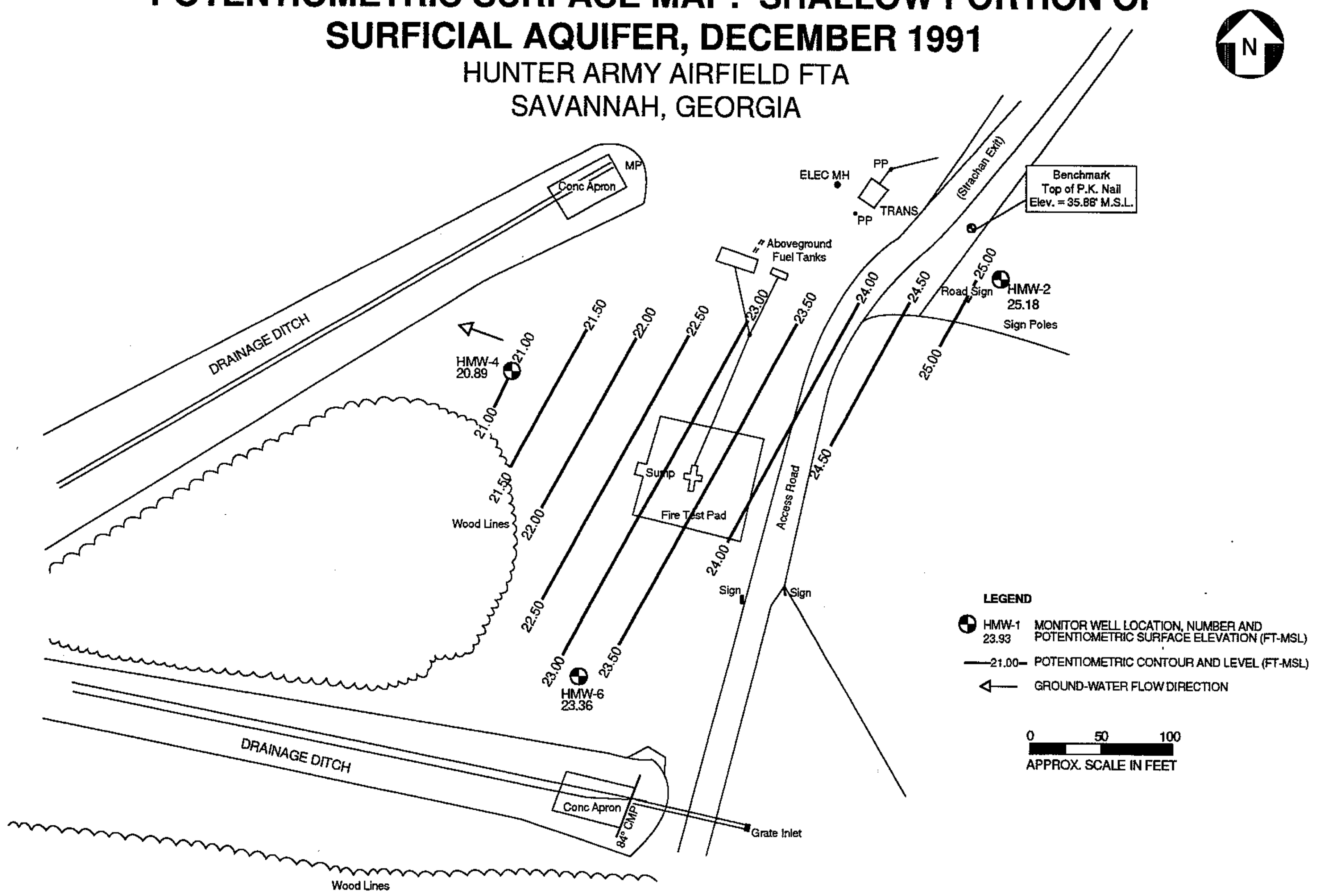
The BH-series soil borings were installed immediately adjacent to the fire training pad by USAEHA in 1987. The soil samples exhibited no significant levels of organic contamination; however, elevated levels of lead were detected. The HSB-series borings were installed mainly on the south side of the pad by ESE in 1990. In this sampling effort, the only significant contamination consisted of elevated levels of PAHs detected in the surficial sample collected from boring HSB-2, located north of the pad. The PSB-series borings were installed by ESE in 1992 in an area predominantly north and west of the pad. These borings encountered varying levels of semi-volatile organics, some of which exceeded the PCT level. The primary soil contaminant of concern was found to be benzo(a)pyrene, a carcinogenic semi-volatile organic compound.

The results from the PCT analysis show that polynuclear aromatic hydrocarbons (PAHs) were detected above their carcinogenic PCTs in soil at the site. These samples were collected from varying depths north and northwest of the fire training pad in 1990 and 1992, in a 3- to 4-foot below land surface (bls) soil sample from the underground fuel line, and in a 0 to 1 foot bls soil sample from the vicinity of the aboveground fuel storage tank. Surface soil samples collected from the fire training pad in 1987 showed lead concentrations exceeding the U.S. Environmental Protection Agency (USEPA) interim cleanup level.

FIGURE 1-6

POTENTIOMETRIC SURFACE MAP: SHALLOW PORTION OF SURFICIAL AQUIFER, DECEMBER 1991

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



ELEVATION DATUM: (NATIONAL GEODETIC VERTICAL DATUM), 1929

(BASE MAP MODIFIED FROM ESE, 1993b)

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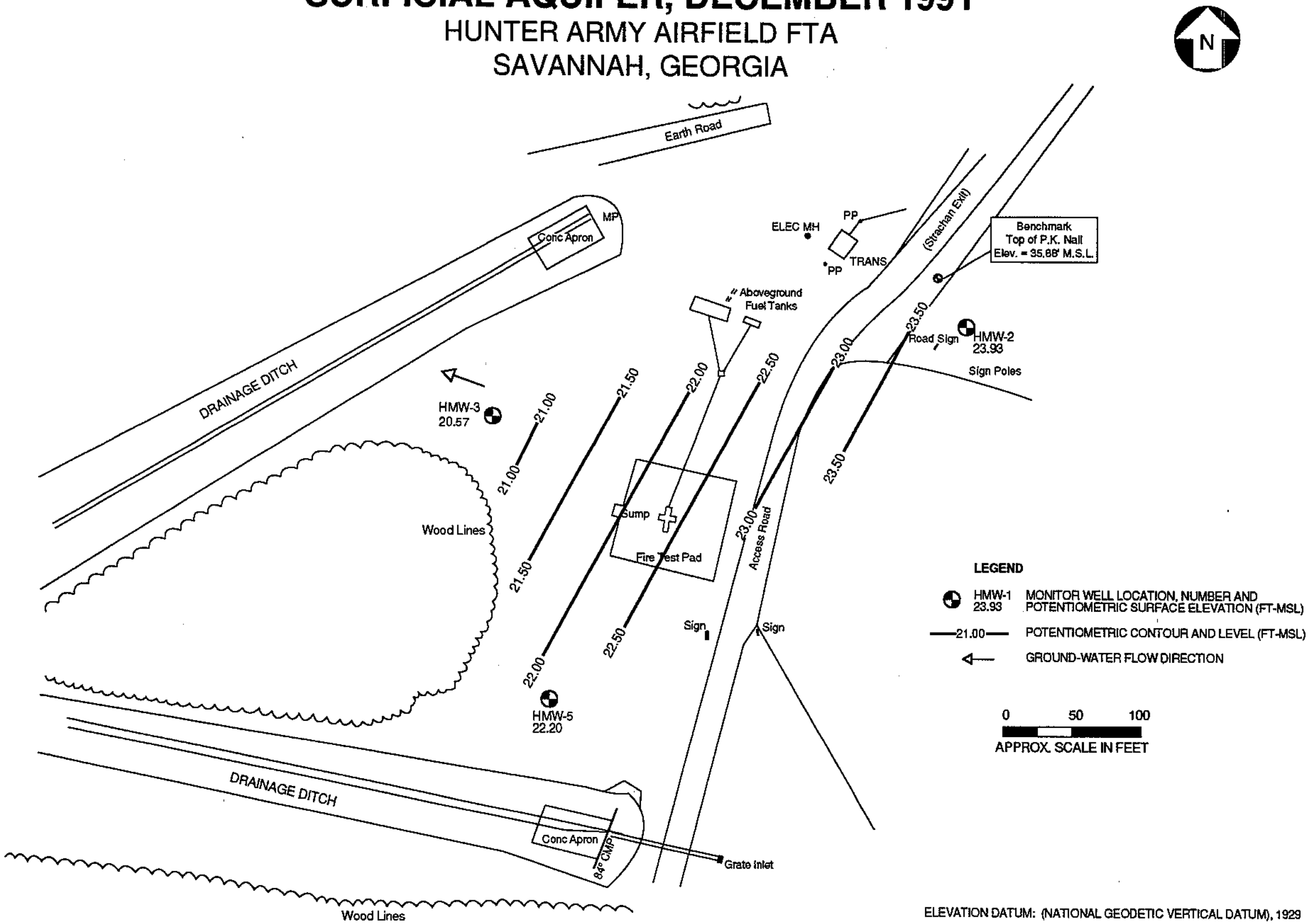
FIGURE 1-7

POTENTIOMETRIC SURFACE MAP: DEEP PORTION OF SURFICIAL AQUIFER, DECEMBER 1991

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



ELEVATION DATUM: (NATIONAL GEODETIC VERTICAL DATUM), 1929

(BASE MAP MODIFIED FROM ESE, 1993b)

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TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL												
Location	PSB-1		PSB-2		PSB-2DUP		PSB-3		PSB-4			PSB-5	
Sample ID	HS-1	HS-2	HS-3	HS-4	HS-DUP		HS-10	HS-11	HS-12	HS-13	HS-14	HS-18	HS-19
Sample Depth	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3.5-4.5	0-1 FT.	3.5-4 FT	5.5-6.5	0-1 FT.	3.5-4 FT
Date	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92
Time	10:15	10:30	11:15	11:30			08:40	08:45	09:30	09:35	10:00	13:35	13:40
1,1,1-TRICHL'ETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,1,2,2-TETRACHLORO- ETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,1,2-TRICHL'ETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,1-DICHLOROETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,1-DICHLOROETHYLENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,2-DICHLOROBENZENE UG/KG-DRY	<78.00	<850.00	<81.00	<84.00	<81.00	<83.00	<380.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
1,2-DICHLOROETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,2-DICHLOROETHENE(TOTAL) UG/KG	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,2-DICHLOROPROPANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
1,3-DICHLOROBENZENE UG/KG-DRY	<78.00	<850.00	<81.00	<84.00	<81.00	<83.00	<380.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
1,4-DICHLOROBENZENE UG/KG-DRY	<78.00	<850.00	<81.00	<84.00	<81.00	<83.00	<380.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
2-CHLOROETHYLVINYL- ETHER UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL												
Location	PSB-1		PSB-2		PSB-2DUP		PSB-3		PSB-4			PSB-5	
Sample ID	HS-1	HS-2	HS-3	HS-4	HS-DUP		HS-10	HS-11	HS-12	HS-13	HS-14	HS-18	HS-19
Sample Depth	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3.5-4.5	0-1 FT.	3.5-4 FT	5.5-6.5	0-1 FT.	3.5-4 FT
Date	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92
Time	10:15	10:30	11:15	11:30			08:40	08:45	09:30	09:35	10:00	13:35	13:40
ACENAPHTHENE UG/KG-DRY	<78.00	<850.00	<81.00	<84.00	<81.00	<83.00	<380.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
ACENAPHTHYLENE UG/KG-DRY	<170.00	<1800.00	<170.00	<180.00	<81.00	<83.00	<810.00	<170.00	<170.00	<170.00	<170.00	<74.00	<82.00
ANTHRACENE UG/KG-DRY	<78.00	<850.00	<81.00	<84.00	<81.00	<83.00	670.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
ARSENIC,SED MG/KG-DRY	1.02	0.63	1.28	2.44	1.32	1.31	0.51	0.34	0.33	0.54	0.59	0.61	0.56
BARIUM,SED MG/KG- DRY	11.40	12.80	14.90	23.40	19.10	23.60	18.30	13.90	9.60	14.70	17.70	16.20	19.10
BENZENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
BENZO(A)ANTHRACENE UG/KG-DRY	370.00	<1200.00	170.00	<120.00	140.00	<120.00	5300.00	<110.00	160.00	<110.00	<120.00	<110.00	<120.00
BENZO(A)PYRENE UG/KG-DRY	320.00	<1700.00	220.00	<170.00	180.00	<170.00	4800.00	<160.00	180.00	<160.00	<160.00	<150.00	<160.00
BENZO(B)FLUORANTHENE UG/KG-DRY	560.00	<1200.00	370.00	<120.00	160.00	<120.00	6900.00	<110.00	260.00	<110.00	<120.00	<110.00	<120.00
BENZO(GHI)PERYLENE UG/KG-DRY	<180.00	<1900.00	<180.00	<190.00	<180.00	<190.00	<870.00	<180.00	<180.00	<180.00	<190.00	<170.00	<190.00
BENZO(K)FLUORANTHENE UG/KG-DRY	250.00	<1200.00	150.00	<120.00	150.00	<120.00	2700.00	<110.00	<110.00	<110.00	<120.00	<110.00	<120.00
BROMODICHLOROMETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL												
Location	PSB-1		PSB-2		PSB-2DUP		PSB-3		PSB-4			PSB-5	
Sample ID	HS-1	HS-2	HS-3	HS-4	HS-DUP		HS-10	HS-11	HS-12	HS-13	HS-14	HS-18	HS-19
Sample Depth	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3.5-4.5	0-1 FT.	3.5-4 FT	5.5-6.5	0-1 FT.	3.5-4 FT
Date	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92
Time	10:15	10:30	11:15	11:30			08:40	08:45	09:30	09:35	10:00	13:35	13:40
BROMOFORM UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
BROMOMETHANE UG/KG-DRY	<11.00	<60.00	<12.00	<12.00	<12.00	<12.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
CADMIUM,SED MG/KG-DRY	<0.52	<0.57	<0.54	<0.55	<0.54	<0.56	<0.51	<0.54	<0.51	<0.54	<0.54	<0.50	<0.55
CARBON DISULFIDE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
CARBON TETRACHLORIDE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
CHLOROBENZENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
CHLOROETHANE UG/KG-DRY	<11.00	<60.00	<12.00	<12.00	<12.00	<12.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
CHLOROFORM UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
CHLOROMETHANE UG/KG-DRY	<11.00	<60.00	<12.00	<12.00	<12.00	<12.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
CHROMIUM,SED MG/KG-DRY	5.61	2.81	5.88	5.51	6.64	6.03	3.55	2.16	3.02	2.44	2.22	3.68	3.98
CHRYSENE UG/KG-DRY	560.00	<1200.00	200.00	<120.00	130.00	<120.00	5300.00	<110.00	170.00	<110.00	<120.00	<110.00	<120.00
CIS-1,3-DICHLORO- PROPENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL												
Location	PSB-1		PSB-2		PSB-2DUP		PSB-3		PSB-4			PSB-5	
Sample ID	HS-1	HS-2	HS-3	HS-4	HS-DUP		HS-10	HS-11	HS-12	HS-13	HS-14	HS-18	HS-19
Sample Depth	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3.5-4.5	0-1 FT.	3.5-4 FT	5.5-6.5	0-1 FT.	3.5-4 FT
Date	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92
Time	10:15	10:30	11:15	11:30			08:40	08:45	09:30	09:35	10:00	13:35	13:40
DIBEN(A,H)ANTHRACENE UG/KG-DRY	<180.00	<1900.00	<180.00	<190.00	<180.00	<190.00	<870.00	<180.00	<180.00	<180.00	<190.00	<170.00	<190.00
DIBROMOCHLOROMETHANE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
DICHLOROBENZENE,TOTAL UG/KG-DRY	<11.00	<60.00	<12.00	<12.00	<12.00	<12.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
DIETHYL ETHER UG/KG-DRY	<10.00	<60.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
ETHYLBENZENE UG/KG-DRY	<5.60	36.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	9.90	<5.30	<5.80
FLUORANTHENE UG/KG-DRY	690.00	<850.00	120.00	<84.00	160.00	<83.00	8100.00	<80.00	170.00	<80.00	<81.00	77.00	<82.00
FLUORENE UG/KG-DRY	<78.00	<850.00	<81.00	<84.00	<81.00	<83.00	<380.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
INDENO(1,2,3-CD) PYRENE UG/KG-DRY	<180.00	<1900.00	<180.00	<190.00	<180.00	<190.00	<870.00	<180.00	<180.00	<180.00	<190.00	<170.00	<190.00
LEAD,SED MG/KG-DRY	28.00	<7.62	17.30	8.82	15.80	7.58	7.39	<7.28	<6.90	<7.29	<7.27	<6.70	<7.31
MERCURY,SED MG/KG-DRY	<0.09	<0.10	<0.10	<0.10	<0.10	<0.10	<0.09	<0.10	<0.09	<0.09	<0.10	<0.09	<0.10
METHYL ETHYL KETONE UG/KG-DRY	<11.00	<60.00	<12.00	13.00	<12.00	25.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
METHYLENE CHLORIDE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL												
Location	PSB-1		PSB-2		PSB-2DUP		PSB-3		PSB-4			PSB-5	
Sample ID	HS-1	HS-2	HS-3	HS-4	HS-DUP		HS-10	HS-11	HS-12	HS-13	HS-14	HS-18	HS-19
Sample Depth	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3.5-4.5	0-1 FT.	3.5-4 FT	5.5-6.5	0-1 FT.	3.5-4 FT
Date	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92
Time	10:15	10:30	11:15	11:30			08:40	08:45	09:30	09:35	10:00	13:35	13:40
METHYLISOBUTYLKETONE UG/KG-DRY	<11.00	<60.00	<12.00	<12.00	<12.00	<12.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
MOISTURE %WET WT	10.40	17.30	13.50	16.30	13.50	16.10	7.70	12.90	10.00	12.50	13.80	6.00	14.40
NAPHTHALENE UG/KG-DRY	<78.00	3500.00	<81.00	<84.00	<81.00	<83.00	<380.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
PHENANTHRENE UG/KG-DRY	440.00	<850.00	<81.00	<84.00	<81.00	<83.00	670.00	<80.00	<78.00	<80.00	<81.00	<74.00	<82.00
PYRENE UG/KG-DRY	580.00	<850.00	190.00	<84.00	130.00	<83.00	5200.00	<80.00	140.00	<80.00	<81.00	<74.00	<82.00
SELENIUM,SED MG/KG-DRY	<0.27	<0.29	<0.28	<0.29	<0.28	<0.29	<0.26	<0.28	<0.27	<0.28	<0.28	<0.26	<0.28
SILVER,SED MG/KG-DRY	<0.78	<0.86	<0.81	<0.83	<0.81	<0.84	<0.77	<0.82	<0.77	<0.82	<0.82	<0.75	<0.82
TETRACHLOROETHENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
TOLUENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
TRANS-1,3-DICHLORO- PROPENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
TRICHLOROETHENE UG/KG-DRY	<5.60	<30.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	<5.70	<5.80	<5.30	<5.80
TRICHLOROFLUOROMETHANE UG/KG-DRY	14.00	<30.00	12.00	12.00	11.00	10.00	10.00	5.80	7.30	10.00	8.90	<5.30	<5.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS		SOIL												
	Location	PSB-1		PSB-2		PSB-2DUP		PSB-3		PSB-4			PSB-5	
	Sample ID	HS-1	HS-2	HS-3	HS-4	HS-DUP		HS-10	HS-11	HS-12	HS-13	HS-14	HS-18	HS-19
	Sample Depth	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3-4 FT.	0-1 FT.	3.5-4.5	0-1 FT.	3.5-4 FT	5.5-6.5	0-1 FT.	3.5-4 FT
	Date	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92	03/04/92
	Time	10:15	10:30	11:15	11:30			08:40	08:45	09:30	09:35	10:00	13:35	13:40
VINYL CHLORIDE UG/KG-DRY		<11.00	<60.00	<12.00	<12.00	<12.00	<12.00	<11.00	<11.00	<11.00	<11.00	<12.00	<11.00	<12.00
XYLENE,TOTAL UG/KG-DRY		<5.60	200.00	<5.80	<6.00	<5.80	<6.00	<5.40	<5.70	<5.60	24.00	60.00	<5.30	<5.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL						SEDIMENT				
Location	PSB-6			PSB-7			PSS-1	PSS-2	PSS-2DUP	PSS-3	PSS-4
Sample ID	HS-7	HS-8	HS-9	HS-15	HS-16	HS-17	HSD-1	HSD-2	HSD-DUP	HSD-3	HSD-4
Sample Depth	0-1 FT.	3-4 FT.	7.5-8.5	0-1 FT.	3-4 FT.	6-7 FT.					
Date	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92
Time	14:05	14:10	14:25	10:55	11:00	11:15	16:00	15:15		15:15	15:00
1,1,1-TRICHL'ETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,1,2,2-TETRACHLORO- ETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,1,2-TRICHL'ETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,1-DICHLOROETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,1-DICHLOROETHYLENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,2-DICHLOROBENZENE UG/KG-DRY	<82.00	<81.00	<3900.00	<76.00	<77.00	<80.00	<190.00	<910.00	<960.00	<94.00	<96.00
1,2-DICHLOROETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,2-DICHLOROETHENE(TOTAL) UG/KG	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,2-DICHLOROPROPANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
1,3-DICHLOROBENZENE UG/KG-DRY	<82.00	<81.00	<3900.00	<76.00	<77.00	<80.00	<190.00	<910.00	<960.00	<94.00	<96.00
1,4-DICHLOROBENZENE UG/KG-DRY	<82.00	<81.00	<3900.00	<76.00	<77.00	<80.00	<190.00	<910.00	<960.00	<94.00	<96.00
2-CHLOROETHYLVINYL- ETHER UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS / Location	SOIL						SEDIMENT				
	PSB-6			PSB-7			PSS-1	PSS-2	PSS-2DUP	PSS-3	PSS-4
Sample ID	HS-7	HS-8	HS-9	HS-15	HS-16	HS-17	HSD-1	HSD-2	HSD-DUP	HSD-3	HSD-4
Sample Depth	0-1 FT.	3-4 FT.	7.5-8.5	0-1 FT.	3-4 FT.	6-7 FT.					
Date	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92
Time	14:05	14:10	14:25	10:55	11:00	11:15	16:00	15:15		15:15	15:00
ACENAPHTHENE UG/KG-DRY	<82.00	<81.00	<3900.00	<76.00	<77.00	<80.00	<190.00	<910.00	<960.00	<94.00	110.00
ACENAPHTHYLENE UG/KG-DRY	<180.00	390.00	<8400.00	<160.00	210.00	<80.00	<190.00	<910.00	<960.00	<94.00	<96.00
ANTHRACENE UG/KG-DRY	<82.00	440.00	<3900.00	<76.00	210.00	<80.00	210.00	2400.00	1500.00	<94.00	130.00
ARSENIC,SED MG/KG-DRY	0.50	0.93	0.37	1.61	1.18	0.85	0.49	<0.30	0.37	<0.31	1.05
BARIUM,SED MG/KG- DRY	23.70	15.00	17.10	47.60	38.40	17.60	15.60	8.70	9.95	7.97	12.00
BENZENE UG/KG-DRY	<5.80	<29.00	39.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
BENZO(A)ANTHRACENE UG/KG-DRY	120.00	370.00	<5600.00	120.00	970.00	<110.00	760.00	13000.00	6400.00	160.00	510.00
BENZO(A)PYRENE UG/KG-DRY	<160.00	690.00	<7900.00	<150.00	1300.00	<160.00	850.00	12000.00	7100.00	<190.00	400.00
BENZO(B)FLUORANTHENE UG/KG-DRY	270.00	830.00	<5600.00	210.00	2000.00	<110.00	760.00	13000.00	7200.00	<130.00	450.00
BENZO(GHI)PERYLENE UG/KG-DRY	<190.00	<180.00	<9000.00	<170.00	<180.00	<180.00	<440.00	5100.00	<2200.00	<210.00	<220.00
BENZO(K)FLUORANTHENE UG/KG-DRY	<120.00	240.00	<5600.00	<110.00	620.00	<110.00	890.00	12000.00	7200.00	280.00	390.00
BROMODICHLOROMETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL						SEDIMENT				
Location	PSB-6			PSB-7			PSS-1	PSS-2	PSS-2DUP	PSS-3	PSS-4
Sample ID	HS-7	HS-8	HS-9	HS-15	HS-16	HS-17	HSD-1	HSD-2	HSD-DUP	HSD-3	HSD-4
Sample Depth	0-1 FT.	3-4 FT.	7.5-8.5	0-1 FT.	3-4 FT.	6-7 FT.					
Date	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92
Time	14:05	14:10	14:25	10:55	11:00	11:15	16:00	15:15		15:15	15:00
BROMOFORM UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
BROMOMETHANE UG/KG-DRY	<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
CADMIUM,SED MG/KG-DRY	<0.54	<0.54	<0.53	<0.51	<0.52	<0.54	<0.62	<0.59	<0.62	<0.62	<0.63
CARBON DISULFIDE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
CARBON TETRACHLORIDE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
CHLOROBENZENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
CHLOROETHANE UG/KG-DRY	<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
CHLOROFORM UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
CHLOROMETHANE UG/KG-DRY	<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
CHROMIUM,SED MG/KG-DRY	4.97	2.80	1.94	5.29	6.10	2.86	5.66	2.55	2.86	1.09	3.54
CHRYSENE UG/KG-DRY	220.00	210.00	<5600.00	150.00	1000.00	<110.00	930.00	15000.00	7600.00	180.00	670.00
CIS-1,3-DICHLORO- PROPENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS		SOIL					SEDIMENT				
Location	PSB-6			PSB-7			PSS-1	PSS-2	PSS-2DUP	PSS-3	PSS-4
Sample ID	HS-7	HS-8	HS-9	HS-15	HS-16	HS-17	HSD-1	HSD-2	HSD-DUP	HSD-3	HSD-4
Sample Depth	0-1 FT.	3-4 FT.	7.5-8.5	0-1 FT.	3-4 FT.	6-7 FT.					
Date	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92
Time	14:05	14:10	14:25	10:55	11:00	11:15	16:00	15:15		15:15	15:00
DIBEN(A,H)ANTHRACENE UG/KG-DRY	<190.00	<180.00	<9000.00	<170.00	<180.00	<180.00	<440.00	<2100.00	<2200.00	<210.00	<220.00
DIBROMOCHLOROMETHANE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
DICHLOROBENZENE,TOTAL UG/KG-DRY	<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
DIETHYL ETHER UG/KG-DRY	<10.00	<60.00	<60.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00
ETHYLBENZENE UG/KG-DRY	<5.80	65.00	540.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
FLUORANTHENE UG/KG-DRY	360.00	320.00	<3900.00	180.00	980.00	<80.00	2200.00	34000.00	15000.00	190.00	1200.00
FLUORENE UG/KG-DRY	<82.00	<81.00	<3900.00	<76.00	<77.00	<80.00	<190.00	1200.00	<960.00	<94.00	130.00
INDENO(1,2,3-CD) PYRENE UG/KG-DRY	<190.00	570.00	<9000.00	<170.00	<180.00	<180.00	440.00	7600.00	3300.00	<210.00	<220.00
LEAD,SED MG/KG-DRY	23.90	8.83	<7.16	13.80	107.00	<7.19	29.40	16.00	22.90	<8.36	<8.46
MERCURY,SED MG/KG-DRY	<0.10	<0.10	<0.09	<0.09	<0.09	<0.09	<0.11	<0.11	<0.12	<0.11	<0.11
METHYL ETHYL KETONE UG/KG-DRY	<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
METHYLENE CHLORIDE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	SOIL						SEDIMENT				
Location	PSB-6			PSB-7			PSS-1	PSS-2	PSS-2DUP	PSS-3	PSS-4
Sample ID	HS-7	HS-8	HS-9	HS-15	HS-16	HS-17	HSD-1	HSD-2	HSD-DUP	HSD-3	HSD-4
Sample Depth	0-1 FT.	3-4 FT.	7.5-8.5	0-1 FT.	3-4 FT.	6-7 FT.					
Date	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92
Time	14:05	14:10	14:25	10:55	11:00	11:15	16:00	15:15		15:15	15:00
METHYLISOBUTYLKETONE UG/KG-DRY	<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
MOISTURE %WET WT	14.50	13.20	11.00	8.30	8.80	12.10	26.60	23.20	27.10	25.40	27.00
NAPHTHALENE UG/KG-DRY	<82.00	1400.00	41000.00	<76.00	<77.00	<80.00	<190.00	<910.00	<960.00	<94.00	<96.00
PHENANTHRENE UG/KG-DRY	170.00	90.00	<3900.00	<76.00	100.00	<80.00	810.00	19000.00	7400.00	<94.00	1400.00
PYRENE UG/KG-DRY	170.00	230.00	<3900.00	110.00	810.00	<80.00	1400.00	21000.00	9100.00	220.00	990.00
SELENIUM,SED MG/KG-DRY	<0.28	<0.28	<0.27	<0.27	<0.26	<0.28	<0.33	<0.31	<0.33	<0.32	<0.34
SILVER,SED MG/KG-DRY	<0.81	<0.80	<0.80	<0.76	<0.78	<0.81	<0.93	<0.89	<0.94	<0.94	<0.95
TETRACHLOROETHENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
TOLUENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
TRANS-1,3-DICHLORO- PROPENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
TRICHLOROETHENE UG/KG-DRY	<5.80	<29.00	<28.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80
TRICHLOROFLUOROMETHANE UG/KG-DRY	14.00	31.00	<28.00	<5.50	<5.50	7.00	6.90	7.40	<6.90	<6.70	<6.80

Source: ESE, 1993b

TABLE 1-1

RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS		SOIL						SEDIMENT				
	Location	PSB-6			PSB-7			PSS-1	PSS-2	PSS-2DUP	PSS-3	PSS-4
	Sample ID	HS-7	HS-8	HS-9	HS-15	HS-16	HS-17	HSD-1	HSD-2	HSD-DUP	HSD-3	HSD-4
	Sample Depth	0-1 FT.	3-4 FT.	7.5-8.5	0-1 FT.	3-4 FT.	6-7 FT.					
	Date	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92	03/04/92	03/03/92	03/03/92	03/03/92	03/04/92	03/04/92
	Time	14:05	14:10	14:25	10:55	11:00	11:15	16:00	15:15		15:15	15:00
VINYL CHLORIDE UG/KG-DRY		<12.00	<58.00	<56.00	<11.00	<11.00	<11.00	<14.00	<13.00	<14.00	<13.00	<14.00
XYLENE,TOTAL UG/KG-DRY		<5.80	220.00	990.00	<5.50	<5.50	<5.70	<6.80	<6.50	<6.90	<6.70	<6.80

Source: ESE, 1993b

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS		SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	UNITS / Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
%MOISTURE	%WET WT	5.00	12.40	16.20	14.00	21.60	16.30	NRQ	13.90	26.20	19.70	19.80	NRQ	NRQ
1,1,1-TRICHL'ETHANE	UG/KG-DRY	<1.40	<1.50	<200.00	<1.60	<2100.00	<1.60	NRQ	<1.50	<1.80	<1.60	<1.60	NRQ	NRQ
1,1,1-TRICHL'ETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.60	NRQ	NRQ	NRQ	NRQ	<1.60	<1.60
1,1,2,2-TETRACHLORO ETHANE	UG/KG-DRY	<1.60	<1.70	<230.00	<1.80	<2400.00	<1.80	NRQ	<1.70	<2.10	<1.90	<1.90	NRQ	NRQ
1,1,2,2-TETRACHLORO ETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.50	NRQ	NRQ	NRQ	NRQ	<1.50	<1.50
1,1,2-TRICHL'ETHANE	UG/KG-DRY	<1.70	<1.80	<240.00	<1.90	<2500.00	<1.90	NRQ	<1.80	<2.20	<2.00	<2.00	NRQ	NRQ
1,1,2-TRICHL'ETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.87	NRQ	NRQ	NRQ	NRQ	<0.87	<0.87
1,1-DICHLOROETHANE	UG/KG-DRY	<0.90	<0.97	<130.00	<1.00	<1400.00	<1.00	NRQ	<0.98	<1.20	<1.00	<1.00	NRQ	NRQ
1,1-DICHLOROETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.85	NRQ	NRQ	NRQ	NRQ	<0.85	<0.85
1,1-DICHLOROETHENE	UG/G-DRY	<1.30	<1.40	<180.00	<1.40	<1900.00	<1.40	NRQ	<1.40	<1.60	<1.50	<1.50	NRQ	NRQ
1,1-DICHLOROETHYLENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.20	NRQ	NRQ	NRQ	NRQ	<1.20	<1.20
1,2-DICHLOROETHANE	UG/KG-DRY	<0.92	<1.00	<130.00	<1.00	<1400.00	<1.00	NRQ	<1.00	<1.20	<1.10	<1.10	NRQ	NRQ
1,2-DICHLOROETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.87	NRQ	NRQ	NRQ	NRQ	<0.87	<0.87
1,2-DICHLOROETHANE-D4	UG/KG-DRY	58.00	60.00	54.00	61.00	48.00	62.00	NRQ	59.00	72.00	59.00	58.00	NRQ	NRQ
1,2-DICHLOROETHANE-D4 (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	47.00
1,2-DICHLOROETHENE, TOTAL	UG/KG-DRY	<1.37	<1.49	<194.00	<1.53	<2070.00	<1.54	NRQ	<1.49	<1.76	<1.60	<1.60	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID / Sample Depth / Date / Time / UNITS	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time / UNITS	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
1,2-DICHLOROETHENE, TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.30	NRQ	NRQ	NRQ	NRQ	<1.30	<1.30
1,2-DICHLOROPROPANE	UG/KG-DRY	<1.00	<1.10	<140.00	<1.10	<1500.00	<1.10	NRQ	<1.10	<1.30	<1.20	<1.20	NRQ	NRQ
1,2-DICHLOROPROPANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.97	NRQ	NRQ	NRQ	NRQ	<0.97	<0.97
2,4,6-TRIBROMOPHENOL	MG/KG-DRY	6750.00	7620.00	9150.00	8940.00	9730.00	8490.00	NRQ	7200.00	7820.00	7370.00	1530.00	NRQ	NRQ
2,4,6-TRIBROMOPHENOL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	120.00
2-BUTANONE	UG/KG-DRY	<9.96	<10.80	<1410.00	<11.10	15100.00	<11.20	NRQ	<10.90	<12.80	<11.60	<11.70	NRQ	NRQ
2-BUTANONE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<9.44	NRQ	NRQ	NRQ	NRQ	<9.44	<9.44
2-FLUORBIPHENYL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	75.00
2-FLUOROBIPHENYL	UG/KG-DRY	3300.00	3880.00	4510.00	4250.00	4490.00	3640.00	NRQ	4030.00	3990.00	4460.00	4530.00	NRQ	NRQ
2-FLUOROPHENOL	UG/KG-DRY	8940.00	9410.00	10200.00	10600.00	10400.00	10300.00	NRQ	8610.00	10000.00	9870.00	9500.00	NRQ	NRQ
2-FLUOROPHENOL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	110.00
2-HEXANONE	UG/KG-DRY	<3.30	<3.60	<470.00	<3.70	<5000.00	<3.70	NRQ	<3.60	<4.20	<3.90	<3.90	NRQ	NRQ
2-HEXANONE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.10	NRQ	NRQ	NRQ	NRQ	<3.10	<3.10
4-METHYL-2-PENTANONE	UG/KG-DRY	<2.83	<3.07	<400.00	<3.15	<4270.00	<3.17	NRQ	<3.08	<3.63	<3.30	<3.31	NRQ	NRQ
4-METHYL-2-PENTANONE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.00	NRQ	NRQ	NRQ	NRQ	<3.00	<3.00
ACENAPHTHENE	UG/KG-DRY	<130.00	300.00	<150.00	<150.00	<160.00	<150.00	NRQ	1100.00	<170.00	<1600.00	4900.00	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
	UNITS													
ACENAPHTHENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.80
ACENAPHTHYLENE	UG/KG-DRY	<96.00	400.00	<110.00	<110.00	<120.00	<110.00	NRQ	<530.00	<120.00	3100.00	2000.00	NRQ	NRQ
ACENAPHTHYLENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.70
ACETONE	UG/KG-DRY	<18.00	<19.00	<2500.00	<20.00	27000.00	<20.00	NRQ	40.00	110.00	120.00	<21.00	NRQ	NRQ
ACETONE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<17.00	NRQ	NRQ	NRQ	NRQ	<17.00	<17.00
ANTHRACENE	UG/KG-DRY	<75.00	1300.00	<85.00	<83.00	<91.00	<85.00	NRQ	3000.00	<97.00	8200.00	9300.00	NRQ	NRQ
ANTHRACENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.10
ARSENIC,SED	MG/KG-DRY	<0.48	<0.52	<0.54	0.65	0.85	<0.55	NRQ	<0.53	0.76	<0.57	<0.57	NRQ	NRQ
ARSENIC,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.30
BARIUM,SED	MG/KG-DRY	3.83	5.97	6.21	4.44	15.40	11.20	NRQ	19.80	8.46	13.40	229.00	NRQ	NRQ
BARIUM,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.70
BENZENE	UG/KG-DRY	<1.20	<1.30	<170.00	<1.30	<1800.00	<1.30	NRQ	<1.30	<1.50	15.00	31.00	NRQ	NRQ
BENZENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.10	NRQ	NRQ	NRQ	NRQ	<1.10	<1.10
BENZO(A)ANTHRACENE	UG/KG-DRY	<62.00	4900.00	<70.00	<68.00	<75.00	<70.00	NRQ	13000.00	<79.00	26000.00	33000.00	NRQ	NRQ
BENZO(A)ANTHRACENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.80
BENZO(A)PYRENE	UG/KG-DRY	<180.00	3400.00	<210.00	<200.00	<220.00	<210.00	NRQ	9200.00	<230.00	18000.00	27000.00	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	UNITS	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
BENZO(A)PYRENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<5.20
BENZO(B)FLUORANTHENE	UG/KG-DRY	<130.00	5000.00	<150.00	<150.00	<160.00	<150.00	NRQ	16000.00	<170.00	21000.00	27000.00	NRQ	NRQ
BENZO(B)FLUORANTHENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.80
BENZO(GHI)PERYLENE	UG/KG-DRY	<74.00	2200.00	<84.00	<81.00	<89.00	<84.00	NRQ	6200.00	<95.00	13000.00	17000.00	NRQ	NRQ
BENZO(GHI)PERYLENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.10
BENZO(K)FLUORANTHENE	UG/KG-DRY	<170.00	2500.00	<190.00	<180.00	<200.00	<190.00	NRQ	7200.00	<210.00	17000.00	29000.00	NRQ	NRQ
BENZO(K)FLUORANTHENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<4.70
BROMODICHLOROMETHANE	UG/KG-DRY	<1.00	<1.10	<150.00	<1.20	<1600.00	<1.20	NRQ	<1.10	<1.30	<1.20	<1.20	NRQ	NRQ
BROMODICHLOROMETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.98	NRQ	NRQ	NRQ	NRQ	<0.98	<0.98
BROMOFLUOROBENZENE	UG/KG-DRY	52.00	46.00	62.00	50.00	54.00	50.00	NRQ	54.00	61.00	67.00	65.00	NRQ	NRQ
BROMOFLUOROBENZENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	45.00
BROMOFORM	UG/KG-DRY	<2.60	<2.80	<370.00	<2.90	<3900.00	<2.90	NRQ	<2.80	<3.30	<3.00	<3.00	NRQ	NRQ
BROMOFORM (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.50	NRQ	NRQ	NRQ	NRQ	<2.50	<2.50
BROMOMETHANE	UG/KG-DRY	<1.20	<1.30	<170.00	<1.40	<1900.00	<1.40	NRQ	<1.30	<1.60	<1.40	<1.40	NRQ	NRQ
BROMOMETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.20	NRQ	NRQ	NRQ	NRQ	<1.20	<1.20
CADMIUM,SED	MG/KG-DRY	<0.37	<0.40	<0.42	<0.41	<0.45	<0.42	NRQ	<0.41	<0.47	<0.44	<0.44	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	UNITS	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
CADMIUM,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.50
CARBON DISULFIDE	UG/KG-DRY	<3.30	<3.60	<460.00	<3.70	<5000.00	<3.70	NRQ	<3.60	23.00	<3.80	<3.80	NRQ	NRQ
CARBON DISULFIDE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.10	NRQ	NRQ	NRQ	NRQ	<3.10	<3.10
CARBON TETRACHLORIDE	UG/KG-DRY	<1.00	<1.10	<140.00	<1.10	<1500.00	<1.10	NRQ	<1.10	<1.30	<1.20	<1.20	NRQ	NRQ
CARBON TETRACHLORIDE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.97	NRQ	NRQ	NRQ	NRQ	<0.97	<0.97
CHLOROBENZENE	UG/KG-DRY	<0.69	<0.74	<97.00	<0.76	<1000.00	<0.77	NRQ	<0.75	<0.88	<0.80	<0.80	NRQ	NRQ
CHLOROBENZENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.65	NRQ	NRQ	NRQ	NRQ	<0.65	<0.65
CHLOROETHANE	UG/KG-DRY	<1.80	<2.00	<260.00	<2.10	<2800.00	<2.10	NRQ	<2.00	<2.40	<2.20	<2.20	NRQ	NRQ
CHLOROETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.80	NRQ	NRQ	NRQ	NRQ	<1.80	<1.80
CHLOROFORM	UG/KG-DRY	<1.20	<1.30	<180.00	<1.40	<1900.00	<1.40	NRQ	<1.40	<1.60	<1.50	<1.50	NRQ	NRQ
CHLOROFORM (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.20	NRQ	NRQ	NRQ	NRQ	<1.20	<1.20
CHLOROMETHANE	UG/KG-DRY	<26.00	<28.00	<3600.00	<28.00	39000.00	<29.00	NRQ	<28.00	<33.00	<30.00	<30.00	NRQ	NRQ
CHLOROMETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<24.00	NRQ	NRQ	NRQ	NRQ	<24.00	<24.00
CHROMIUM,SED	MG/KG-DRY	0.78	3.49	3.85	5.87	1.93	2.39	NRQ	3.38	2.20	69.70	52.00	NRQ	NRQ
CHROMIUM,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<7.00
CHRYSENE	UG/KG-DRY	<97.00	5100.00	<110.00	<110.00	<120.00	<110.00	NRQ	22000.00	<120.00	40000.00	52000.00	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID / Sample Depth / Date / Time / UNITS	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
CHRYSENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.80
CIS-1,3-DICHLOROPROPENE	UG/KG-DRY	<1.60	<1.80	<230.00	<1.80	<2400.00	<1.80	NRQ	<1.80	<2.10	<1.90	<1.90	NRQ	NRQ
CIS-1,3-DICHLOROPROPENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.50	NRQ	NRQ	NRQ	NRQ	<1.50	<1.50
DIBEN'(A,H)ANTH'CENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.80
DIBEN(A,H)ANTHRACENE	UG/KG-DRY	<63.00	1100.00	<72.00	<70.00	<77.00	<72.00	NRQ	4200.00	<81.00	8100.00	11000.00	NRQ	NRQ
DIBROMOCHLOROMETHANE	UG/KG-DRY	<1.40	<1.50	<200.00	<1.50	<2100.00	<1.50	NRQ	<1.50	<1.80	<1.60	<1.60	NRQ	NRQ
DIBROMOCHLOROMETHANE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.30	NRQ	NRQ	NRQ	NRQ	<1.30	<1.30
ETHYLBENZENE	UG/KG-DRY	<1.10	<1.10	1500.00	<1.20	10000.00	<1.20	NRQ	<1.10	<1.40	<1.20	<1.20	NRQ	NRQ
ETHYLBENZENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.00	NRQ	NRQ	NRQ	NRQ	<1.00	<1.00
FLUORANTHENE	UG/KG-DRY	<110.00	13000.00	140.00	<130.00	360.00	<130.00	NRQ	36000.00	<150.00	54000.00	62000.00	NRQ	NRQ
FLUORANTHENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.20
FLUORENE	UG/KG-DRY	<110.00	720.00	<120.00	<120.00	<130.00	<120.00	NRQ	1500.00	<140.00	2500.00	8300.00	NRQ	NRQ
FLUORENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<3.10
INDENO(1,2,3-CD)PYRENE	UG/KG-DRY	<95.00	2900.00	<110.00	<110.00	<120.00	<110.00	NRQ	7900.00	<120.00	15000.00	23000.00	NRQ	NRQ
INDENO(1,2,3-CD)PYRENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.70
LEAD,SED	MG/KG-DRY	<5.26	<5.71	<5.97	<5.81	7.40	<5.97	NRQ	7.65	7.71	275.00	362.00	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	UNITS	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
LEAD,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<25.00
MERCURY,SED	MG/KG-DRY	<0.10	<0.11	<0.11	<0.11	<0.12	<0.12	NRQ	<0.11	<0.13	<0.12	<0.12	NRQ	NRQ
MERCURY,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.20
METHYLENE CHLORIDE	UG/KG-DRY	<1.70	<1.80	<240.00	<1.90	<2600.00	6.70	NRQ	7.00	12.00	<2.00	<2.00	NRQ	NRQ
METHYLENE CHLORIDE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	2.60	NRQ	NRQ	NRQ	NRQ	<1.60	<1.60
NAPHTHALENE	UG/KG-DRY	<210.00	<230.00	5700.00	<230.00	11000.00	<240.00	NRQ	<230.00	<270.00	<250.00	390.00	NRQ	NRQ
NAPHTHALENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<5.90
NITROBENZENE-D(5)	UG/KG-DRY	3670.00	3910.00	4180.00	4130.00	3740.00	4060.00	NRQ	3790.00	4310.00	4270.00	4070.00	NRQ	NRQ
NITROBENZENE-D(5) (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	87.00
PHENANTHRENE	UG/KG-DRY	<67.00	8100.00	150.00	<74.00	290.00	<76.00	NRQ	20000.00	<87.00	33000.00	62000.00	NRQ	NRQ
PHENANTHRENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.90
PHENOL-D(5)	UG/KG-DRY	9640.00	9660.00	10800.00	10000.00	11000.00	10700.00	NRQ	7980.00	9510.00	8650.00	8780.00	NRQ	NRQ
PHENOL-D(5) (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	77.00
PYRENE	UG/KG-DRY	<72.00	9700.00	140.00	<79.00	340.00	<81.00	NRQ	27000.00	<92.00	43000.00	58000.00	NRQ	NRQ
PYRENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.00
SELENIUM,SED	MG/KG-DRY	<0.42	<0.45	<0.47	<0.46	0.67	<0.47	NRQ	<0.46	<0.54	<0.49	<0.49	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	UNITS	SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
SELENIUM,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.00
SILVER,SED	MG/KG-DRY	<0.60	<0.65	<0.68	<0.66	<0.73	<0.68	NRQ	<0.66	<0.77	<0.71	<0.71	NRQ	NRQ
SILVER,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<5.70
STYRENE	UG/KG-DRY	<1.70	<1.80	<240.00	<1.90	<2500.00	<1.90	NRQ	<1.80	<2.20	<2.00	<2.00	NRQ	NRQ
STYRENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.60	NRQ	NRQ	NRQ	NRQ	<1.60	<1.60
TERPHENYL-(D14)	MG/KG-DRY	5880.00	5940.00	4000.00	10600.00	5450.00	5260.00	NRQ	5430.00	4240.00	4890.00	4850.00	NRQ	NRQ
TERPHENYL-(D14) (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	73.00
TETRACHLOROETHENE	UG/KG-DRY	<0.54	<0.58	<76.00	<0.60	<810.00	<0.60	NRQ	<0.59	<0.69	<0.63	<0.63	NRQ	NRQ
TETRACHLOROETHENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.51	NRQ	NRQ	NRQ	NRQ	<0.51	<0.51
TOLUENE	UG/KG-DRY	2.80	2.90	<100.00	<0.82	<1100.00	5.50	NRQ	<0.81	3.20	<0.86	<0.86	NRQ	NRQ
TOLUENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.70	NRQ	NRQ	NRQ	NRQ	<0.70	<0.70
TOLUENE-D(8) (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	51.00
TOLUENE-D8	UG/KG-DRY	59.00	66.00	61.00	66.00	55.00	67.00	NRQ	63.00	73.00	68.00	54.00	NRQ	NRQ
TRANS-1,3-DICHLOROPROPENE	UG/KG-DRY	<0.91	<0.98	<130.00	<1.00	<1400.00	<1.00	NRQ	<0.99	<1.20	<1.10	<1.10	NRQ	NRQ
TRANS-1,3-DICHLOROPROPENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.86	NRQ	NRQ	NRQ	NRQ	<0.86	<0.86
TRICHLOROETHENE	UG/KG-DRY	<0.92	<1.00	<130.00	<1.00	<1400.00	<1.00	NRQ	<1.00	<1.20	<1.10	<1.10	NRQ	NRQ

TABLE 1-2

1990 RESULTS OF SOIL AND SEDIMENT SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS		SOIL							SEDIMENT					
	Sample ID	HSB-1	HSB-2	HSB-3	HSB-4	HSB-5	HSB-6	TRPBLK	SD-1	SD-2	SD-3	SD-3DUP	TRPBLK	RINSEBLK
	Sample Depth	8-10 FT.	3-5 FT.	6-8 FT.	2-4 FT.	5-8 FT.	8-10 FT.							
	Date	02/12/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/13/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90	02/12/90
	Time UNITS	17:05	07:45	08:35	09:35	11:35	12:45	12:00	09:00	09:20	09:30	09:30	10:30	10:45
TRICHLOROETHENE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<0.87	NRQ	NRQ	NRQ	NRQ	<0.87	<0.87
VINYL ACETATE	UG/KG-DRY	<2.70	<2.90	<380.00	<3.00	<4100.00	<3.00	NRQ	<3.00	<3.50	<3.20	<3.20	NRQ	NRQ
VINYL ACETATE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<2.60	NRQ	NRQ	NRQ	NRQ	<2.60	<2.60
VINYL CHLORIDE	UG/KG-DRY	<1.60	<1.80	<230.00	<1.80	<2500.00	<1.80	NRQ	<1.80	<2.10	<1.90	<1.90	NRQ	NRQ
VINYL CHLORIDE (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.60	NRQ	NRQ	NRQ	NRQ	<1.60	<1.60
XYLENE,SED	UG/KG-DRY	<1.10	<1.20	<150.00	<1.20	57000.00	<1.20	NRQ	<1.20	<1.40	2.40	<1.30	NRQ	NRQ
XYLENES,TOTAL (EPTOX)	UG/L	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	<1.00	NRQ	NRQ	NRQ	NRQ	<1.00	<1.00

TABLE 1-3

1987 RESULTS OF SOIL SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS UNITS	Sample ID	BH-10		BH-11		BH-12		BH-13			QA ALCOHOL	QA WASH
	Sample Depth	0-1 FT.	7.5-8.5 FT.	0-1 FT.	7.5-8.5 FT.	0-1 FT.	6.5-7.5 FT.		0-1 FT.	6.0-7.5 FT.		
2 METHYLNAPHTHALENE	UG/KG	<1.00	19000.00	<1.00	12000.00	<1.00	10000.00	<2.00	<1.00	<1.00	<1.00	<1.00
ARSENIC	UG/G	5.99	2.00	13.90	3.88	4.00	<1.96	11.98	7.75	3.94	<1.96	<1.96
BARIUM	UG/G	64.40	9.19	33.50	18.10	7.19	8.12	27.10	19.80	8.28	<0.01	<0.01
BIS (2 ETHYLHEXYL) PHTHALATE	UG/KG	<1.00	1.70	<1.00	900.00	<1.00	300.00	<3.00	<1.00	NRQ	<1.00	<1.00
CADMIUM	UG/G	<1.98	<1.98	1.99	<1.98	<1.98	<1.98	0.02	3.87	<1.98	<1.98	<1.98
CHROMIUM	UG/G	12.80	<3.96	4.16	<3.96	5.19	<3.96	2.84	9.10	<3.96	<3.96	<3.96
DI-N-LATEBUTYLPHTHALATE	UG/KG	<1.00	1300.00	<1.00	600.00	<1.00	2400.00	<2.00	<1.00	<1.00	<1.00	<1.00
DIETHYLPHTHALATE	UG/KG	<1.00	<1.00	<1.00	<1.00	<1.00	200.00	<2.00	<1.00	<1.00	<1.00	<1.00
FLUORENE	UG/KG	<1.00	400.00	<1.00	<1.00	<1.00	200.00	<3.00	<1.00	NRQ	<1.00	<1.00
LEAD	UG/G	645.00	35.90	1163.70	NRQ	102.00	19.30	1179.80	1185.00	13.80	<1.98	<1.98
MERCURY	UG/G	0.40	0.39	0.38	0.38	0.40	0.38	0.79	0.38	0.39	<0.04	<0.04
NAPHTHALENE	UG/KG	<1.00	10000.00	<1.00	7000.00	<1.00	5800.00	<2.00	<1.00	<1.00	<1.00	<1.00
PHENANTHRENE	UG/KG	<1.00	900.00	<1.00	<1.00	<1.00	200.00	<3.00	<1.00	NRQ	<1.00	<1.00
SELENIUM	UG/G	<0.20	<0.20	<0.20	<0.20	0.79	0.60	0.22	0.33	<0.20	<0.20	<0.20
SILVER	UG/G	<3.99	<3.99	<3.99	<3.99	<3.99	<3.99	<7.98	<3.99	<3.99	<3.99	<3.99

Source: ESE, 1993

ESE (1993a and 1993b) estimated the volume of soil contaminated with volatile and semi-volatile organics at the site to be in the range of 3,000 to 11,000 cubic yards (yd^3). The majority of this soil is in the depth range of 0 to 1 foot bls. Metal contamination in soils at the site was estimated to be present in approximately 200 to 300 yd^3 of soil on and around the fire training pad, with lead being the primary metal contaminant of concern (ESE, 1993a and 1993b).

Figures 1-8, 1-9, and 1-10 shows ESE's interpretation of the extent of soil contamination at the site. These figures illustrate a greater confidence level in the interpreted extent of subsurface soil contamination as compared to surface soil contamination.

1.3.3.3 Sediment Contamination - The two drainage ditches flanking the site to the north and south represent sites of active sediment accumulation. The ditches intersect at a point approximately 600 feet west-southwest of the fire training pad. Sediments from these ditches were sampled during both the 1990 and 1992 investigations. The sample locations are presented in Figure 1-5. The analytical results are shown on Tables 1-1 and 1-2 for 1992 and 1990 sampling events, respectively.

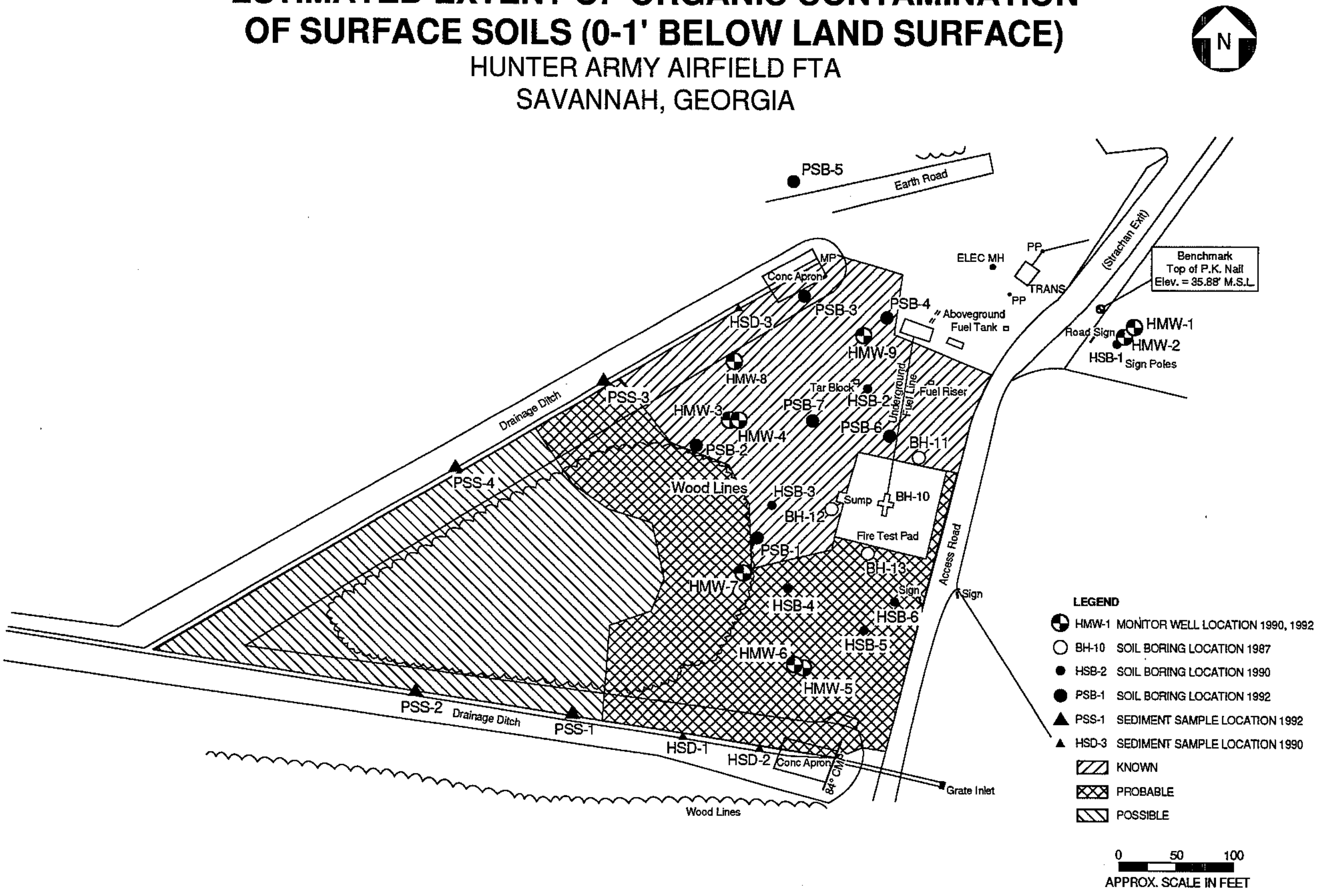
The results of sediment sampling during the 1990 investigation indicated the presence of benzo[a]anthracene, benzofluoranthene, chrysene, and several other semi-volatile organics at elevated levels in the north and south ditch. Other semi-volatile organic compounds were detected at lower levels. During the 1992 investigation, three of the four sediment samples collected from the north and south ditches were found to be contaminated primarily by benzo(a) pyrene, and to a lesser degree by other semi-volatile organics. The only volatile organic compound detected during the 1992 investigation was trichlorofluoromethane, which was present at levels nearly equal to the method's detection limit. Figure 1-11 depicts the distribution of the carcinogenic semi-volatile compound, benzo(a)pyrene, in sediments at the site.

The majority of sediment samples from the two drainage ditches revealed concentrations of several PAHs at levels exceeding carcinogenic PCTs (based on soil ingestion, which is

FIGURE 1-8

ESTIMATED EXTENT OF ORGANIC CONTAMINATION OF SURFACE SOILS (0-1' BELOW LAND SURFACE)

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



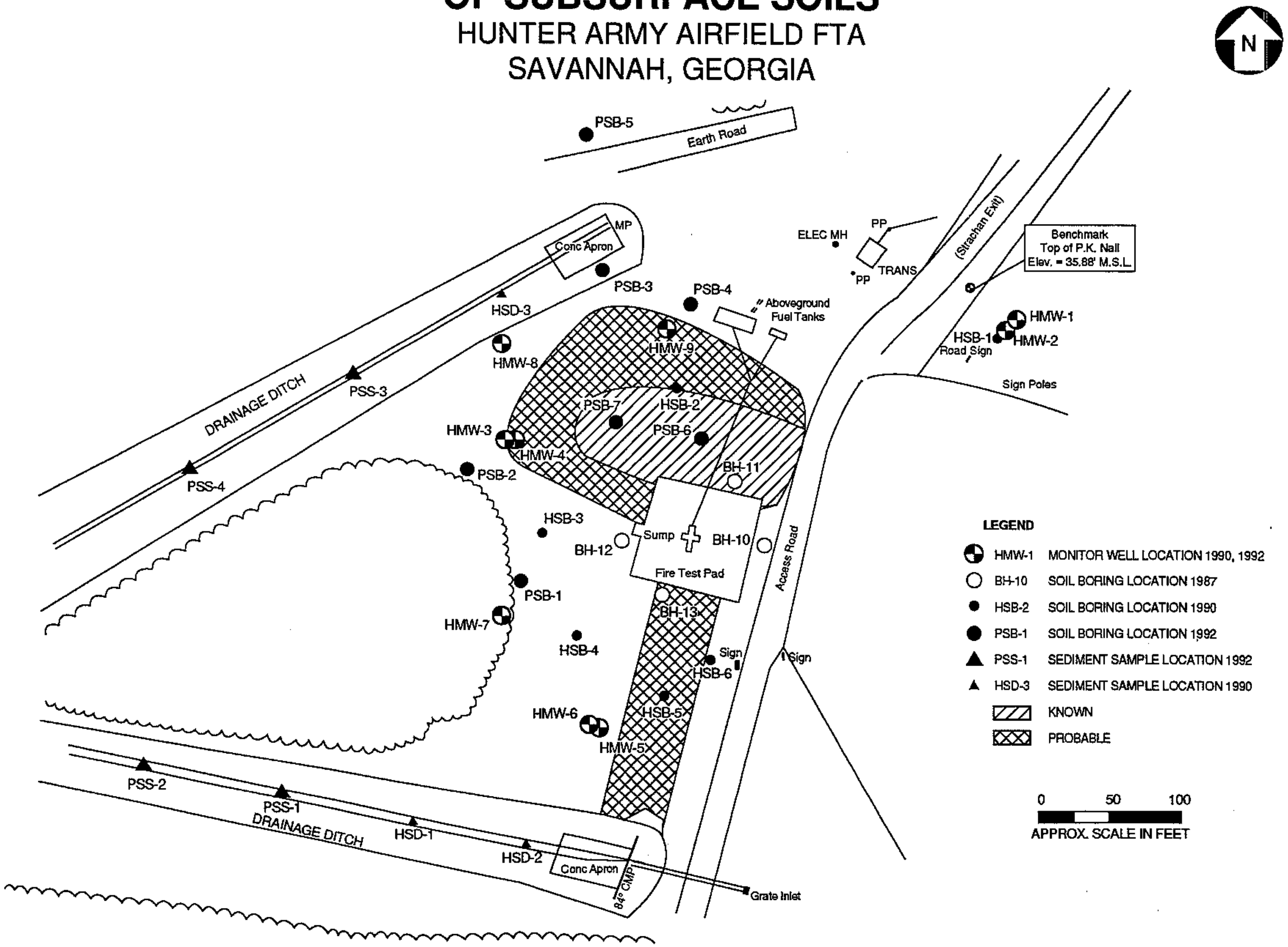
(BASE MAP MODIFIED FROM ESE, 1993)

3551-0320.04

FIGURE 1-9

ESTIMATED EXTENT OF ORGANIC CONTAMINATION OF SUBSURFACE SOILS

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



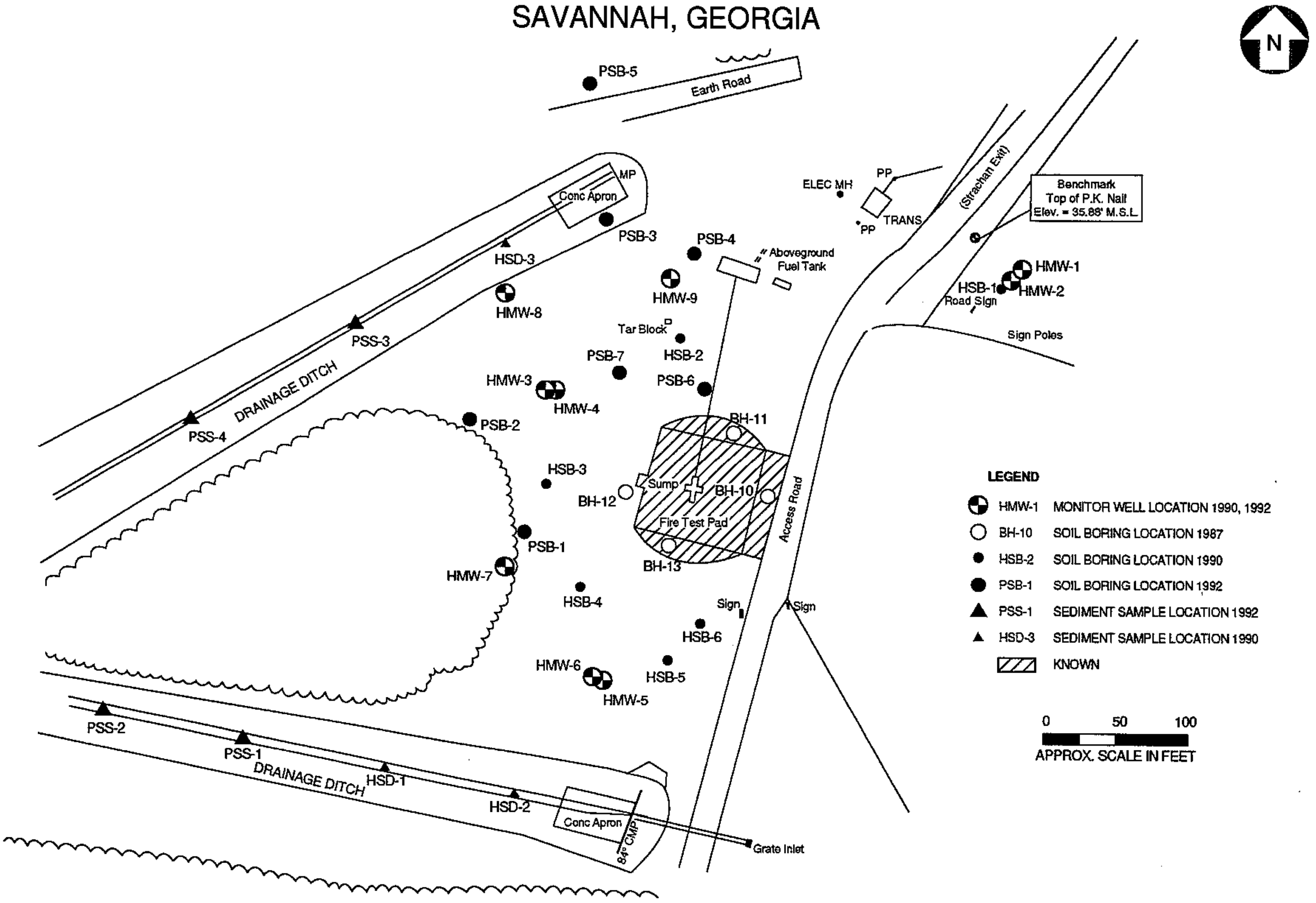
(BASE MAP MODIFIED FROM ESE, 1993)

3551-0320.04

FIGURE 1-10

ESTIMATED EXTENT OF METALS CONTAMINATION OF SURFACE SOILS (0-1' BELOW LAND SURFACE)

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



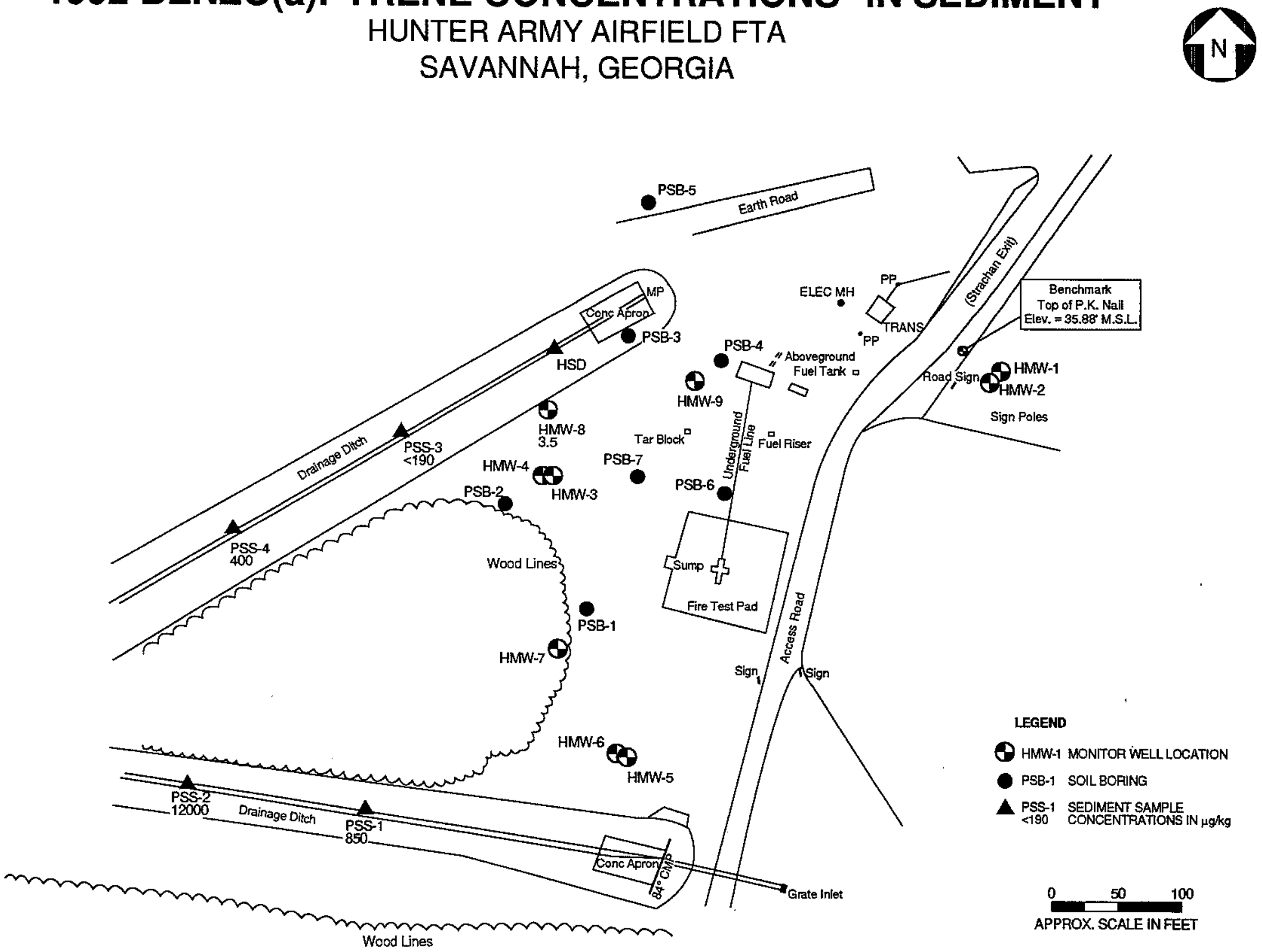
(BASE MAP MODIFIED FROM ESE, 1993)

3551-0320.04

FIGURE 1-11

1992 BENZO(a)PYRENE CONCENTRATIONS* IN SEDIMENT

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



* CONCENTRATIONS IN MICROGRAM PER KILOGRAM (µg/kg)

(BASE MAP MODIFIED FROM ESE, 1993b)

3551-0320.04

conservative for sediment exposure). ESE (1993b) indicated that due to the limited number of sediment samples which have been collected at the site, it is likely that the downstream limit of sediment contamination extends to or beyond the confluence of the ditches. During a site visit on October 28, 1993, a possible petroleum sheen was observed emanating from below a culvert located adjacent to Hunter FTA and discharging into the nearby creek. Based on discussions with HAAF staff, it was learned that the drainage area for this creek includes flight lines, maintenance areas, motor pools, and related facilities. Therefore, it is likely that some of the organic and inorganic constituents detected in the creek sediment may be present to ongoing upstream activities and not past practices at the FTA.

1.3.3.4 Ground-Water Contamination - Ground-water samples were collected from on-site monitoring wells during the 1990 and 1992 investigations. Well locations are shown on Figure 1-5. The analytical results are shown in Tables 1-4 and 1-5 for the 1992 and 1990 sampling events, respectively.

The results of 1990 ground-water sampling of the shallow downgradient well HMW-6 indicated that state of Georgia and federal maximum contaminant levels (MCLs) for arsenic (50 μg/L), chromium (50 μg/L), and selenium (10 μg/L) were exceeded. The concentrations of lead detected in wells HMW-4 and HMW-6 during the 1990 sampling event also exceeded the EPA action level for lead. The 1990 concentrations of arsenic, barium, chromium, chromium, and lead from the shallow upgradient well HMW-2 met or exceeded their respective PCTs. The 1992 sampling event indicated no metals to be present above their PCTs.

Organic compounds detected in ground water at the site included benzene, which was detected at levels exceeding its 5 μg/L MCL in several wells across the site during both 1990 and 1992 sampling events. Vinyl chloride was also detected above its MCL in the 1992 sample collected from well HMW-6. The detection of PAHs above their PCTs in 1990 from well HMW-6 was not repeated in the sample collected from the HMW-6 in 1992.

TABLE 1-4

1992 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6	HMW-7	HMW-8	HMW-9	HMW-5DUP	NSOURCE	TRPBLK	EQPBLK
	Date	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92
	Time	13:30	13:40	14:20	14:30	13:50	14:00	14:10	14:40	15:00		16:30		13:15
1,1,1-TRICHL'ETHANE	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<13.00	<2.50	<2.50	<2.50	<2.50
1,1,2,2-TETRACHLORO- ETHANE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<15.00	<1.50	<7.50	<1.50	<1.50	<1.50	<1.50
1,1,2-TRICHL'ETHANE	UG/L	<2.80	<2.80	<2.80	<2.80	<2.80	<2.80	<28.00	<2.80	<14.00	<2.80	<2.80	<2.80	<2.80
1,1-DICHLOROETHANE	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<13.00	<2.50	<2.50	<2.50	<2.50
1,1-DICHLOROETHYLENE	UG/L	<3.20	<3.20	<3.20	<3.20	<3.20	<3.20	<32.00	<3.20	<16.00	<3.20	<3.20	<3.20	<3.20
1,2-DICHLOROETHANE	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<13.00	<2.50	<2.50	<2.50	<2.50
1,2-DICHLOROETHENE(TOTAL)	UG/L	<2.40	<2.40	<2.40	<2.40	<2.40	3.50	<24.00	<2.40	<12.00	<2.40	<2.40	<2.40	<2.40
1,2-DICHLOROPROPANE	UG/L	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<20.00	<2.00	<10.00	<2.00	<2.00	<2.00	<2.00
2-CHLOROETHYLVINYL- ETHER	UG/L	<3.10	<3.10	<3.10	<3.10	<3.10	<3.10	<31.00	<3.10	<16.00	<3.10	<3.10	<3.10	<3.10
ACENAPHTHENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
ACENAPHTHYLENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
ANTHRACENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
ARSENIC,TOTAL	UG/L	9.40	<2.30	<2.30	2.30	2.70	14.70	11.30	<2.30	5.20	<2.30	<2.30	NRQ	<2.30
BARIUM,TOTAL	UG/L	76.60	46.50	88.10	54.40	56.60	57.20	147.00	65.00	113.00	56.50	14.90	NRQ	<1.10
BENZENE	UG/L	<1.00	<1.00	<1.00	18.00	<1.00	120.00	660.00	3.50	15.00	<1.00	<1.00	<1.00	<1.00
BENZO(A)ANTHRACENE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<15.00	<1.50	<1.50	<1.50	<1.50	NRQ	<1.50
BENZO(A)PYRENE	UG/L	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<20.00	<2.00	<2.00	<2.00	<2.00	NRQ	<2.00
BENZO(B)FLUORANTHENE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<15.00	<1.50	<1.50	<1.50	<1.50	NRQ	<1.50
BENZO(GHI)PERYLENE	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<2.50	<2.50	<2.50	NRQ	<2.50
BENZO(K)FLUORANTHENE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<15.00	<1.50	<1.50	<1.50	<1.50	NRQ	<1.50
BROMODICHLOROMETHANE	UG/L	<2.20	<2.20	<2.20	<2.20	<2.20	<2.20	<22.00	<2.20	<11.00	<2.20	<2.20	<2.20	<2.20
BROMOFORM	UG/L	<2.60	<2.60	<2.60	<2.60	<2.60	<2.60	<26.00	<2.60	<13.00	<2.60	<2.60	<2.60	<2.60

Source: ESE, 1993b

TABLE 1-4

1992 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6	HMW-7	HMW-8	HMW-9	HMW-5DUP	HSOURCE	TRPBLK	EQPBLK
	Date	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92
	Time	13:30	13:40	14:20	14:30	13:50	14:00	14:10	14:40	15:00		16:30		13:15
BROMOMETHANE	UG/L	<3.50	<3.50	<3.50	<3.50	<3.50	<3.50	<35.00	<3.50	<18.00	<3.50	<3.50	<3.50	<3.50
CADMIUM,TOTAL	UG/L	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	NRQ	<4.40
CARBON DISULFIDE	UG/L	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<44.00	<4.40	<22.00	<4.40	<4.40	<4.40	<4.40
CARBON TETRACHLORIDE	UG/L	<2.60	<2.60	<2.60	<2.60	<2.60	<2.60	<26.00	<2.60	<13.00	<2.60	<2.60	<2.60	<2.60
CHLOROBENZENE	UG/L	<1.40	<1.40	<1.40	<1.40	<1.40	<1.40	<14.00	<1.40	<7.00	<1.40	<1.40	<1.40	<1.40
CHLOROETHANE	UG/L	<8.20	<8.20	<8.20	<8.20	<8.20	<8.20	<82.00	<8.20	<41.00	<8.20	<8.20	<8.20	<8.20
CHLOROFORM	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<13.00	<2.50	<2.50	<2.50	<2.50
CHLOROMETHANE	UG/L	<4.40	<4.40	<4.40	<4.40	<4.40	<4.40	<44.00	<4.40	<22.00	<4.40	<4.40	<4.40	<4.40
CHROMIUM,TOTAL	UG/L	17.60	<7.40	<7.40	<7.40	<7.40	<7.40	18.60	<7.40	9.10	<7.40	<7.40	NRQ	<7.40
CHRYSENE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50	<15.00	<1.50	<1.50	<1.50	<1.50	NRQ	<1.50
CIS-1,3-DICHLORO- PROPENE	UG/L	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<20.00	<2.00	<10.00	<2.00	<2.00	<2.00	<2.00
DIBEN'(A,H)ANTH'CENE	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<2.50	<2.50	<2.50	NRQ	<2.50
DIBROMOCHLOROMETHANE	UG/L	<2.30	<2.30	<2.30	<2.30	<2.30	<2.30	<23.00	<2.30	<12.00	<2.30	<2.30	<2.30	<2.30
DICHLOROBENZENE,TOT.	UG/L	<4.00	<4.00	<4.00	<4.00	<4.00	<4.00	<40.00	<4.00	<20.00	<4.00	<4.00	<4.00	<4.00
DIETHYL ETHER, TOTAL	UG/L	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<50.00	<5.00	<30.00	<5.00	<5.00	<5.00	<5.00
ETHYLBENZENE	UG/L	<1.30	<1.30	<1.30	<1.30	<1.30	82.00	130.00	<1.30	180.00	<1.30	<1.30	<1.30	<1.30
FLUORANTHENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
FLUORENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
INDENO(1,2,3-CD) PYRENE	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<25.00	<2.50	<2.50	<2.50	<2.50	NRQ	<2.50
LEAD,TOTAL	UG/L	<63.80	<63.80	<63.80	<63.80	<63.80	<63.80	<63.80	<63.80	<63.80	<63.80	<63.80	NRQ	<63.80
MERCURY,TOTAL	UG/L	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	NRQ	<0.18
METHYL ETHYL KETONE	UG/L	<10.00	<10.00	<10.00	<10.00	<10.00	<10.00	<100.00	<10.00	<50.00	<10.00	<10.00	<10.00	<10.00

Source: ESE, 1993b

TABLE 1-4

1992 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6	HMW-7	HMW-8	HMW-9	HMW-SDUP	HSOURCE	TRPBLK	EOPBLK
	Date	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92	03/12/92
	Time	13:30	13:40	14:20	14:30	13:50	14:00	14:10	14:40	15:00		16:30		13:15
METHYL ISOBUT'KETONE	UG/L	<12.00	<12.00	<12.00	<12.00	<12.00	<12.00	<120.00	<12.00	<60.00	<12.00	<12.00	<12.00	<12.00
METHYLENE CHLORIDE	UG/L	<6.40	<6.40	<6.40	<6.40	<6.40	<6.40	<64.00	<6.40	<32.00	<6.40	<6.40	<6.40	<6.40
NAPHTHALENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	14.00	13.00	<1.00	33.00	<1.00	<1.00	NRQ	<1.00
PHENANTHRENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
PYRENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<10.00	<1.00	<1.00	<1.00	<1.00	NRQ	<1.00
SELENIUM,TOTAL	UG/L	<2.00	<2.00	<2.00	<2.00	<2.00	2.10	6.50	<2.00	<2.00	<2.00	<2.00	NRQ	<2.00
SILVER,TOTAL	UG/L	<6.10	<6.10	<6.10	<6.10	<6.10	<6.10	<6.10	<6.10	<6.10	<6.10	<6.10	NRQ	<6.10
TETRACHLOROETHENE	UG/L	<1.90	<1.90	<1.90	<1.90	<1.90	<1.90	<19.00	<1.90	<9.50	<1.90	<1.90	<1.90	<1.90
TOLUENE	UG/L	<1.70	<1.70	<1.70	<1.70	<1.70	1.80	<17.00	<1.70	<8.50	<1.70	<1.70	<1.70	<1.70
TRANS-1,3-DICHLORO- PROPENE	UG/L	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60	<16.00	<1.60	<8.00	<1.60	<1.60	<1.60	<1.60
TRICHLOROETHENE	UG/L	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00	<30.00	<3.00	<15.00	<3.00	<3.00	<3.00	<3.00
TRICHLOROFLUORO- METHANE	UG/L	<4.60	<4.60	<4.60	<4.60	<4.60	<4.60	<46.00	<4.60	<23.00	<4.60	<4.60	<4.60	<4.60
VINYL CHLORIDE	UG/L	<4.60	<4.60	<4.60	<4.60	<4.60	12.00	<46.00	<4.60	<23.00	<4.60	<4.60	<4.60	<4.60
XYLENES,TOTAL	UG/L	<3.70	<3.70	<3.70	<3.70	<3.70	<3.70	820.00	<3.70	950.00	<3.70	<3.70	<3.70	<3.70

Source: ESE, 1993b

TABLE 1-5

1990 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6
	Date	03/07/90	03/07/90	03/08/90	03/08/90	03/08/90	03/08/90
	Time	16:55	10:20	09:20	09:35	10:35	11:10
1,1,1-TRICHL'ETHANE	UG/L	<1.30	<1.30	<1.30	<1.30	<1.30	<1.30
1,1,2,2-TETRACHLORO ETHANE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50
1,1,2-TRICHL'ETHANE	UG/L	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60
1,1-DICHLOROETHANE	UG/L	<0.85	<0.85	<0.85	<0.85	<0.85	<0.85
1,1-DICHLOROETHYLENE	UG/L	<1.20	<1.20	<1.20	<1.20	<1.20	<1.20
1,2-DICHLOROETHANE	UG/L	<0.87	<0.87	<0.87	<0.87	<0.87	<0.87
1,2-DICHLOROETHANE-D4	UG/L	49.00	55.00	46.00	47.00	46.00	46.00
1,2-DICHLOROETHENE, TOTAL	UG/L	<1.30	<1.30	<1.30	<1.30	<1.30	<1.30
1,2-DICHLOROPROPANE	UG/L	<0.97	<0.97	<0.97	<0.97	<0.97	<0.97
2,4,6-TRIBROMOPHENOL	UG/L	180.00	170.00	190.00	180.00	160.00	180.00
2-BUTANONE	UG/L	<9.44	<9.44	<9.44	<9.44	<9.44	<9.44
2-FLUORBIPHENYL	UG/L	66.00	74.00	66.00	69.00	76.00	79.00
2-FLUOROPHENOL	UG/L	180.00	160.00	150.00	170.00	150.00	170.00
2-HEXANONE	UG/L	<3.10	<3.10	<3.10	<3.10	<3.10	<3.10
4-METHYL-2-PENTANONE	UG/L	<3.00	<3.00	<3.00	<3.00	<3.00	<3.00
ACENAPHTHENE	UG/L	<3.80	<3.80	<3.80	<3.80	<3.80	<3.80
ACENAPHTHYLENE	UG/L	<2.70	<2.70	<2.70	<2.70	<2.70	<2.70
ACETONE	UG/L	<17.00	<17.00	<17.00	<17.00	<17.00	<17.00
ANTHRACENE	UG/L	<2.10	<2.10	<2.10	<2.10	<2.10	<2.10
ARSENIC,TOTAL	UG/L	3.10	51.60	2.40	8.50	8.90	77.30
BARIUM,TOTAL	UG/L	59.20	1000.00	36.80	166.00	104.00	864.00
BENZENE	UG/L	<1.10	<1.10	7.80	1.90	<1.10	44.00

TABLE 1-5

1990 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6
	Date	03/07/90	03/07/90	03/08/90	03/08/90	03/08/90	03/08/90
	Time	16:55	10:20	09:20	09:35	10:35	11:10
BENZO(A)ANTHRACENE	UG/L	<1.80	<1.80	<1.80	<1.80	<1.80	3.20
BENZO(A)PYRENE	UG/L	<5.20	<5.20	<5.20	<5.20	<5.20	<5.20
BENZO(B)FLUORANTHENE	UG/L	<3.80	<3.80	<3.80	<3.80	<3.80	7.00
BENZO(GHI)PERYLENE	UG/L	<2.10	<2.10	<2.10	<2.10	<2.10	2.30
BENZO(K)FLUORANTHENE	UG/L	<4.70	<4.70	<4.70	<4.70	<4.70	<4.70
BROMODICHLOROMETHANE	UG/L	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98
BROMOFLUOROBENZENE	UG/L	49.00	52.00	52.00	53.00	50.00	47.00
BROMOFORM	UG/L	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
BROMOMETHANE	UG/L	<1.20	<1.20	<1.20	<1.20	<1.20	<1.20
CADMIUM,TOTAL	UG/L	<3.50	<3.50	<3.50	<3.50	<3.50	3.96
CARBON DISULFIDE	UG/L	<3.10	<3.10	<3.10	<3.10	<3.10	<3.10
CARBON TETRACHLORIDE	UG/L	<0.97	<0.97	<0.97	<0.97	<0.97	<0.97
CHLOROBENZENE	UG/L	<0.65	<0.65	<0.65	<0.65	<0.65	<0.65
CHLOROETHANE	UG/L	<1.80	<1.80	<1.80	<1.80	<1.80	<1.80
CHLOROFORM	UG/L	<1.20	<1.20	<1.20	<1.20	<1.20	<1.20
CHLOROMETHANE	UG/L	<24.00	<24.00	<24.00	<24.00	<24.00	<24.00
CHROMIUM,TOTAL	UG/L	11.20	217.00	12.00	46.70	46.80	239.00
CHRYSENE	UG/L	<2.80	<2.80	<2.80	<2.80	<2.80	5.30
CIS-1,3-DICHLOROPROPENE	UG/L	<1.50	<1.50	<1.50	<1.50	<1.50	<1.50
DIBEN'(A,H)ANTH'CENE	UG/L	<1.80	<1.80	<1.80	<1.80	<1.80	<1.80
DIBROMOCHLOROMETHANE	UG/L	<1.30	<1.30	<1.30	<1.30	<1.30	<1.30
ETHYLBENZENE	UG/L	<1.00	<1.00	<1.00	<1.00	<1.00	120.00

TABLE 1-5

1990 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6
	Date	03/07/90	03/07/90	03/08/90	03/08/90	03/08/90	03/08/90
	Time	16:55	10:20	09:20	09:35	10:35	11:10
FLUORANTHENE	UG/L	<3.20	<3.20	<3.20	<3.20	<3.20	7.30
FLUORENE	UG/L	<3.10	<3.10	<3.10	<3.10	<3.10	<3.10
INDENO(1,2,3-CD)PYRENE	UG/L	<2.70	<2.70	<2.70	<2.70	<2.70	<2.70
LEAD,TOTAL	UG/L	<25.00	261.00	<25.00	28.60	<25.00	337.00
MERCURY,TOTAL	UG/L	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
METHYLENE CHLORIDE	UG/L	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60
NAPHTHALENE	UG/L	<5.90	<5.90	<5.90	<5.90	<5.90	43.00
NITROBENZENE-D(5)	UG/L	83.00	81.00	77.00	78.00	79.00	85.00
PHENANTHRENE	UG/L	<1.90	<1.90	<1.90	<1.90	<1.90	5.20
PHENOL-D(5)	UG/L	110.00	99.00	96.00	110.00	97.00	100.00
PYRENE	UG/L	<2.00	<2.00	<2.00	<2.00	<2.00	6.80
SELENIUM,TOTAL	UG/L	<2.00	2.80	<2.00	5.20	4.30	14.40
SILVER,TOTAL	UG/L	<5.70	<5.70	<5.70	<5.70	<5.70	<5.70
STYRENE	UG/L	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60
TERPHENYL-(D14)	UG/L	64.00	69.00	59.00	65.00	70.00	93.00
TETRACHLOROETHENE	UG/L	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51
TOLUENE	UG/L	<0.70	1.60	0.74	<0.70	<0.70	1.70
TOLUENE-D(8)	UG/L	51.00	53.00	52.00	53.00	51.00	47.00
TRANS-1,3-DICHLOROPROPENE	UG/L	<0.86	<0.86	<0.86	<0.86	<0.86	<0.86
TRICHLOROETHENE	UG/L	<0.87	<0.87	<0.87	<0.87	<0.87	<0.87
VINYL ACETATE	UG/L	<2.60	<2.60	<2.60	<2.60	<2.60	<2.60
VINYL CHLORIDE	UG/L	<1.60	<1.60	<1.60	<1.60	<1.60	<1.60

TABLE 1-5

1990 RESULTS OF GROUND-WATER SAMPLING
FIRE TRAINING AREA
Hunter Army Airfield, Georgia

PARAMETERS		HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6
	Sample ID	HMW-1	HMW-2	HMW-3	HMW-4	HMW-5	HMW-6
	Date	03/07/90	03/07/90	03/08/90	03/08/90	03/08/90	03/08/90
	Time	16:55	10:20	09:20	09:35	10:35	11:10
XYLENES,TOTAL	UG/L	<1.00	<1.00	3.30	<1.00	<1.00	9.40

The PCT analysis indicated that concentrations of arsenic, chromium, and selenium detected in a 1990 sample from a shallow downgradient well (HMW-6) exceeded federal and state of Georgia maximum contaminant levels (MCLs). Lead levels detected in the 1990 samples from the same well, as well as shallow downgradient HMW-4, exceeded the federal action level for lead. The concentrations of arsenic, barium, chromium, and lead detected in the shallow upgradient well (HMW-2) meet or exceed their respective PCTs.

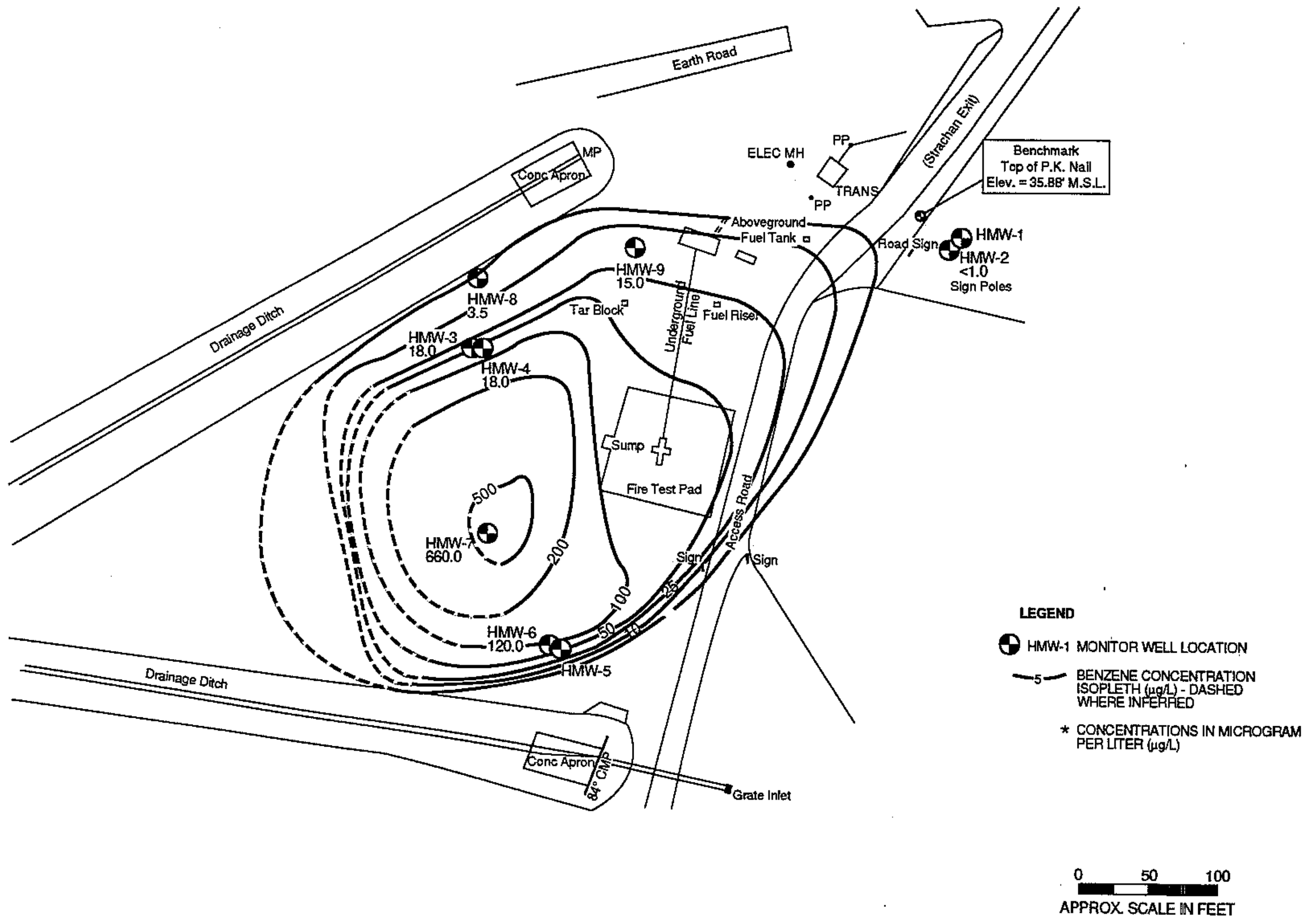
Benzene was detected above its MCL in several wells (HMW-3 [1990], HMW-4 [1992], HMW-6 [1990 and 1992], HMW-7 [1992], and HMW-9 [1992]. Vinyl chloride was detected above its MCL in the 1992 sample from HMW-6. Three PAHs were detected in the 1990 ground-water sample from HMW-6 at levels exceeding PCTs. Figure 1-12 depicts the interpreted distribution of benzene in the surficial aquifer during the 1992 sampling event.

From the data obtained the maximum ground-water fluctuation was shown to be 3.79 feet by the monitor, and 3.3 feet by manual monitoring. The direction of ground-water flow across the site in the surficial aquifer was determined to be northwest, at a hydraulic gradient of 0.015.

The current array of monitoring wells at the site does not permit the delineation of the downgradient extent of ground-water contamination at the site. Wells proposed to be installed during the predesign investigation will provide data for delineating the downgradient extent of ground-water contamination in the surficial aquifer.

FIGURE 1-12

1992 BENZENE CONCENTRATIONS*
IN SURFICIAL GROUND WATER (0-15' BELOW LAND SURFACE)
HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



(BASE MAP MODIFIED FROM ESE, 1993b) **3551-0320.04**

2.0 PROJECT MANAGEMENT

LAW has established standards and requirements for project management and quality assurance (QA). Our QA Program is one of the most important factors contributing to project success. The purpose of the program is to assure that services are being performed using industry-standard scientific engineering practices. The following sections discuss the project organization, QA program and project management and shows the interrelationship between each function.

2.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

This project will be executed by a team of engineers and scientists of the Government Services Division of LAW. The headquarters of Law Environmental, Inc., Government Services Division (LEGS) is in Kennesaw, Georgia. The interrelationship of the project members is shown in Figure 2-1. The following paragraphs describe the responsibilities of the key personnel.

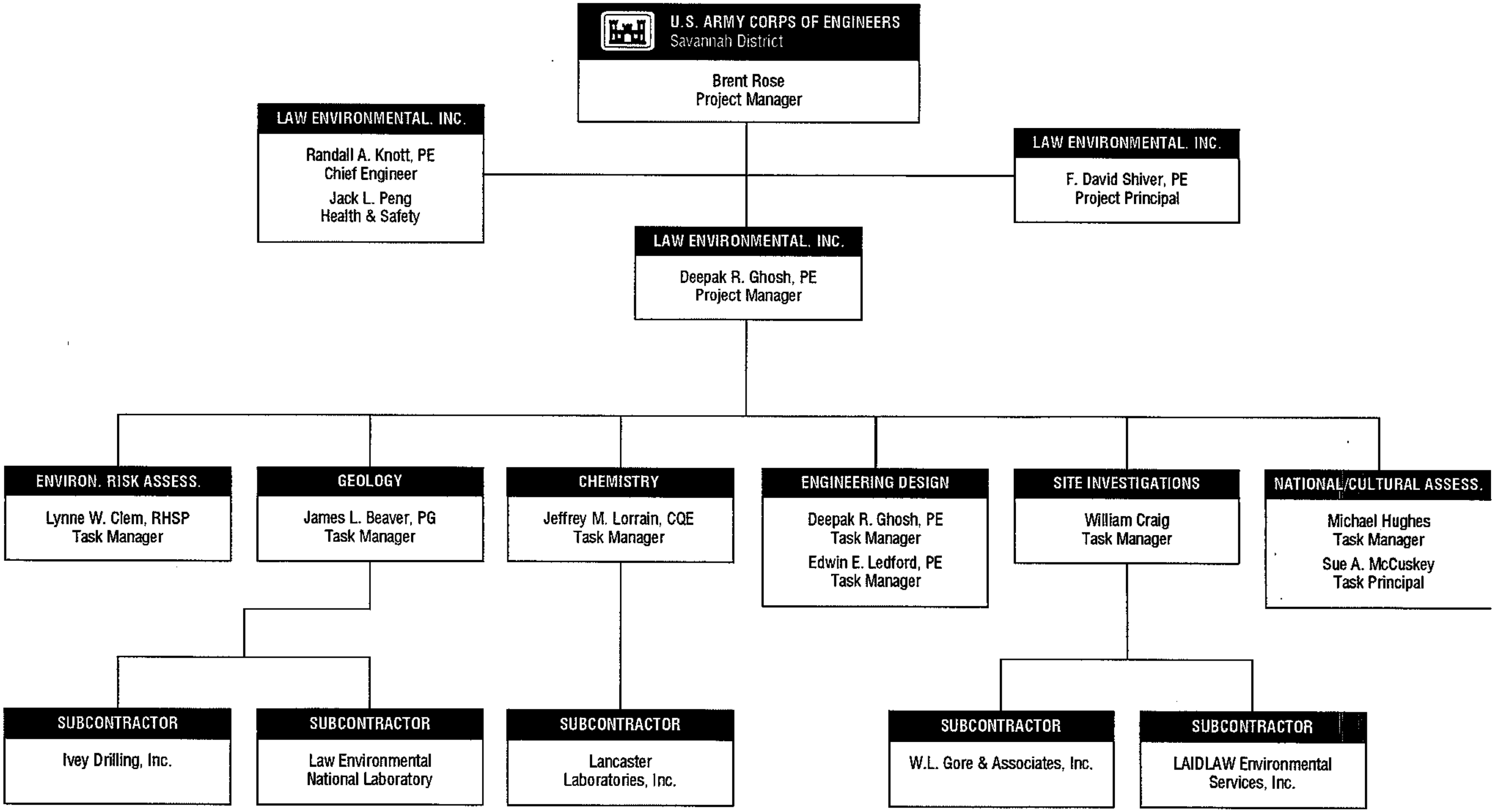
Each project undertaken by LAW is under the direct supervision of a project principal. Mr. F. David Shiver, P.E. will serve as principal engineer for this project. The project principal provides technical and administrative review, provides all quality assurance (QA) and quality control (QC) functions and overall technical direction of the project. He is also the principal contact for project contractual matters. As Chief Engineer, Mr. Randall A. Knott, P.E., will act as QA/QC program manager for the investigative and design activities for this project.

The project manager works under the direct of the project principal and is responsible for the management of the project, which includes client contact, management of administrative requirements, coordination and management of personnel assigned to the project, and supervision of schedules, technical approach, implementation, and report preparation. Mr. Deepak R. Ghosh, P.E. will serve as the project manager for this project.

FIGURE 2-1

PROJECT ORGANIZATION

SITE INVESTIGATIONS AND REMOVAL ACTION DESIGN
HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



3551-0320.04

Mr. James L. Beaver, P.G. will serve as the task manager for geology-related issues. Ms. Lynne W. Clem, R.H.S.P. will serve as task manager for risk assessments, regulatory criteria and action level determination. Mr. Jeffrey M. Lorrain, C.Q.E., C.H.M.M. will serve as the task manager for chemistry-related issues. He will have responsibility of sample acquisition and coordination with the laboratory. Mr. Deepak R. Ghosh, P.E. and Mr. Edwin E. Ledford, P.E., R.L.S. will be responsible for all design activities, including preparing plans, specifications, and construction cost estimates.

Mr. Paul A. Vogt will serve as task manager for natural and cultural resource assessment activities associated with construction related activities at the site. Ms. Sue Ann McCuskey will serve as the principal for this effort.

2.1.1 Subcontractors

LAW will subcontract some of the services to selected qualified firms. Ivey Drilling, Inc., a minority-owned business, will provide drilling and monitoring well installation services during the field investigation activities. Lancaster Laboratories, a COE certified laboratory will be responsible for all chemistry-related analysis of samples collected at the site. Physical analysis of samples will be performed by Law Environmental National Laboratories, which is also a COE certified laboratory. W.L. Gore and Associates, Inc., will provide services for soil gas survey and analysis and LaidLaw Environmental Services, Inc., will be the IDW disposal subcontractor.

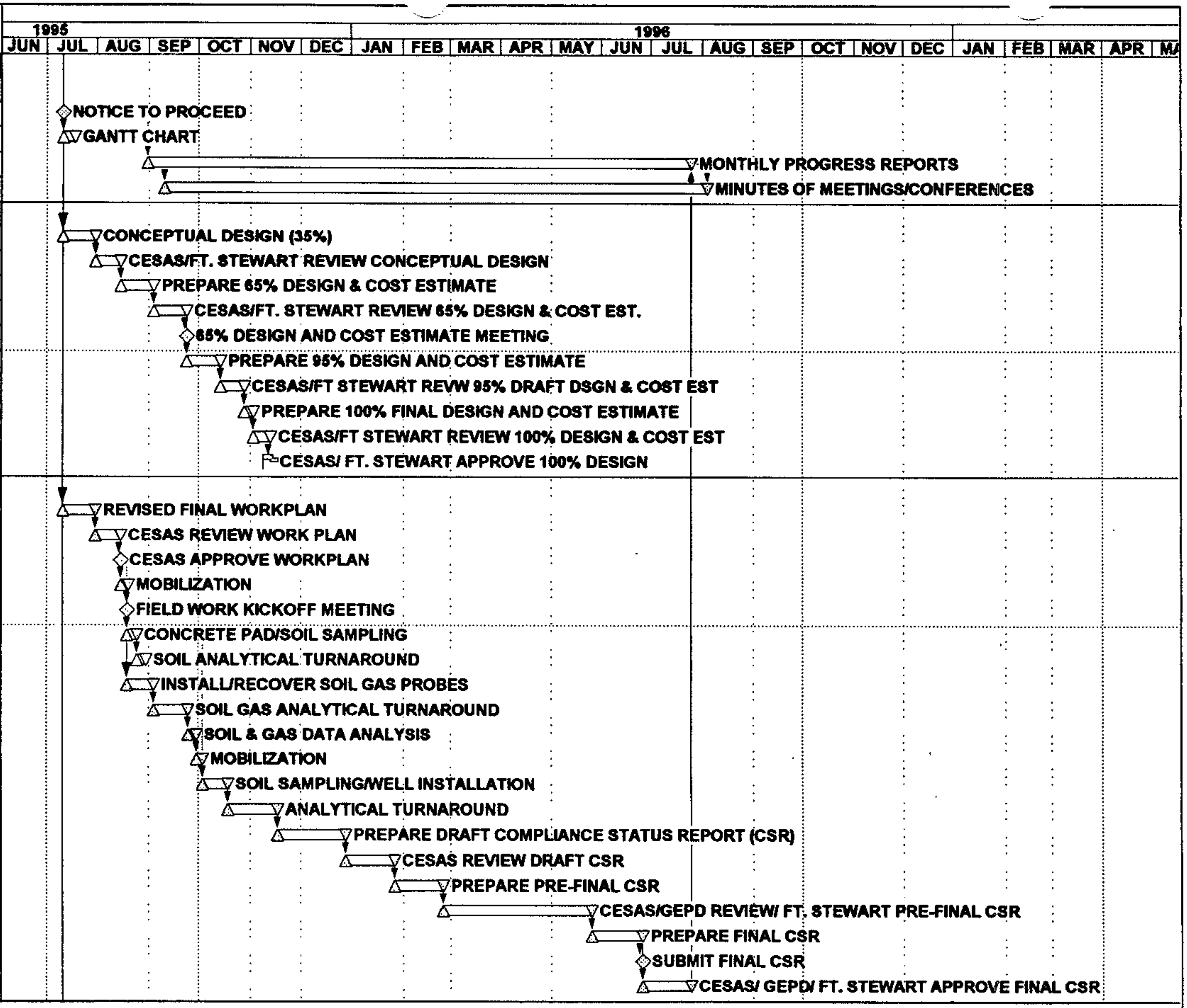
2.2 QUALITY ASSURANCE

LAW has established a strong internal QA program with an associated QA manual, engineering procedures manual, equipment calibration procedures manual, and specialty manuals for hazardous waste site investigations and software documentation. LAW employees use these manuals as the basis for conducting all company work within the QA program. Each project is assigned to a principal engineer/scientist who is responsible for maintaining the required professional quality from beginning to end of the project. Mr. F. David Shiver, P.E. will serve as principal for this project. Every deliverable must be reviewed and signed by two persons and at least one must be a certified principal with credentials and experience relevant to the area of work. Calculations are independently checked for accuracy, and design drawings and specifications are approved in accordance with company policy and applicable engineering requirements. Mr. Randall A. Knott, P. E., is responsible for the LEGS QA functions and application of the QA manuals, policies and procedures for all projects being conducted through this branch.

2.3 PROJECT PROGRESS AND SCHEDULING

To complete the project within established schedule restraints, timely submittals by LAW and review by the U.S. Army Corps of Engineers, Savannah District (CESAS-EN-GH) are necessary. A project schedule is included as Figure 2-2. Monthly progress reports will be prepared and submitted to CESAS. All required documents will be submitted, Draft and Final, as requested in the scope of work and according to proposed scheduled dates. The schedule will be updated as required by Project Managers and Project Principals. To provide timely submittals, review comments from all parties are expected on the date specified on the project schedule (Figure 2-2).

Activity ID	Early Start	Early Finish	Dur
HUNTER ARMY AIRFIELD			
PROJECT PLANNING			
LHU100	11JUL95*		0
LHU102	11JUL95	17JUL95	7
LHU104	31AUG95	24JUL96	329
LHU106	10SEP95	03AUG96	329
DESIGN			
LHU200	11JUL95	30JUL95	20
LHU202	31JUL95	14AUG95	15
LHU204	15AUG95	03SEP95	20
LHU206	04SEP95	23SEP95	20
LHU206A		23SEP95	0
LHU208	24SEP95	13OCT95	20
LHU210	14OCT95	28OCT95	15
LHU212	29OCT95	02NOV95	5
LHU214	03NOV95	12NOV95	10
LHU216		12NOV95	0
FIELD ACTIVITIES			
LHU300	11JUL95	30JUL95	20
LHU300A	31JUL95	14AUG95	15
LHU302		14AUG95	0
LHU303	15AUG95	19AUG95	5
LHU303A	19AUG95		0
LHU304	19AUG95	24AUG95	6
LHU304A	25AUG95	29AUG95	5
LHU304B	19AUG95	03SEP95	16
LHU304C	04SEP95	24SEP95	21
LHU304D	25SEP95	29SEP95	5
LHU305	30SEP95	03OCT95	4
LHU306	04OCT95	18OCT95	15
LHU306A	19OCT95	17NOV95	30
LHU308	18NOV95	27DEC95	40
LHU310	28DEC95	26JAN96	30
LHU312	27JAN96	25FEB96	30
LHU314	26FEB96	25MAY96	90
LHU316	26MAY96	24JUN96	30
LHU316A		24JUN96	0
LHU318	25JUN96	24JUL96	30



Project Start 11JUL95
Project Finish 03AUG96
Data Date 11JUL95
Plot Date 12JUL95

(c) Primavera Systems, Inc.

△▽ Early Bar
▲▼ Progress Bar
△▽ Critical Activity

HUN8

HUNTER ARMY AIRFIELD
SOURCE REMOVAL ACTION DESIGN
LAW PROPOSED SCHEDULE

Sheet 1 of 1

LAW ENGINEERING/ENVIRONMENTAL SERVICES, INC.

Date	Revision	Checked	Approved
		RKG	

3.0 PROJECT OBJECTIVES

3.1 GENERAL OBJECTIVES

This work plan describes the field investigation program for the Source Removal Predesign investigation at Hunter FTA. The project objectives and the technical approach to the data gathering effort are described below. The purpose of this work plan is to describe and outline project activities needed to perform a quality-controlled sampling effort at the site. The results of the field investigation will be used to prepare plans and specifications for source removal design.

The primary objective of activities described in this plan is to gather data necessary to support a source removal design. The concrete samples and soil samples from below and around the concrete pad are intended to characterize the concrete for off-site disposal and assess the extent of soil which is contaminated in excess of the action levels calculated for the site pursuant to the Georgia Hazardous Site Response Act (HSRA) and associated rules.

The secondary objective of the activities described in this plan is to gather additional site characterization data to be used in a Compliance Status Report for the site as described in Rule 391-3-19 of the Official Code of Georgia Annotated (O.C.G.A.).

3.2 SAMPLING OBJECTIVES

The objective of this work plan is to (1) assure that appropriate procedures are implemented for drilling, sampling, decontamination, equipment calibration, aquifer testing, and maintenance of quality assurance/quality control (QA/QC) for both laboratory work and field activities; and (2) perform recordkeeping to assure that data collected will satisfy the overall project objectives and its intended use. Table 3-1 lists the sampling rationale for the predesign investigation.

TABLE 3-1

RATIONALE FOR PREDESIGN INVESTIGATION FIELD TASKS
Hunter Army Airfield FTA
Savannah, Georgia

	FIELD INVESTIGATION TASK		RATIONALE
1.	Collect four concrete samples from pad.	1.	To determine waste characterization and proper disposal.
2.	Collect eight soil samples from around pad.	2.	To assess extent of contaminated soil associated with concrete burn pad.
3.	Collect four soil samples from beneath concrete pad.	3.	To assess extent of contaminated soil associated with concrete burn pad.
4.	Advance five hand augered soil borings in the study area and collect two soil samples per boring.	4.	To assess extent and degree of contamination.
5.	Perform a soil gas survey consisting of 20 locations.	5.	To determine placement of hand auger borings and wells in study area.
6.	Install shallow ground-water monitoring wells HMW-10, HMW-11, HMW-12, and HMW-13 in study area.	6.	Provide additional data on geology and the nature and extent of contamination in the upper portion of the surficial aquifer. Provide additional monitoring locations for the aquifer pump test.
7.	Perform in-situ hydraulic conductivity testing of new wells at the site.	7.	Estimate the lateral and vertical variations in hydraulic conductivity across the site, prior to performing the aquifer pump test.

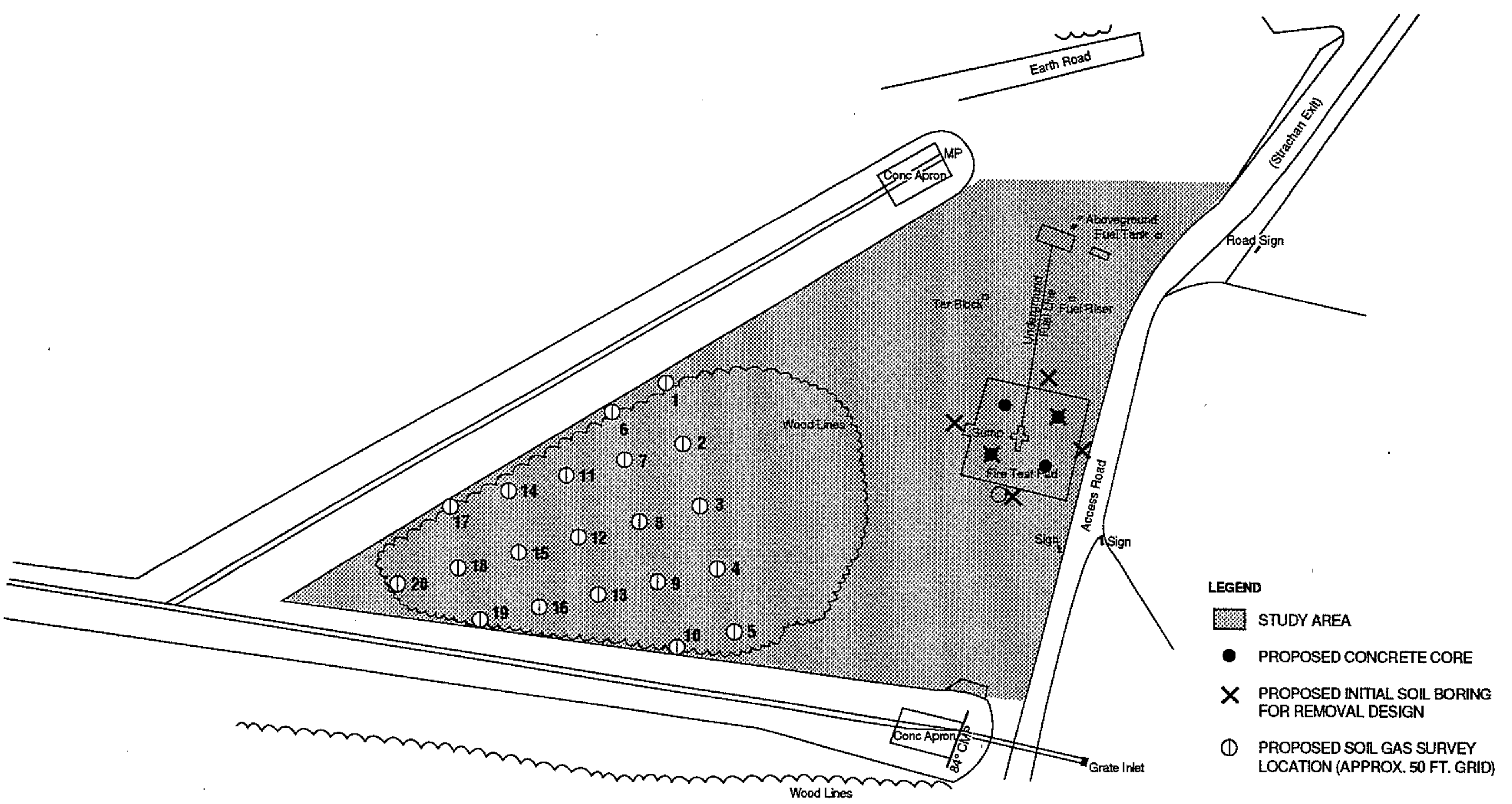
PREPARED BY/DATE: 7/28/95
CHECKED BY/DATE: 7/28/95
APPROVED BY/DATE:

The proposed soil, concrete, and soil gas survey locations to be advanced at the site during the first phase of field investigations are presented in Figure 3-1. These locations were chosen based upon results of previous investigations and site observations. The location of the monitoring wells and additional soil borings in the second phase will be chosen based on the results of the soil gas survey with concurrence from CESAS.

FIGURE 3-1

PROPOSED SAMPLE LOCATIONS

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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(BASE MAP MODIFIED FROM ESE, 1993b)

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4.0 FIELD ACTIVITIES

The following subsections describe the field sampling program to be conducted at the Hunter FTA. These activities include collection of soil and concrete samples for chemical analyses; collection of soil samples for geotechnical analyses; installation of ground-water monitoring wells to include developing, in-situ hydraulic conductivity testing, and ground-water sampling for chemical analyses; and sample location surveys.

4.1 PREPARATION

The following subsections describe the activities necessary to prepare the site for the field investigation.

4.1.1 Site Reconnaissance

On October 28, 1993, representatives of LAW and HAAF Environmental Department visited the Hunter FTA. The observations made during the site visit include:

- HAAF environmental personnel indicated that the steel storage tank currently located at the site is used as an accumulation point for off-specification fuels generated at the airfield. In July-October 1993, the Georgia Environmental Protection Division (EPD) requested that HAAF designate the tank as a hazardous waste storage tank based on the fuels ignitability potential. As a result, HAAF has labeled the tank as hazardous waste. The wastes are periodically transferred into a truck by a contractor, and transported from the installation. During the process of transferring the contents of the tank, water which has accumulated in the tank is emptied to the ground surface.

- A petroleum-like odor was noticed at the outfall of the storm sewer into the north drainage ditch. A sheen was observed on the water surface at the same location.

- The wooded area to the west of the fire training pad was observed to contain construction (hardfill) debris, including concrete and metal. The topography in the wooded area is also highly irregular. As a result, the use of an all-terrain vehicle (ATV) drilling rig may be required in this area.

Prior to the commencement of field operations, the site will be inspected to identify access routes, and overhead, surface, and potential subsurface obstructions. Any preliminary activities required to safely access or conduct work at the site, and obvious signs and/or sources of contamination will also be identified and documented.

4.1.2 Utility Clearance

Prior to mobilizing for drilling, the site will be checked by appropriate authorities for underground utility locations. Utility clearance at HAAF requires a minimum of two weeks. Due to the tight schedule, LAW requests that base personnel begin the utility clearance permitting as soon as possible. The study area in which the monitoring wells will be located is shown on Figure 4-1. Drilling for the monitoring wells will not proceed where aboveground or overhead utilities are within 30 feet of the drill rig or where subsurface obstructions exist. Should utility locations require offsetting boring locations, the new locations chosen will be as close as possible to the originally proposed locations. Under no condition will drilling proceed without the requisite utility clearance.

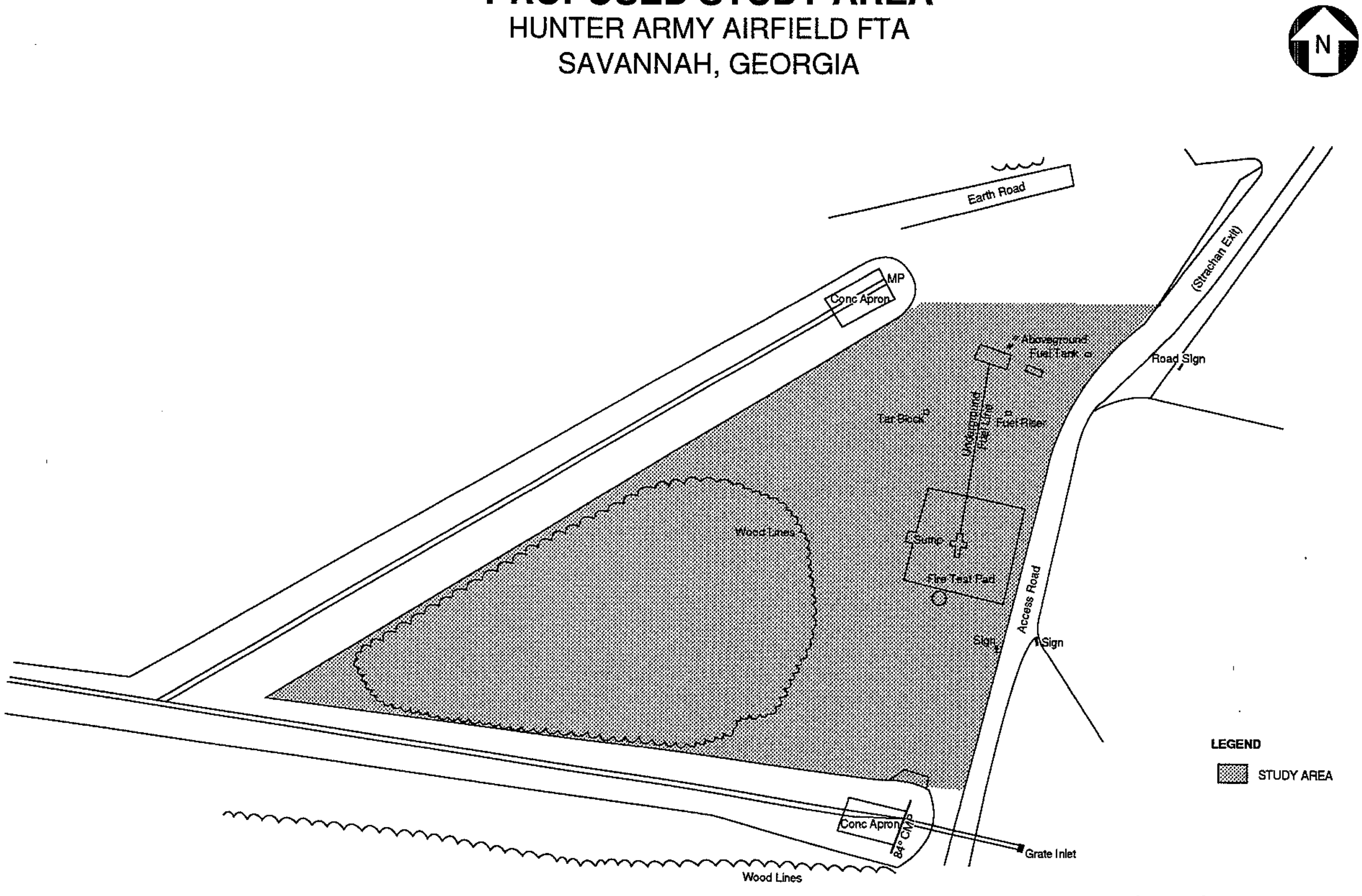
4.1.3 Traffic Control

If field activities occur in (or near to) roadways at HAAF, a flag-person will be required to direct traffic flow around the area of work.

FIGURE 4-1

PROPOSED STUDY AREA

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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(BASE MAP MODIFIED FROM ESE, 1993b)

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4.1.4 Site Safety and Health Meeting

During the field investigation, the site manager will serve as the site safety officer (SSO). Prior to the start of the field activities, the SSO will meet with the site investigation team members to discuss site safety procedures. The purpose of this meeting is to discuss in detail the hazards specific to the site and the tasks to be performed, and to specify the proper level of protection, decontamination procedures, required monitoring, waste disposal procedures for each work area, and also emergency procedures and site evacuation. As part of this meeting, the Standard Operating Procedures (SOPs) for safety activities at the site will be outlined. It is the responsibility of the SSO that workers are thoroughly familiar with each specific SOP and the overall chain of command during work at the site. Detailed safety procedures are included in the Site Safety and Health Plan (SSHP) (Appendix C).

4.2 CONCRETE CHARACTERIZATION

Four concrete samples will be collected from the concrete pad in order to determine the waste characterization and proper disposal of the structure. The sampling locations will be selected in the field based on site conditions and visual observations. The protocol which will be used to collect these samples is provided in the CDAP in Appendix A. The samples will be analyzed for the parameters shown on Table 4-1 of this Work Plan.

4.3 SOIL INVESTIGATIONS

4.3.1 Rationale for Sample Location Selection

The rationale for collecting soil samples and the proposed locations at which the sampling will be performed are discussed in the following paragraphs. Table 3-1 of this Work Plan provides a summary of the rationale for each field task.

TABLE 4-1

ANALYTICAL REQUIREMENTS FOR SOIL/CONCRETE SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

			ANALYTICAL PARAMETERS			
SAMPLE TYPE	NO. LOCATIONS	SAMPLES PER LOCATION	RCRA METALS	VOCs 8240	SVOCs 8270	TPH 8015
Monitoring Well Borings	4	2	8	8	8	8
Soil Borings (3)	6	2	12	12	12	12
Soil Borings (4)	5	2	10	10	10	10
Concrete	4	1	4	4	4	4
Subtotal			34	34	34	34
Field Duplicates (2-Soil,			4	4	4	4
Rinsates			2	2	0	2
Tripblanks (VOA only)				[Not required for soils]		
MS: (2-Soil, 1-Sediment)			3	3	3	3
MSD: (2-Soil, 1-Sediment)			3	3	3	3
Total Field and QC Samples			30	30	30	30
QA Samples						
Soil			2	2	2	2
Sediment			1	1	1	1

NOTES:
(1) Soil samples only
(2) EPA Method of Analysis
(3) Ten foot borings associated with remedial design of concrete pad
(4) Twelve foot borings

VOC = Volatile Organic Compounds
SVOC = Target compound list semi-volatile organic compounds
TPH = Total petroleum hydrocarbons
RCRA Metals = Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver

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4.3.2 Soil Samples

Soil samples will be collected through the use of two methods: a drill rig in conjunction with monitoring well installation, and by hand auger.

4.3.2.1 Drill Rig Soil Samples - The soil samples which will be collected during installation of the wells will be addressed in Section 4.5 of this document.

4.3.2.2 Hand Auger Soil Samples - A total of 22 soil samples will be collected using a hand auger. The protocol which will be used to collect the samples is provided in the CDAP (Appendix A). The locations of the samples and the sampling rationale are as follows.

- Hand auger borings will be advanced around the pad to approximately the water table depth (not to exceed 2 feet bls) and soil samples will be collected approximately every 2 feet beginning at 0.5 feet below ground surface (bgs). A description of each sample will be made in the field to include visual observations, odor, and PID/OVA readings. Based on the field observations, the site chemist will select eight soil samples to be sent to the lab for complete analyses to supplement the field PID/OVA readings for assessing the extent and degree of contamination. These eight samples will be analyzed for the parameters shown on Table 4-1 on an expedited lab turnaround time of not more than five days. The protocol for obtaining the hand auger samples is provided in the CDAP (Appendix A).

- Hand auger borings will be advanced beneath the concrete pad in the locations from which the concrete samples were collected (Section 4.2 of this Work Plan). Soil samples will be collected approximately every 2 feet. A description of each sample will be made in the field to include visual observations, odor, and

PID/OVA readings. Based on the field observations, the site chemist will select four soil samples to be sent to the lab for complete analyses to supplement the field PID/OVA readings for assessing the extent and degree of contamination. These four samples will be analyzed for the parameters shown on Table 4-1 on an expedited laboratory turnaround time of not more than five days. The protocol for obtaining the hand auger samples is provided in the CDAP (Appendix A).

- Five hand auger borings will be advanced to approximately the water table (not to exceed 12 feet bgs) in the study area shown on Figure 4-1. The locations will be dependent upon the results of the soil gas survey (discussed in Section 4.4 of this work plan). The actual boring locations will be recommended by LAW with concurrence from the client after reviewing the soil gas survey results. As the borings are advanced, soil samples will be collected approximately every 2 feet. A description of each sample will be made in the field to include visual observations, odor, and PID/OVA headspace readings. Based on the field observations two soil samples will be selected by the site chemist from each boring to be sent to the lab for complete analyses. These ten soil samples will be analyzed for the parameters shown in Table 4-1 of this Work Plan. The protocol for sampling is provided in the CDAP (Appendix A).

4.4 SOIL GAS SURVEY

A passive soil gas survey consisting of 20 samples will be conducted in the study area shown on Figure 4-1. Using the results of the soil gas survey, LAW will recommend, with the concurrence of CESAS, five hand auger soil sampling locations (discussed in Section 4.3 of this Work Plan) and four shallow monitoring well locations. The protocol for the soil gas survey is contained in the CDAP (Appendix A).

4.5 GROUND-WATER INVESTIGATIONS

This section presents the rationale for ground-water monitoring well installation.

4.5.1 Rationale for Well Location Selection

Four ground-water monitoring wells will be installed at the site in the upper portion of the surficial aquifer. Wells will be constructed in a manner to facilitate the detection of free-phase hydrocarbons and, as such, will be installed with the uppermost portion of the well screen above the water table.

4.5.2 Well Locations

The four wells will be located within the study area shown in Figure 4-1. The well locations will be dependent upon the results of the soil gas survey (discussed in Section 4.4 of this document). The actual well locations will be recommended by LAW with concurrence from representatives of HAAF and CESAS after reviewing the soil gas survey results.

4.5.3 Soil Sampling

In conjunction with the well installations, soil samples for both chemical analyses and geotechnical tests will be collected. Samples will be collected continuously with a stainless steel split spoon sampler and logged by the site geologist. The boring log will include the geologic description, and field observations such as color, odor, PID/OVA headspace readings, soil sample recovery, and penetration resistance. Based on the field observations two soil samples will be selected by the site chemist from each boring for laboratory analysis. These eight soil samples will be analyzed for the parameters shown in Table 4-1. The protocol for split spoon sampling is provided in the CDAP (Appendix A).

The protocol for monitoring wells including drilling procedures; well installation, development, sampling, and acceptance is provided in the Geologic Data Acquisition Plan (GDAP) (Appendix B).

4.5.4 Geotechnical Analysis

Geotechnical information will be required to perform site geohydrological characterization, remedial design, prepare remedial design cost estimates, and prepare bid documents. This information can be gathered by performing additional sampling while the field investigation is mobilized on site. This would save costs associated with remobilizing a field team at a later date.

One soil sample will be collected from each well boring. The depth from which the sample will be collected will be determined by the site geologist with input from the project engineer. The samples will be tested for grain size distribution (ASTM D422) and Atterberg Limits with moisture content (ASTM D4318).

4.5.5 Well Development

The purpose of well development is to create good hydraulic contact between the well and the aquifer, and to remove accumulated sediments from the well. The well development procedures are provided in the GDAP (Appendix B).

4.5.6 Ground-Water Sampling

Following well development, ground water from the four new and nine existing wells will be collected per the protocol in the CDAP (Appendix A) and analyzed for the parameters shown in Table 4-2 of this Work Plan.

TABLE 4-2

ANALYTICAL REQUIREMENTS GROUND-WATER SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

	ANALYTICAL PARAMETERS			
	RCRA Metals	VOCs 8240 (b)	SVOC 8270	TPH 8015 (med)
Field Locations	13	13	13	13
Field Duplicates	1	1	1	1
Rinsates	0	0	0	0
Trip Blanks (VOA only)	0	1	0	0
MS:	1	1	1	1
MSD:	1	1	1	1
Total Field and QC Samples	16	17	16	16
QA Samples	1	1	1	1

NOTES:
(b) EPA Method of Analysis
VOC - Target Compound list Volatile organic compounds
SVOC - Target Compound list Semi-volatile organic compounds
TPH - Total petroleum hydrocarbons
RCRA Metals - Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver

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4.5.7 In-Situ Permeability Testing

Hydraulic conductivity tests will be performed on each newly installed well at the site following ground-water sampling. The procedures for conducting this test are provided in the GDAP (Appendix B).

4.5.8 Survey of Well Locations

Upon completion of the wells, a survey crew will locate by standard surveying methods each new monitoring well. These methods are described in detail in the GDAP (Appendix B).

4.6 INVESTIGATION-DERIVED WASTE MANAGEMENT

The following description outlines the proposed approach to investigation-derived waste (IDW) management during the predesign activities at Hunter FTA. Six categories of waste are anticipated to be generated during the predesign activities: (1) drill cuttings from borings drilled for well installation; (2) development water from well development activities; (3) purge water from monitoring well sampling activities; (4) decontamination fluids resulting from steam cleaning of heavy equipment and from decontamination of sampling equipment; (5) miscellaneous waste, consisting of disposable supply containers, used personal protective clothing (i.e., Tyvek coveralls, boot covers, gloves, respirator cartridges).

Based upon the requirements of the scope of work dated April 25, 1995, LAW will collect all IDW generated during field activities and store it in properly labelled drums at the site. The drums will be placed on pallets and the location of pallets shall be chosen by CESAS and/or HAAF. Based on the results of laboratory analysis of soil and ground-water samples, the material in the drums will be disposed. Therefore, LAW will wait for the chemical analysis to be completed, and compare the results to HSRA cleanup criteria. If the sample results are below applicable HSRA criteria, LAW will return to the site and dispose of the material at the site. If the sample results indicate that levels of contaminants exceed HSRA cleanup criteria, the material will be disposed at an off-site location. Testing of the IDW stored in drums will be performed if HSRA levels are exceeded and such a request is made by CESAS. CESAS will assign additional budget for such testing activities. LAW will be responsible for disposal of all non-hazardous waste, including foil and paper. Empty nonhazardous drums will be triple rinsed with clean water and taken to the installation DRMO for recycling.

4.6.1 Drilling Cuttings

Soil cuttings will be placed into open-top, U.S. Department of Transportation (DOT) approved 17H drums and all drums will be labeled as described in Section 4.5.4. All drums generated will be annotated on a drum log to be maintained by the LAW site manager. A copy of the drum log will be provided to the CESAS project manager.

4.6.2 Well Development Water, Purge Water, Decontamination Water

The aqueous wastes produced during all site activities will be drummed in closed-top, DOT-approved 17H drums, inventoried, labeled and transported as described in the preceding paragraph to a staging area on the base. Decontamination fluids from steam cleaning, sampling equipment decontamination and personal decontamination will be collected in a sump and will be periodically pumped into DOT-approved 17H drums. The drums will be inventoried and labeled. All drums will be staged on pallets adjacent to the boring from which they are derived until final disposal is implemented.

4.6.3 Other Waste

An open-top 17H drum will be provided at the site during work in the decontamination reduction zone for the collection of miscellaneous wastes resulting from site activities such as gloves and personal protective clothing. Disposable supply containers (boxes) will be taken to the recycling facility at HAAF. Other (noncontaminated) disposables used in drilling and sampling operations will be placed at a HAAF solid waste collection point (i.e., trash dumpster) at the completion of work each day.

4.6.4 Drum Inventory and Labeling

As site investigations proceed, IDW will be containerized in 55-gallon drums at the boring. Each drum will be labeled on the top and opposite sides of the barrel with a "Non-Regulated Waste" sticker which includes the following:

Generator's Name: ______________________________
Generator's Address: ____________________________
Manifest Doc. Number: __________________________
Date Containerized: _____________________________

In addition to this minimum information, other information will be placed on the drum with a paint pen, such as:

- Project number
- Site name
- Well or borehole number
- Waste type

Final classification and labeling of drums will be completed after receipt of the analytical results from the field sampling program. Once information is recorded on the drums for future identification, an inventory of all drums containing IDW will be retained by the site manager or his delegate on a daily basis. This inventory shall contain the following information:

- Project number and name
- Borehole or well number
- Container type

- Waste type (liquid, solid, sludge, PPE)
- Volume of each waste type at final closing
- Date accumulation of IDW began
- Condition of container (new, refurbished, etc.)
- Storage location and date noted at that location
- What type of chemical analytical data exists for IDW
- If the IDW drums have been sampled and date sampled and analyzed for disposal
- Accessibility of trucks for drum removal

Two copies of this inventory will be provided to the base contact for his records upon LAW's demobilization if drums are to be left on site.

4.6.5 Drum Staging and Temporary Storage

Because the drums and all activities will be conducted within the base, the drums containing IDW will be temporarily stored at their respective borehole or monitoring well. Properly secured and labeled drums will be stored together on pallets. The palleted drums will be placed with consideration that stake body trucks or forklifts will be used to load the drums from the area. Once waste characterization data as discussed in Section 4.6.6 are received, the drums and contents will be moved to their ultimate destination. Transport of any drums will be performed by a licensed transporter.

Since the investigation samples for soil are the same material as the IDW, minimal supplemental sampling is anticipated for characterization of soil based on the laboratory results from the site investigations. LAW has negotiated budget for 4 TCLP P6 analysis on drummed soil cuttings. Note that water samples taken during the investigation tend to exhibit higher concentrations than the water contained in the drums because of dilution during decontaminations, etc. Therefore, if ground-water concentrations from the investigation prohibit disposal in the city's wastewater collection system, additional sampling will be performed to more accurately characterize the water.

4.6.6 Transportation and Disposal

Once all waste has been characterized, waste profiles will be submitted by LAW, and disposal authorization will be received for all waste requiring off-site disposal. Soil and water which do not warrant off-site disposal will be disposed at the well location from which they were generated. A transporter licensed to transport hazardous waste will be retained to move the waste requiring off-site disposal to a licensed treatment, storage, and disposal facility (TSDF). A representative of the generator will be available to execute manifests and disposal documents before the waste leaves its origin. After acceptance and disposal at the TSDF, the generator will receive documentation verifying receipt of the waste for their permanent records and annual reporting.

4.7 FIELD EQUIPMENT OPERATION, CALIBRATION, AND MAINTENANCE

The following sections will present an overview of the methods to be utilized in the measurement of field parameters. Table 4-3 provides a list of field equipment.

4.7.1 pH Measurement

The pH of a water sample will be determined by EPA Method 150.1. This method utilizes a pH meter to determine pH electrometrically using either a glass electrode in combination with a reference potential or a combination electrode. Each instrument/electrode system is calibrated at a minimum of two points that bracket the expected pH of the sample and are approximately three or more pH units apart. The instrument will be calibrated twice a day. Calibration checks will be performed hourly. The pH is measured at the temperature of the sample which is compensated for by the instrument. This analysis will be performed in the field.

TABLE 4-3

FIELD EQUIPMENT REQUIREMENTS
Hunter Army Airfield FTA
Savannah, Georgia

Field Analytical Equipment

- Organic vapor analyzer equipped with a photoionization detector to measure possible contamination while drilling. Range of 1 ppm to 2000 ppm
- pH meter
- Thermometer
- Conductivity meter
- Turbidity meter

Field Sample Collection Devices

- Teflon® Bailers
- Purge pump
- Poly tubing
- Generator
- Nylon rope
- Glass beaker
- Stainless steel split spoon
- Stainless steel hand auger
- Stainless steel bowls
- Stainless steel spoons

Sample Collection Containers

- Pre-cleaned glass jars and vials equipped with teflon-lined lids or septae

Decontamination Solutions

- Deionized water
- Methanol
- Potable water
- Decon tubs
- Scrub brushes
- Spray bottles
- Drums for decontamination waste fluids
- Plastic sheeting
- Paper towels
- Gloves (latex)

Preservation Solutions

- Hydrochloric Acid
- Nitric Acid
- Sulfuric Acid

Personal Protective Equipment

- Tyvek
- Hard hat
- Safety glasses
- Surgical gloves
- Rubber steel toe boots
- Protective gloves (latex)

Documentation Supplies

- Field log book, pens, sharpies
- All field forms
- Sample chain-of-custodies, custody seals, sample labels, request for analysis forms, Federal Express labels
- Clear and strapping tape
- Camera and film

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4.7.2 Conductivity Measurement

The specific conductance of a sample will be determined by EPA Method 120.1. The method utilizes a self-contained conductivity meter utilizing a Wheatstone bridge or equivalent. Samples are analyzed preferably at 25 degrees Celsius. If not, the temperature corrections are compensated for by the instrument. The instrument is factory calibrated and the calibration checked daily with a standard potassium chloride solution. This analysis will be performed in the field.

4.7.3 Temperature Measurement

The temperature of the sample will be measured by EPA Method 170.1. This method utilizes a mercury-filled or dial-type thermometer or thermistor. This analysis will be performed in the field.

4.7.4 Turbidity Measurement

This method is a comparison of the light scattered by a sample versus the light scattered by a reference solution. The nephelometer (turbidimeter) is calibrated daily with a 0.1 NTU solution. The sample is then poured into the turbidimeter tube and read directly from the instrument. This analysis will be performed in the field.

4.7.5 Field Screening for Volatile Organics by PID

During field sampling activities, the presence of volatile organics will be monitoring by a PID. For additional information regarding this procedure, see Appendix A2 of CDAP.

5.0 HSRA REGULATIONS

5.1 INTRODUCTION

Under the Georgia Hazardous Site Response Act (HSRA) (Chapter 391-3-19), owners of sites where hazardous wastes, hazardous constituents or hazardous substances have been released in amounts identified as reportable are required to notify the Georgia Environmental Protection Division (EPD) of the site releases. The EPD then evaluates the sites to determine if they should be listed on the state's Hazardous Site Inventory (HSI). Once a site has been placed on the Hazardous Site Inventory, the director may request the submittal of a Compliance Status Report (CSR). The CSR documents the status of the site with regard to the risk reduction standards of Rule 391-3-19-.07.

Based on information obtained from the CESAS, it is our understanding that the Fire Training Area of the Hunter Army Airfield has been placed on the Hazardous Site Inventory. As a result, CESAS has advised LAW to proceed with the investigation and remedial actions as required under HSRA.

5.2 RISK REDUCTION STANDARDS

The Risk Reduction Standards specify the procedures to demonstrate compliance with the HSRA requirements for corrective action. The risk reduction standards are intended to be protective of human health. A summation of the five types of standards are presented in Table 5-1.

All of the Risk Reduction Standards are potentially appropriate for the FTA site because its land use is currently nonresidential, and is expected to remain nonresidential in the future. Type 3 and 4 soil standards address nonresidential sites and, therefore, generally allow higher standards than Type 1 and 2 soil standards. Type 1 and Type 3 standards for groundwater are the same and are presented in Table 5-2. Type 1 and Type 3 standards for soil are listed in Table 5-3.

TABLE 5-1

SUMMARY OF RISK REDUCTION STANDARDS
Hunter Army Airfield FTA
Savannah, Georgia

CRITERION	TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5
Current land use	any		nonresidential		any
Level of oversight by EPD	low	med-high	low	med-high	high
Continuing requirements for responsible party	none		deed notice		deed notice, monitoring & maintenance, and restrictive covenant
Criteria for waste and other source materials	remove or decontaminate to standards applicable to environmental media				treated, contained, or otherwise controlled to prevent principal threats
Ground-water criteria for NAPLS	free product must be removed to the extent practicable				
Ground-water criteria for dissolved contaminants	greatest of Table 1 (App. III), background, or PQL (sum of organics must not exceed 10 mg/L)	RAGS with site-specific exposure factors for residential setting	same as Type 1	RAGS with site-specific exposure factors for nonresidential setting	Type 1-4 standards, as applicable; EPD may exempt ground water beneath a source if further migration is prevented
Applicable soil zones for direct ingestion criteria	all soil above water table or bedrock		top 2 feet of soil		soil beyond actively-controlled zone must meet Type 1-4 standards
Direct ingestion criteria for soil	RAGS with standard exposure assumptions for residential setting	RAGS with site-specific exposure factors for residential setting	RAGS with standard exposure assumptions for workplace	RAGS with site-specific exposure factors for nonresidential setting	site-specific risk assessment which acknowledges control measures
Leaching criteria for soil	greatest of App. I, 100X Type 1 ground-water criteria, or TCLP demonstration, for any point above water table	physical demonstration that any potential DW well will meet Type 2 ground-water criteria	greatest of App. I, 100X Type 1 ground-water criteria, or TCLP demonstration, for any point above water table	physical demonstration that any potential DW well will meed Type 4 ground-water criteria	any soil outside actively-controlled zone must not exceed concentrations required by Type 1-4 standards, as applicable

EPD = Environmental Protection Division
NAPLS = Non-Aqueous Phase Liquids
PQL = Practical Quantitation Limit
RAGS = Risk Assessment Guidance for Superfund (USEPA, 1989)
DW = Drinking Water
TCLP = Toxicity Characteristic Leaching Procedure

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TABLE 5-2

SUMMARY OF HSRA TYPE 1 GROUND-WATER STANDARDS FOR DETECTION CONSTITUENTS
Hunter Army Airfield FTA
Savannah, Georgia

Chemical	HSRA Risk Reduction Standards (mg/L) Type 1 Ground Water (a)
Inorganics	
Arsenic	0.05
Barium	2.0
Cadmium	0.005
Chromium, total	0.1
Lead	0.015
Selenium	0.05
PAHs	
Benzo(a)anthracene	0.0001
Benzo(b)fluoranthene	0.0002
Benzo(g,h,i) perylene	1.0(d)
Chrysene	0.0002(b)
Fluoranthene	1.0
Naphthalene	0.02
Phenanthrene	1.0(d)
Pyrene	1.0
VOCs	
Benzene	0.005
1,2-Dichloroethene	0.1(c)
Ethylbenzene	0.7
Toluene	1.0
Vinyl Chloride	0.002
Xylenes, total	10

(a) HSRA Type 1 and Type 3 standards are the same for ground water.
(b) Detection limit or background is the Type 1 ground-water concentration.
(c) Value for trans-1,2-dichloroethene.
(d) Table 1 value for Pyrene used as surrogate per guidance from USEPA Region IV.

Note: Type 1 Standards are based on MCLs and Proposed MCLs for benzo(a)anthracene and benzo(b)fluoranthene have been withdrawn by USEPA and will not be reproposed in FY1995.

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TABLE 5-3

SUMMARY OF HSRA TYPE 1 AND TYPE 3 SOIL STANDARDS FOR DETECTED CONSTITUENTS
Hunter Army Airfield FTA
Savannah, Georgia

Chemical	HSRA Risk Reduction Standards (mg/kg)	
	Type 1 Soil (a)	Type 3 Soil (b)
Inorganics		
Arsenic	20(c)	610
Barium	1,000	100,000(g)
Cadmium	2.0	1,000
Chromium, total	100	10,000
Lead	75	75
Mercury	0.5	0.012
Selenium	2.0	10,000
PAHs		
Acenaphthene	300(d)	100,000(g)
Acenaphthylene	130(d)	61,000(f)
Anthracene	500(d)	100,000(g)
Benzo(a)anthracene	5.0(d)	64
Benzo(a)pyrene	1.64(d)	7.7
Benzo(b)fluoranthene	5.0(d)	70
Benzo(g,h,i) perylene	500(d)	61,000(f)
Benzo(k)fluoranthene	5.0(d)	78
Chrysene	5.0(d)	6,600
Dibenzo(a,h)anthracene	5.0(d)	7.8
Fluoranthene	500(d)	82,000
Fluorene	360(d)	82,000
Indeno(1,2,3-cd)pyrene	5.0(d)	78
Naphthalene	100(d)	82,000
Phenanthrene	110(d)	61,000(f)
Pyrene	500(d)	61,000
VOCs		
Benzene	0.5(e)	14
Ethylbenzene	70(e)	15,000
Methylene Chloride	0.5(e)	120
Toluene	100(e)	3,500
Trichlorofluoromethane	200(e)	820
Xylenes, total	1,000(e)	100,000(g)

(a) Type 1 standards are applicable for all soil above the water table or bedrock.
(b) Type 3 standards are applicable for surface soils (soil within two feet of the landsurface).
(c) Metals values are from Table 2, Appendix III (HSRA).
(d) PAH values are from Notification Concentration Table, Appendix I (HSRA).
(e) Volatile values are Type 1 ground-water standards multiplied by 100.
(f) Toxicity value for pyrene used as surrogate per guidance from USEPA Region IV.
(g) Concentrations above 100,000 ppm are considered "inherently waste-like" and are unlikely to meet the requirements of Rule 391-3-19.07(4)(a)-(d).

PREPARED/DATE: LWC 7/28/95
CHECKED/DATE: [illegible] 7/28/95

5.3 EVALUATION OF RISK REDUCTION STANDARDS

Although a feasibility study has been performed for this site and remedial technologies have been selected under CERCLA, the recently implemented HSRA regulations and additional site investigations to be performed by LAW have prompted a review of the remedial action strategy. LAW recommends that the new field investigation data be compared to the various types of risk reduction standards in order to evaluate the need for corrective action. In addition, an exposure assessment will be prepared which discusses the human or environmental receptors who may have been or could be potentially exposed to the constituents at the site. This exposure assessment and comparison of site data to the risk reduction standards will be documented in the CSR.

Following the submittal of the Compliance Status Report (CSR) and a signed Certification Statement, a notice must be published in both a major local newspaper and the legal organ of the local governments in whose jurisdiction the site is located. This notification of the report's availability must be made within seven days of the report's submittal to the director. The director must be sent a copy of the notice within 15 days of its publication. A written notice of the notification must also be submitted to the government of Chatham County and the City of Savannah within seven days of the report submittal.

The objective of the CSR is to document that the site is in compliance with the risk reduction standards and achieve the director's concurrence. At that time, the director will reclassify the site and state that corrective action should occur in order to maintain compliance with the risk reduction standards and remove the site from the HSI.

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LIST OF ACRONYMS

AA	Atomic absorption
AAFTA	Army Airfield Fire Training Area
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
bls	below land surface
BOD	Biological Oxygen Demand
BTEX	Benzene, ethylbenzene, toluene, and xylene compounds
CCB	Continuing Calibration Blanks
CCV	Continuing Calibration Verification
CDAP	Chemical Data Acquisition Plan
CDQM	Chemical Data Quality Management
CEMRD	Corps of Engineers - Missouri River Division
CESAS	Corps of Engineers - Savannah District
CF	Calibration Factor
COC	Chain-of-custody
COD	Chemical Oxygen Demand
CV	Coefficient of Variation
DER	Department of Environmental Excellence
DQCR	Daily Quality Control Report
DQOs	Data Quality Objectives
EA	Environmental Assessment Report
ECD	Electron capture detector
ESE	Environmental Science and Engineering, Inc.
FDHRS	Florida Department of Health and Rehabilitative Services
FID	Flame ionization detector
FNSI	Findings of No Significant Impact

LIST OF ACRONYMS
(continued)

FTA	Fire Training Area
GC	Gas chromatograph(y)
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Metals by Graphite Furnace Atomic Absorption
HAA	Hunter Army Airfield
ICP	Inductively-coupled plasma
ICV	Initial Calibration Verification
IDL	Instrument Detection Limits
IDW	Investigation Derived Waste
IR	Infrared
LCL	Lower Control Limit
LIMS	Laboratory Information Management System
LOQ	Limit of Quantitation
MDL	Method Detection Limit
MS/MSD	Matrix Spike and Matrix Spike Duplicate
MSA	Method of Standard Additions
NOI	Notice of Intent
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCTs	Preliminary Cleanup Targets
PID	Photoionization Detector
ppb	parts per billion
ppm	Parts per million
PQL	Practical Quantitation Limits
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report

LIST OF ACRONYMS
(continued)

RD	Remedial Design Plan
RD	Remedial Design
RF	Internal standard technique
RPD	Relative Percent Difference
RT	Retention Time
SOW	Scope of Work
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TOX	Total Organic Halides
TRPH	Total Recoverable Petroleum Hydrocarbons
TSS	Total Suspended Solids
UCL	Upper Control Limit
USACE	U.S. Army Corp of Engineers
USAEHA	U.S. Army Environmental & Health Agency
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UXO	Unexploded Ordnance
VOA	Volatile Organic Analysis
μg/Kg	Micrograms per kilogram

1.0 INTRODUCTION

This document has been prepared to consolidate documentation of the activities planned for the collection of environmental data associated with the Hunter Army Airfield (HAAF) Fire Training Area (FTA). The following sections describe the site history, project organization, planned activities, planned Quality Control activities, and documentation.

1.1 LOCATION OF QUALITY ASSURANCE PROJECT PLAN ELEMENTS

As per the EPA guidance document entitled "Interim Guidelines And Specifications For Preparing Quality Assurance Project Plans (QAPP)," [QAMS-005/80] (USEPA, 1980), a written QAPP is required to be prepared for all environmental monitoring or measurement projects. All 16 of the required elements are presented in this Chemical Data Acquisition Plan. It is not necessary to repeat the information, however it is useful to cite the specific location where the QAPP information is located (USEPA, 1980). Table 1-1 lists each of the required items a QAPP must discuss and the section in which the information is located.

TABLE 1-1

LOCATION OF QUALITY ASSURANCE PROJECT PLAN ELEMENTS
Hunter Army Airfield FTA
Savannah, Georgia

	Required QA Element	Location	
1.	Title page with provision for approval signatures	Title Page (a)	
2.	Table of Contents	Section 1.0	
3.	Project Description	Section 2.0	
4.	Project Organization and Responsibility	Section 4.0	
5.	QA Objectives for Precision, Accuracy, Completeness, Representativeness, and Comparability	Section 3.0	
6.	Sampling Procedures	Section 5.0	
7.	Sample Custody	Section 6.0	
8.	Calibration Procedures and Frequency	Section 7.2, Appendix A-3	
9.	Analytical Procedures	Section 7.2	
10.	Data Reduction, Validation and Reporting	Reduction: Validation: Reporting:	Section 7.3 Section 7.3, 8.0 Section 7.3
11.	Internal Quality Control Checks and Frequency	Field: Laboratory:	Sections 5.1, 5.4 Section 7.2, and Appendix A-3
12.	Performance and System Audits and Frequency	Not required (b)	
13.	Preventative Maintenance Procedures and Schedules	Field: Laboratory:	Section 5.5 Section 7.5
14.	Specific Routine Procedures Used to Assess Data Precision, Accuracy and Completeness	Section 7.0	
15.	Corrective Action	Field: Laboratory:	Sections 5.6, 6.4 Section 7.7 Appendix A-3
16.	Quality Assurance Reports to Management	Section 8.0	

(a) Internal approval of documents is signified by signature on the applicable cover letter. Two signatures are required for submission, one of which must be from a Principal/Officer of the company who is authorized to commit the resources of the company. External approval is signified by a letter from the USACE-Omaha District stating that the document has been approved.

(b) Laboratory has undergone a performance audit and a systems audit by the USACE - Missouri River Division in order to be validated to perform this work. No additional audits are required.

PREPARED/DATE: 7/28/95
CHECKED/DATE: DRG 7/28/95

2.0 PROJECT DESCRIPTION

The following sections provide an introduction to the project, the facility location, site descriptions, and previous investigations.

2.1 INTRODUCTION

This Chemical Data Acquisition Plan (CDAP) has been prepared for the project "Hunter Army Airfield Fire Training Area" located at Hunter Army Airfield, (HAAF) Georgia. This CDAP has been prepared in response to the Scope of Work (SOW) issued on April 25, 1995, by the Savannah District, U.S. Army Corps of Engineers (USACE).

The purpose of this CDAP is to present the Data Quality Objectives (DQOs) for the project, provide detailed sampling and analysis instructions, and provide guidance for aspects of chemical data quality management for the project. This document has been prepared in substantial compliance with the USACE's guidance document entitled "Chemical Data Quality Management For Hazardous Waste Remedial Activities" (USACE, 1990).

2.2 FACILITY LOCATION

HAAF occupies 5,400 acres in Chatham County, near Savannah, Georgia. It is bounded by residential and light commercial areas. It is part of Ft. Stewart and is approximately 50 miles northeast of the main installation. The Fire Training Area (FTA) is located on the northwestern portion of the airfield, approximately 800 feet north-northwest of the aircraft control tower and 2,200 feet north of the center of the east-west runway.

The FTA is in a grassy cleared area approximately 200 feet by 400 feet, bounded on the north and south by drainage ditches, by the airfield pavement on the east, and by trees on the west.

The FTA consists of a 6,400 square foot concrete pad. The pad has a deteriorated concrete curb around the perimeter with soil bermed around it. There is a simulated aircraft constructed from a used steel storage tank in the center of the pad. Fuel (mostly JP-4) for the fire training exercises was supplied from a nearby aboveground storage tank through a buried fuel line. During training exercises, some of the fuel and water splashed or ran over the top of the curb and berms and contaminated adjacent soil. This also has led to the contamination of shallow ground water. Use of the FTA was discontinued in 1991. Figure 2-1 shows the plan view of the FTA.

2.3 PREVIOUS SITE INVESTIGATIONS

In March 1987, a preliminary contamination assessment was performed by the U.S. Army Environmental and Health Agency (USAEHA) (see Appendix B of the Significance of Contamination Report for Wright Army Airfield Fire Training Area [AAFTA]). This Hazardous Waste Study (No. 37-26-0127-88) was performed to evaluate the existence of contamination in the soils and pit residues at three fire training areas and four Explosive Ordnance Disposal (EOD) sites at Fort Stewart and HAAF. During February 1990, Environmental Science and Engineering, Inc., (ESE) performed the first phase of a contamination evaluation at the Hunter FTA (ESE, 1993a). From July to December 1992, ESE conducted additional tests at Hunter FTA to determine the significance of contamination.

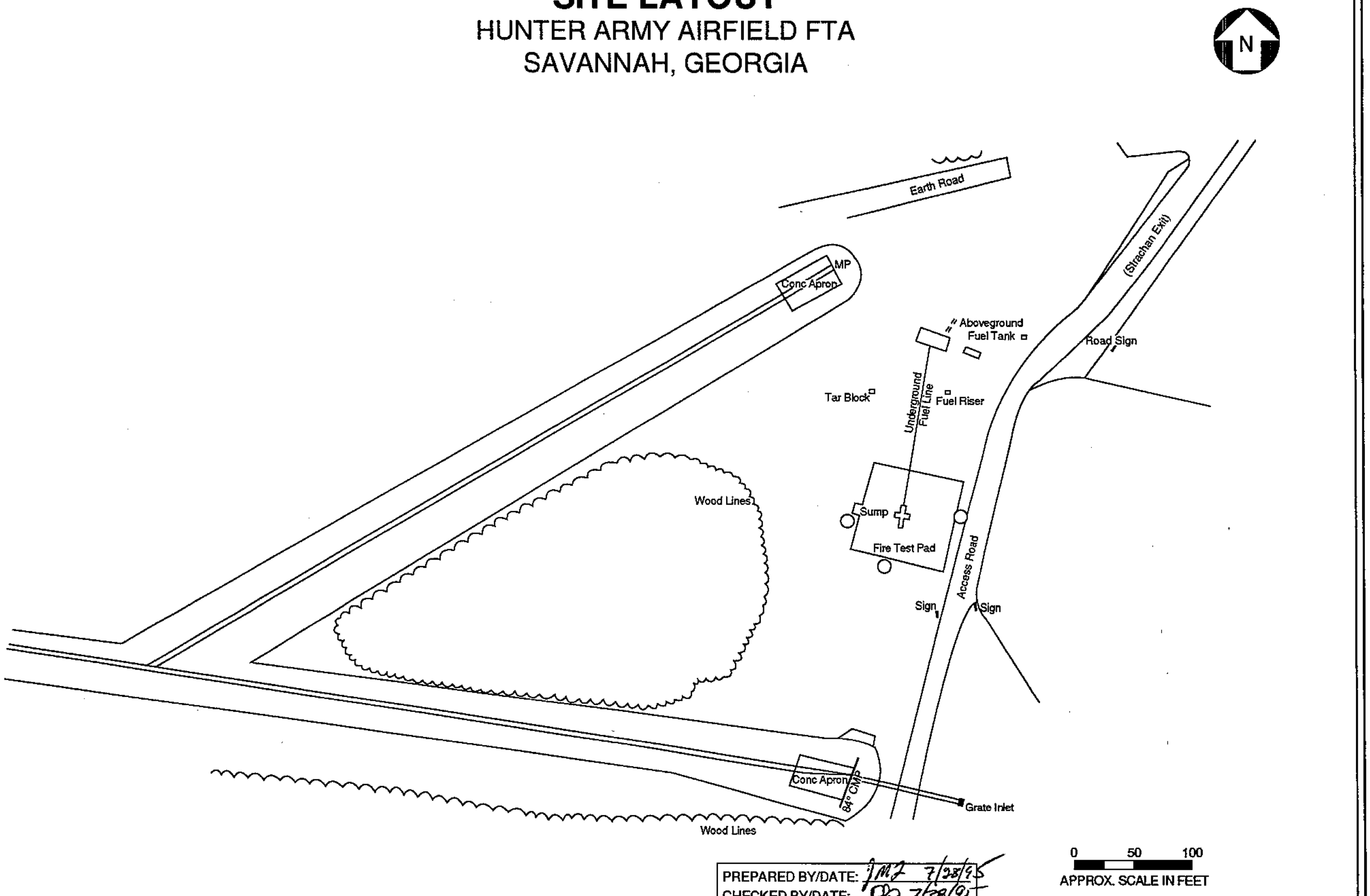
The ESE investigations included drilling of boreholes, installation of monitoring wells, and sampling and analyses of sediments, soil, and ground water. Figure 2-2 shows the location of the samples taken during 1987, 1990, and 1992. These analyses have provided the following information about the contaminants present, and geologic and hydrogeologic data above Preliminary Cleanup Targets (PCTs) (ESE, 1993a).

The results from the PCT analyses show that several polynuclear aromatic hydrocarbons (PAHs) were detected above their carcinogenic PCTs. These soil samples were collected from varying depths north and northwest of the fire pit in 1990 and 1992 around the underground fuel line,

FIGURE 2-1

SITE LAYOUT

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



PREPARED BY/DATE: JMJ 7/28/95
CHECKED BY/DATE: DQ 7/28/95
REVIEWED BY/DATE: ____________

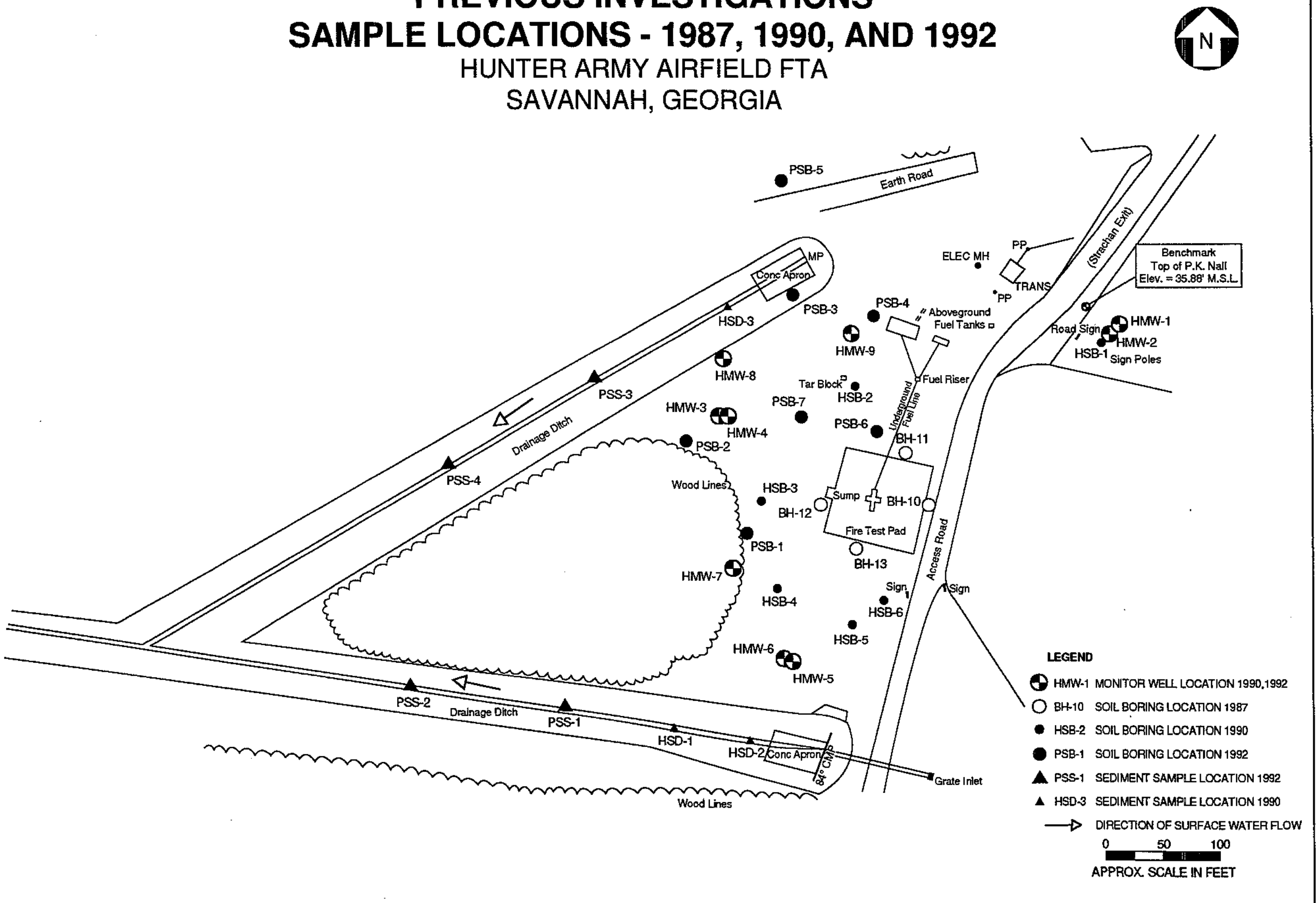
(BASE MAP MODIFIED FROM ESE, 1993b)

3551-0320.04

FIGURE 2-2

PREVIOUS INVESTIGATIONS SAMPLE LOCATIONS - 1987, 1990, AND 1992

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



(BASE MAP MODIFIED FROM ESE, 1993b) **3551-0320.04** and in the vicinity of the aboveground fuel storage tank. Also, surface soil samples collected from the fire pit in 1987 showed lead concentrations exceeding the EPA interim cleanup level. The majority of sediment samples from the two drainage ditches revealed concentrations of several PAHs that exceed carcinogenic PCTs (based on soil ingestion, which is conservative for sediment exposure) (ESE, 1993a). The ground-water analyses performed included hydraulic conductivity (slug) testing, ground-water level monitoring, and PCT analysis.

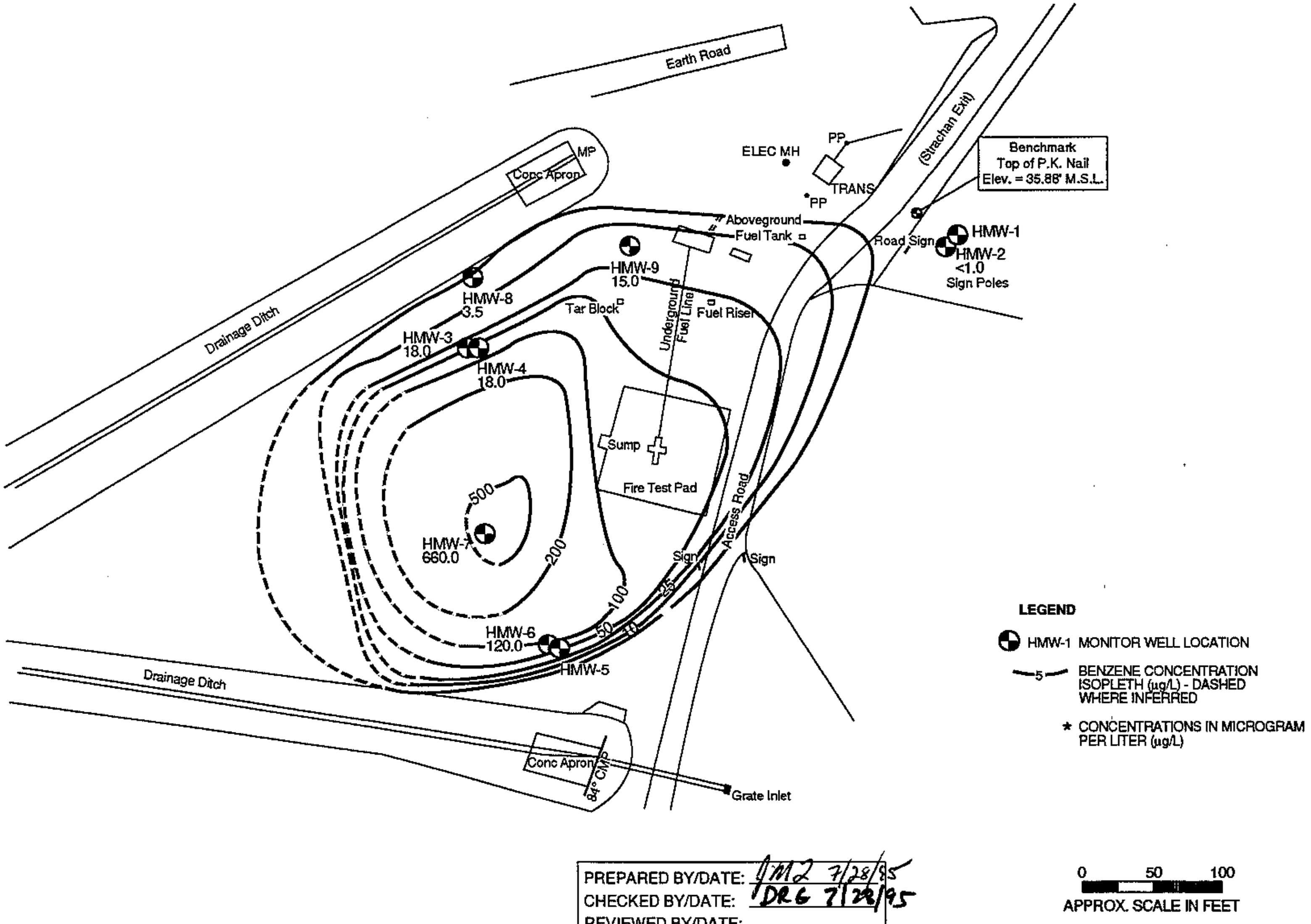
Ground-water levels were monitored in monitoring wells at the site for 6 months during the 1992 investigation. The monitoring was performed hourly by a Telog® logging device and manually once a month. From the data obtained the maximum ground-water fluctuation was shown to be 3.79 feet by Telog® and 3.3 feet by manual monitoring (ESE, 1993a). Hydraulic conductivity (slug) testing was performed to determine the conductivities of the aquifer during 1992 investigation. The conductivities of HMW-3 and HMW-4 were found to be 0.0018 and 0.0013 feet/minute, respectively. The ground-water gradient was determined to be 0.015 feet/foot to the northwest and the ground-water flow velocity to be approximately 35.9 feet per year (ft/yr) (ESE, 1993a).

The PCT analysis indicated the following: The concentrations of arsenic, chromium, and selenium detected in a 1990 sample from a shallow downgradient well (HMW-6) exceed Federal and State of Georgia Maximum Contaminant Levels (MCLs). Lead levels detected in the 1990 samples from the same well, as well as shallow downgradient well HMW-4 are above the EPA action level for lead. The concentrations of arsenic, barium, chromium, and lead detected in the shallow upgradient well HMW-2 also exceed or are equivalent to their respective PCTs. Benzene was detected above its MCL in several wells [HMW-3 (1990), HMW-4 (1992), HMW-6 (1990 and 1992), HMW-7 (1992), and HMW-9 (1992)]. Figure 2-3 presents benzene concentrations detected in ground-water samples during the 1992 field effort. Also, vinyl chloride was detected above its MCL in the 1992 sample from HMW-6. The only other chemicals measured in ground water above PCTs were three PAHs, which were detected in the 1990 sample from HMW-6 (ESE, 1993b).

FIGURE 2-3

1992 BENZENE CONCENTRATIONS* IN SURFICIAL GROUND WATER (0-15' BELOW LAND SURFACE)

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



PREPARED BY/DATE: JMZ 7/28/95
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(BASE MAP MODIFIED FROM ESE, 1993b)

3551-0320.04

2.4 SCHEDULE OF SAMPLING ACTIVITIES

Table 2-1 shows the schedule for the field investigation activities from pre-mobilization through the completion of all field sampling and testing. The overall project schedule is discussed in Section 2.3 of this work plan.

TABLE 2-1

APPROXIMATE SCHEDULE OF FIELD ACTIVITIES
Hunter Army Airfield FTA
Savannah, Georgia

Dates	Activities
July 30, 1995	Final Work Plan and CDAP Submittal
August 15, 1995	Field Investigation Mobilization
August 19 - August 24, 1995	Concrete pad/soil sampling around pad
August 19 - September 3, 1995	Soil gas survey collection
October 4 - October 18, 1995	Soil sampling, monitor well installation ground-water sampling, staging IDW

PREPARED/DATE: 7/28/95
CHECKED/DATE: DRG 7/28/95

3.0 CHEMICAL DATA QUALITY OBJECTIVES

The parameters of precision, accuracy, representativeness, completeness, and comparability (PARCC) are indicators of data quality (USEPA, 1987a). Establishing goals for these parameters serves to guide the choice of the analytical methodology. It also establishes a strategy for the evaluation of the data once it is acquired to determine whether the collected data will support the goals of the project. One of the primary functions of this CDAP is to establish these DQOs. The following sections present the data uses, site-specific DQOs, and PARCC parameters.

3.1 DATA USES

The data acquired for this project will be used to prepare a Compliance Status Report (CSR), and remedial design plans, specification and cost estimates. Specifically, the concrete analysis results and the analytical results for those soil samples collected immediately around the pad will be used for a remedial design to remove the pad and grossly contaminated soil. Soil, ground water, concrete and previous data will be used to prepare the CSR.

3.1.1 Site-Specific Objectives

The objective of the investigation at the FTA is to complete a CSR/remedial design (RD). Data uses for the CSR/RD include site assessment, risk assessment, and a remediation design planning. The site investigation of the FTA will include soil, and ground-water analyses to assess the extent of the contamination. The nature of the present contamination has been investigated and discussed in previous reports (ESE 1992, 1993a,b). By achieving to the PARCC DQOs discussed in the next section, the data generated will be of sufficient quality and quantity to support a CSR/RD.

The estimated extent of organic contamination from the previous investigations by ESE is shown in Figures 3-1 and 3-2.

3.2 PARCC PARAMETERS AND DQOs

Only qualitative statements concerning representativeness and comparability can be made. Numerical goals for precision, accuracy completeness are possible, however, and are reported as a percentage. Precision is generally expressed as the relative percent difference of two measurements while accuracy is expressed as bias. Completeness is expressed as the amount of valid data acquired divided by the amount of data planned to be acquired and applies to the project as a whole. A completeness goal of 90 percent has been established for this project.

Precision measures the reproductibility of measurements under a given set of conditions. Field sampling precision will be determined by the collection of field duplicate samples. Analytical precision is measured by the analysis of laboratory duplicate and matrix spike duplicate samples.

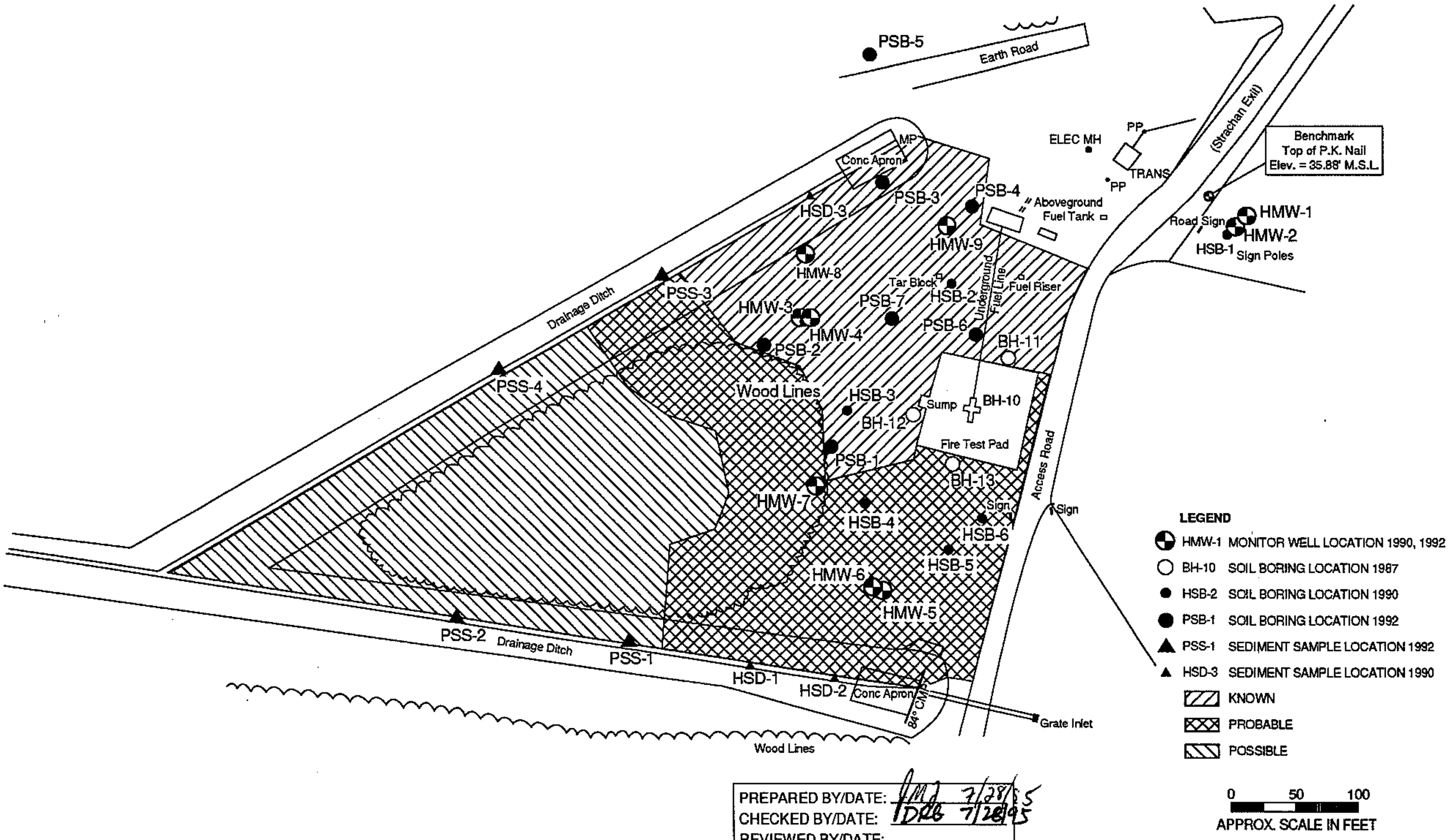
Accuracy measures the bias in a measurement system. Sampling accuracy may be assessed by evaluating the results of trip and field blanks. Analytical accuracy can be evaluated through the analysis of method blanks, matrix spike and laboratory control samples. Appendix A-3 provided DQO goals for analytical accuracy expressed as control limits by method.

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sample point or an environmental condition. To ensure the samples to be collected at the fire training area are representative, samples will be collected utilizing standard sampling procedures and the rationale for sample locations will be provided. Biased (based on existing data, field screening and observations) sampling approaches will be used. The rationale for sample locations and the details of sampling procedures are provided in Sections 5.3 and 5.4, respectively.

FIGURE 3-1

ESTIMATED EXTENT OF ORGANIC CONTAMINATION OF SURFACE SOILS (0-1' BELOW LAND SURFACE)

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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(BASE MAP MODIFIED FROM ESE, 1993)

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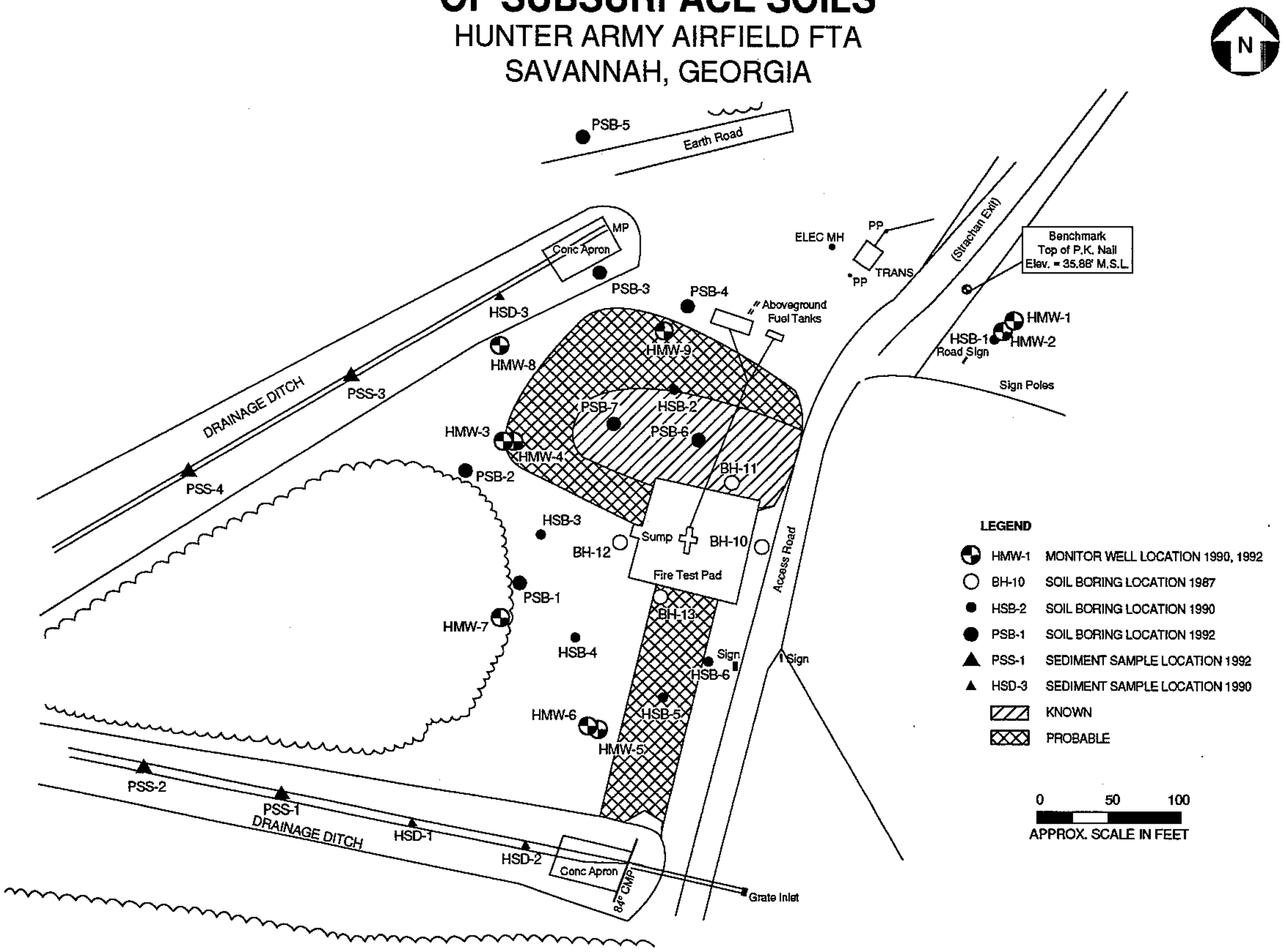
FIGURE 3-2

ESTIMATED EXTENT OF ORGANIC CONTAMINATION OF SUBSURFACE SOILS

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. This goal is achieved through using standard sampling techniques to collect representative samples and using standard analytical methods to produce data of known analytical quality. For this investigation, two levels of data (USEPA, 1987a) will be required. Level I data, field screening, will be used at several sites to provide real-time data. Level I data includes field screening or analysis by portable instruments. Examples of Level I data collection activities will include HNU monitoring, water level measuring, and water quality characterization (such as pH, specific conductance, and temperature). Level III data will also be obtained. Level III data is laboratory analysis utilizing standard EPA methods and produces both qualitative and quantitative data which may be compared to future investigations required at HAAF Hunter Army Airfield. The method reporting limits of each analysis (provided in Section 7) are adequate to quantify analytes at or below Applicable or Relevant and Appropriate Requirements (ARARs). Comparability is also assessed by comparing the results of the split samples collected at a frequency of 10 percent and sent to the U.S. Army Corps of Engineers - South Atlantic Division Laboratory for analysis.

Quality data is essential to overall project quality. The DQOs defined above were selected to design data collection programs which can support the project objectives described in Section 3.1. The analytical data produced from this investigation will be of sufficient quality and quantity to meet the overall project objectives and satisfy regulatory requirements.

4.0 PROJECT MANAGEMENT

LAW has established standards and requirements for project management and quality assurance (QA). Our QA Program is one of the most important factors contributing to project success. The purpose of the program is to assure that services are being performed using industry-standard scientific engineering practices. The following sections discuss the project organization, QA program and project management and shows the interrelationship between each function.

4.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

This project will be executed by a team of engineers and scientists of the Government Services Division of LAW. Law Environmental, Inc., Government Services Division (LEGS) is located at Kennesaw, Georgia. The interrelationship of the project members is shown in Figure 4-1. The following paragraphs describe the responsibilities of the key personnel.

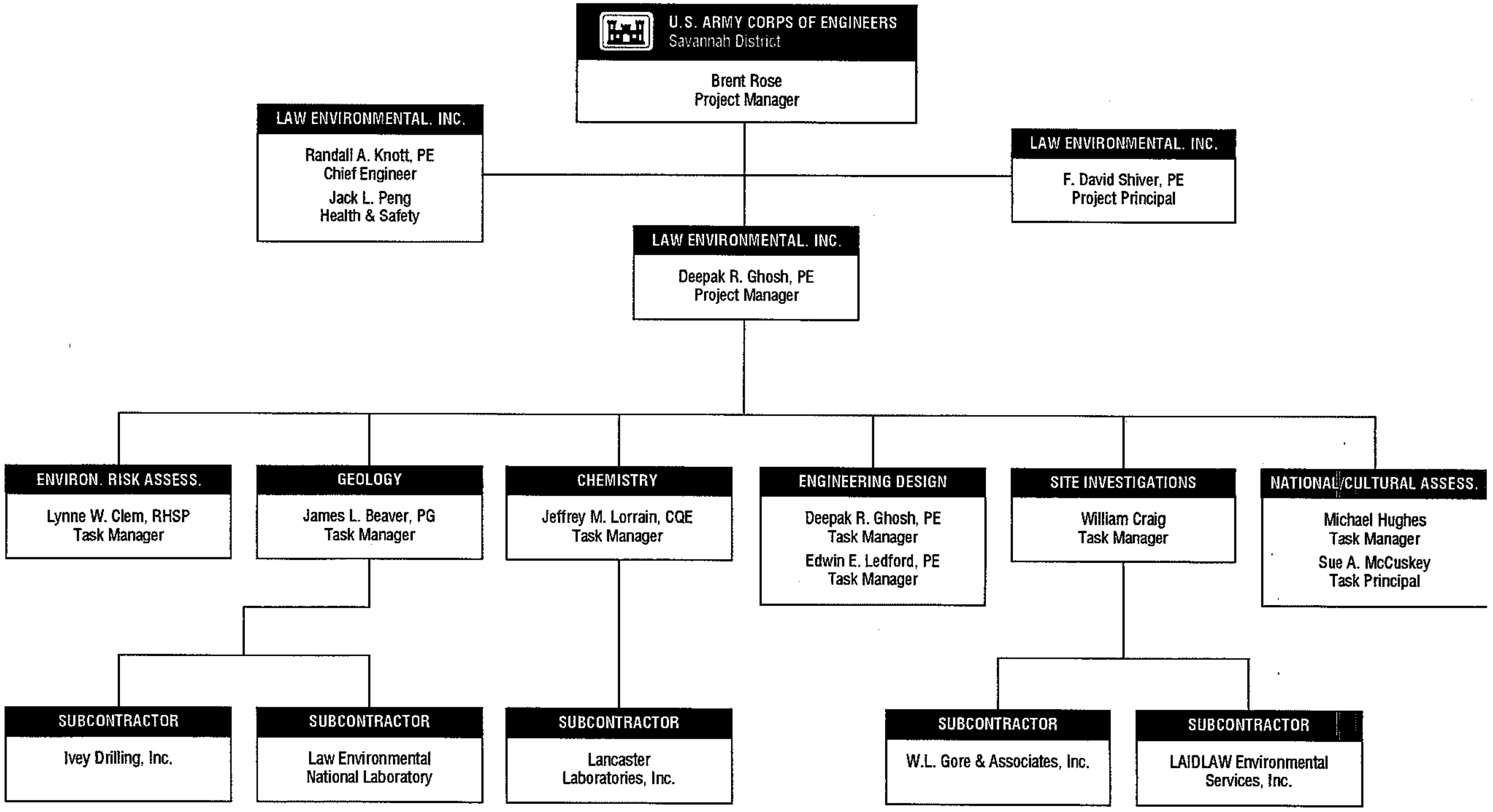
Each project undertaken by LAW is under the direct supervision of a project principal. Mr. F. David Shiver, P.E. will serve as principal engineer for this project. The project principal provides technical and administrative review, provides all quality assurance (QA) and quality control (QC) functions and overall technical direction of the project. He is also the principal contact for project contractual matters. As Chief Engineer, Mr. Randall A. Knott, P.E., will act as QA/QC program manager for the Investigative and Design activities for this project.

The project manager works under the direct of the project principal and is responsible for the management of the project, which includes client contact, management of administrative requirements, coordination and management of personnel assigned to the project, and supervision of schedules, technical approach, implementation, and report preparation. Mr. Deepak R. Ghosh, P.E. will serve as the project manager for this project.

FIGURE 4-1

PROJECT ORGANIZATION

SITE INVESTIGATIONS AND REMOVAL ACTION DESIGN
HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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Mr. James L. Beaver, P.G. will serve as the task manager for geology-related issues. Ms. Lynne W. Clem, R.H.S.P. will serve as task manager for risk assessments, regulatory criteria and action level determination. Mr. Jeffrey M. Lorrain, L.Q.M., G.H.M.M. will serve as the task manager for chemistry-related issues. He will have responsibility of sample acquisition and coordination with the laboratory. Mr. Deepak R. Ghosh, P.E. and Mr. Edwin E. Ledford, P.E., R.L.S. will be responsible for all design activities, including preparing plans, specifications, and construction cost estimates.

Mr. Paul A. Vogt will serve as task manager for natural and cultural resource assessment activities associated with construction related activities at the site. Ms. Sue Ann McCuskey will serve as the principal for this effort.

4.1.1 Subcontractors

LAW will subcontract some of the services to selected qualified firms. Ivey Drilling, Inc., a minority-owned business, will provide drilling and monitoring well installation services during the field investigation activities. Lancaster Laboratories, a COE certified laboratory will be responsible for all chemistry-related analysis of samples collected at the site. Physical analysis of samples will be performed by Law Environmental National Laboratories, which is also a COE certified laboratory.

W.L. Gore and Associates, Inc., will provide services for soil gas survey and analysis and LaidLaw Environmental Services, Inc. will be the IDW disposal subcontractor.

4.2 QUALITY ASSURANCE

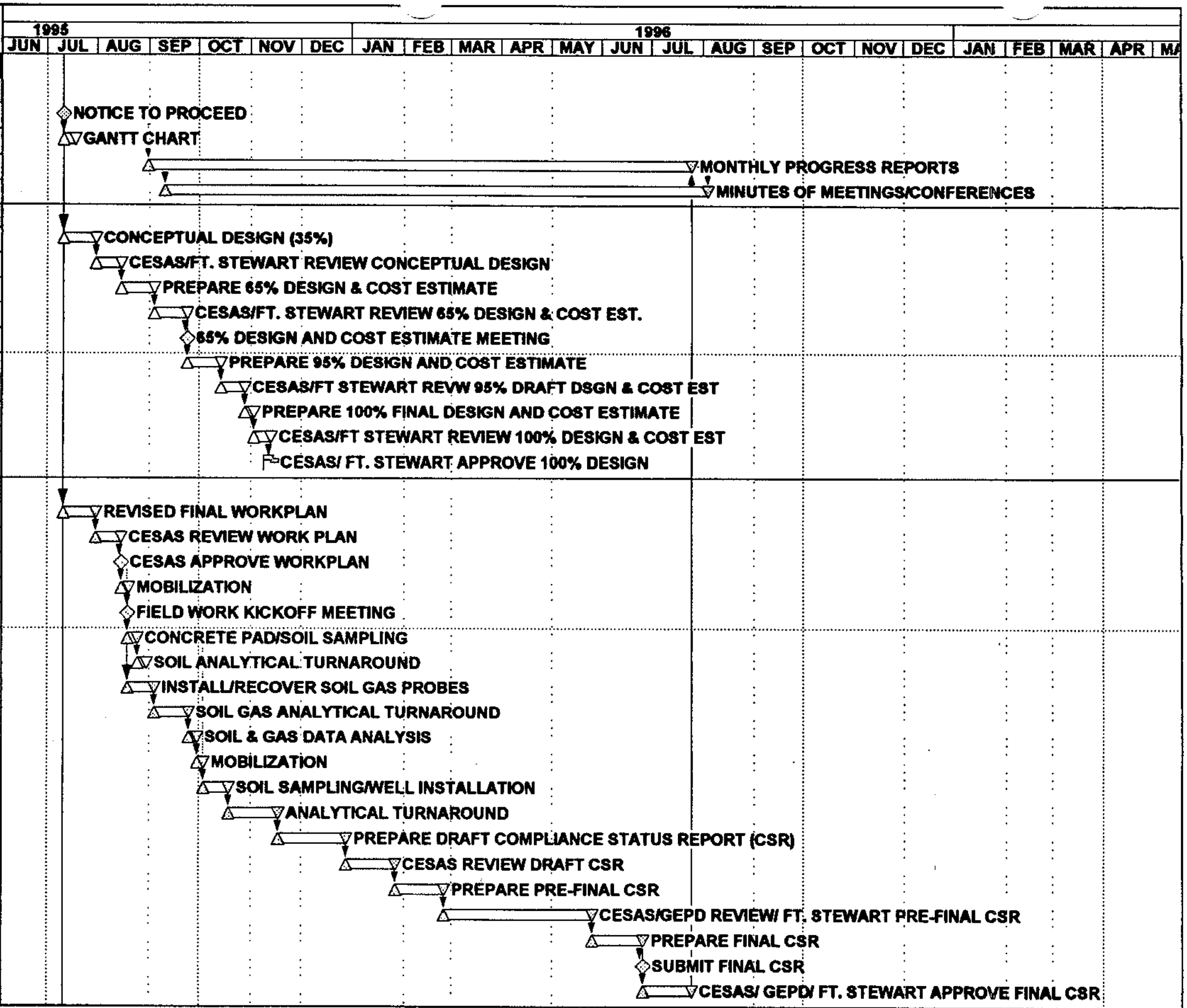
LAW has established a strong internal QA program with an associated QA manual, engineering procedures manual, equipment calibration procedures manual, and specialty manuals for hazardous waste site investigations and software documentation. LAW employees use these manuals as the basis for conducting all company work within the QA program. Each project is assigned to a principal engineer/scientist who is responsible for maintaining the required professional quality from beginning to end of the project. Mr. F. David Shiver, P.E. will serve as principal for this project. Every deliverable must be reviewed and signed by two persons and at least one must be a certified principal with credentials and experience relevant to the area of work. Calculations are independently checked for accuracy, and design drawings and specifications are approved in accordance with company policy and applicable engineering requirements. Mr. Randall A. Knott is responsible for the LEGS QA functions and application of the QA manuals, policies and procedures for all projects being conducted through this branch.

4.3 PROJECT PROGRESS AND SCHEDULING

To complete the project within established schedule restraints, timely submittals by LAW and review by the U.S. Army Corps of Engineers, Savannah District (CESAS-EN-GH) are necessary. A Project Schedule is included as Figure 4-2. Monthly progress reports will be prepared and submitted to CESAS-EN-GH. All required documents will be submitted, Draft and Final, as requested in the Scope of Work and According to proposed scheduled dates. The schedule will be updated as required by Project Managers and Project Principals.

To provide timely submittals, review comments from all parties are expected on the date specified on the Project Schedule, Figure 4-2.

Activity ID	Early Start	Early Finish	Dur
HUNTER ARMY AIRFIELD			
PROJECT PLANNING			
LHU100	11JUL95*		0
LHU102	11JUL95	17JUL95	7
LHU104	31AUG95	24JUL96	329
LHU106	10SEP95	03AUG96	329
DESIGN			
LHU200	11JUL95	30JUL95	20
LHU202	31JUL95	14AUG95	15
LHU204	15AUG95	03SEP95	20
LHU206	04SEP95	23SEP95	20
LHU206A		23SEP95	0
LHU208	24SEP95	13OCT95	20
LHU210	14OCT95	28OCT95	15
LHU212	29OCT95	02NOV95	5
LHU214	03NOV95	12NOV95	10
LHU216		12NOV95	0
FIELD ACTIVITIES			
LHU300	11JUL95	30JUL95	20
LHU300A	31JUL95	14AUG95	15
LHU302		14AUG95	0
LHU303	15AUG95	19AUG95	5
LHU303A	19AUG95		0
LHU304	19AUG95	24AUG95	6
LHU304A	25AUG95	29AUG95	5
LHU304B	19AUG95	03SEP95	16
LHU304C	04SEP95	24SEP95	21
LHU304D	25SEP95	29SEP95	5
LHU305	30SEP95	03OCT95	4
LHU306	04OCT95	18OCT95	15
LHU306A	19OCT95	17NOV95	30
LHU308	18NOV95	27DEC95	40
LHU310	28DEC95	26JAN96	30
LHU312	27JAN96	25FEB96	30
LHU314	26FEB96	25MAY96	90
LHU316	26MAY96	24JUN96	30
LHU316A		24JUN96	0
LHU318	25JUN96	24JUL96	30



Project Start	11JUL95
Project Finish	03AUG96
Data Date	11JUL95
Plot Date	12JUL95

(c) Primavera Systems, Inc.

△▽ Early Bar
▲▼ Progress Bar
△▽ Critical Activity

HUNB

HUNTER ARMY AIRFIELD
SOURCE REMOVAL ACTION DESIGN
LAW PROPOSED SCHEDULE

Sheet 1 of 1

LAW ENGINEERING/ENVIRONMENTAL SERVICES, INC.

Date	Revision	Checked	Approved
		DPG	

5.0 FIELD ACTIVITIES

The initial steps in chemical data acquisition are the implementation of proper sampling and sample handling procedures. The sections that follow will provide a definition of terms, sampling locations, sampling and sample preservation procedures, field analysis procedures, and field documentation.

5.1 DEFINITIONS

5.1.1 A-E (LAW) Laboratory

The laboratory responsible for performing the chemical analysis of all field samples will be Lancaster Laboratories, Inc. (Lancaster) located in Lancaster, Pennsylvania.

5.1.2 Quality Assurance (QA) Laboratory

The U.S. Army Corps of Engineers - South Atlantic Division laboratory (CESAD) will serve as the QA Laboratory. The QA laboratory will receive and analyze splits of field samples as an evaluation of the LAWs laboratory's performance.

5.1.3 Quality Control Samples

These samples are collected by the field sampling team and analyzed by the A-E Laboratory to evaluate the quality of the field samples and analytical data. QC samples include field duplicates, trip blanks and equipment rinsates. The number of QC samples to be collected represent approximately ten percent of the field samples.

5.1.4 Quality Assurance (QA) Samples

QA samples are collected by the field sampling team and sent to the QA Laboratory. The results are utilized by the QA Laboratory to assess the quality of the data produced by the field team and the LAW selected laboratory. QA samples include split samples, trip blanks, and equipment rinsate samples. The number of QA samples collected represents approximately ten percent of the field samples.

5.1.5 Split Samples

A split sample is a sample that is collected, homogenized, and then divided, "split" into two equal aliquots for analysis. Samples for volatile analysis will be collected and split prior to homogenizing. The sample shall be split in the field prior to delivery to the laboratory. Ordinarily split samples are analyzed by two different laboratories.

5.1.6 Field Duplicates

Multiple grab samples, collected separately, that equally represent a medium at a given time and location are known as field duplicates. These samples will be coded in a manner so as to prevent laboratory personnel from distinguishing them from other field samples. Field duplicate samples are used to assess sampling and laboratory precision. They will be collected at a frequency of one per twenty field samples.

5.1.7 Background Samples

Background samples are taken from areas away from contaminated areas that are known to be free of human activity and are not contaminated with the analytes of interest. These samples provide a naturally occurring or 'background' value for suspected contaminants.

5.1.8 Rinsates

Rinsates are samples consisting of reagent grade water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of the rinsate is to determine whether the sampling equipment decontamination procedure is working properly. Rinsates will be collected at a frequency of one per twenty field samples.

5.1.9 Trip Blanks

Trip blanks are VOA sample vials that are filled with organic free water and preserved with HCl to a pH less than 2 at the laboratory. They accompany the field sample containers from the time they leave laboratory until they are returned to the laboratory for analysis. These blanks are not opened in the field. The purpose of the trip blank is to determine whether samples are being contaminated during transit or sample collection. Trip blanks pertain to volatile organic analyses of aqueous samples only. One trip blank is required for each day of sampling if water samples for VOA are shipped in the same cooler. At a minimum, a trip blank must be included in any sample cooler that contains water samples that are to be analyzed for volatile constituents.

5.2 FIELD ANALYSIS PROCEDURES

The following sections will present an overview of the methods to be utilized in the measurement of field parameters. Table 5-1 provides a list of field equipment.

5.2.1 pH Measurement

The pH of a water sample will be determined by EPA Method 150.1. This method utilizes a pH meter to determine pH electrometrically using either a glass electrode in combination with a reference potential or a combination electrode. Each instrument/electrode system is calibrated

TABLE 5-1

FIELD EQUIPMENT REQUIREMENTS
Hunter Army Airfield FTA
Savanna, Georgia

Field Analytical Equipment

- Organic vapor analyzer equipped with a photoionization detector to measure possible contamination while drilling. Range of 1 ppm to 2000 ppm
- pH meter
- Thermometer
- Conductivity meter
- Turbidity meter

Field Sample Collection Devices

- Teflon® Bailers
- Purge pump
- Poly tubing
- Generator
- Nylon rope
- Glass beaker
- Stainless steel split spoon
- Stainless steel hand auger
- Stainless steel bowls
- Stainless steel spoons

Sample Collection Containers

- Pre-cleaned glass jars and vials equipped with teflon-lined lids or septae

Decontamination Solutions

- Deionized water
- Methanol
- Potable water
- Decon tubs
- Scrub brushes
- Spray bottles
- Drums for decontamination waste fluids
- Plastic sheeting
- Paper towels
- Gloves (latex)

Preservation Solutions

- Hydrochloric Acid
- Nitric Acid
- Sulfuric Acid

Personal Protective Equipment

- Tyvek
- Hard hat
- Safety glasses
- Surgical gloves
- Rubber steel toe boots
- Protective gloves (latex)

Documentation Supplies

- Field log book, pens, sharpies
- All field forms
- Sample chain-of-custodies, custody seals, sample labels, request for analysis forms, Federal Express labels
- Clear and strapping tape
- Camera and film

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at a minimum of two points that bracket the expected pH of the sample and are approximately three or more pH units apart. The instrument will be calibrated twice a day. The pH is measured at the temperature of the sample which is compensated for by the instrument. This analysis will be performed in the field.

5.2.2 Conductivity Measurement

The specific conductance of a sample will be determined by EPA Method 120.1. The method utilizes a self-contained conductivity meter utilizing a Wheatstone bridge or equivalent. Samples are analyzed preferably at 25 degrees Celsius. If not, the temperature corrections are compensated for by the instrument. The instrument is factory calibrated and the calibration checked daily with a standard potassium chloride solution. This analysis will be performed in the field.

5.2.3 Temperature Measurement

The temperature of the sample will be measured by EPA Method 170.1. This method utilizes a mercury-filled or dial-type thermometer or thermistor. This analysis will be performed in the field.

5.2.4 Turbidity Measurement

This method is a comparison of the light scattered by a sample versus the light scattered by a reference solution. The nephelometer (turbidimeter) is calibrated daily with a 0.1 NTU solution. The sample is then poured into the turbidimeter tube and read directly from the instrument. This analysis will be performed in the field.

5.2.5 Photoionization Detector

The photoionization detector (PID) used for field detection of volatile organic vapors for soil during headspace screening will be the Photovac Microtip HL-2000 or an equivalent unit. The HNu will be calibrated with a 100 parts per million (ppm) factory standard of isobutylene gas. As a general rule, the instrument will be calibrated at least twice a day; at the beginning, and middle of each day. Additionally, the instrument will be calibrated in a safe area, free of contamination and/or hazards. The battery power supply for the PID will be recharged as specified in the equipment manual. The protocol for Field Screening Analysis for Volatile Organic Compounds by Photoionization Detector is included as Appendix A-2.

The PID described above, or an equivalent unit, will be used to screen the air space (breathing zone) at work areas where intrusive activities are being performed. The PID is very sensitive to moisture in the air, therefore, temperature and humidity will be recorded at the beginning of each day and as changes occur during the day.

5.3 SAMPLING LOCATIONS

Samples for chemical analysis at the Hunter FTA will include ground water and soils. To accomplish the objectives of the investigation, historical data gathered during the previous site investigations, including geologic, hydrogeologic, and chemical information as well as the results of the soil gas survey will be used to select locations that will provide samples which should satisfy all of the DQOs defined in Section 3.0 of this document. In general, samples will be obtained in locations so that the extent of contamination can be assessed. This should facilitate decisions concerning the appropriate closure of the FTA. This section of the CDAP describes the specific field tasks that will be performed at the FTA, and includes the rationale for conducting these tasks. The locations from which samples will be collected during the field investigation are also included in this section. At the FTA, four shallow (15 foot) wells and five soil borings will be installed. The procedures to be used during sampling activities are defined in Section 5.4. The procedures for drilling and well installation are defined in Section 4.0 of the Work Plan.

5.3.1 Soil Gas Survey Sample Locations and Nationale

A soil gas survey consisting of 20 samples will be conducted in the study area shown on Figure 4-1. Using the results of the soil gas survey, LAW will recommend, with the client's concurrence, five hand auger soil sampling locations and four monitoring well locations. The protocol for the soil gas survey is contained in Section 5.4.4 of this document.

5.3.2 Soil Boring Sample Location and Rationale

The rationale for collecting soil samples and the proposed locations at which the sampling will be performed are discussed in the following paragraphs. Table 3-1 of the work plan provides a summary of the rationale for each field task.

- Hand auger borings will be advanced around the pad to approximately the water table depth (not to exceed 2 feet bls) and soil samples will be collected approximately every 2 feet beginning at 0.5 feet below ground surface (bgs). A description of each sample will be made in the field to include visual observations, odor, and PID/OVA readings. Based on the field observations, the site chemist will select eight soil samples to be sent to the lab for complete analyses to supplement the field PID/OVA readings for assessing the extent and degree of contamination. These eight samples will be analyzed for the parameters shown on Table 4-1 on an expedited lab turnaround time of not more than five days. The protocol for obtaining the hand auger samples is provided in Section 5.4.2 of this document.
- Hand auger borings will be advanced beneath the concrete pad in the locations from which the concrete samples were collected. Soil samples will be collected approximately every 2 feet. A description of each sample will be made in the field to include visual observations, odor, and PID/OVA readings. Based on the field observations, the site chemist will select four soil samples to be sent to the lab for analyses to supplement the field PID/OVA readings for assessing the extent and degree of contamination. These four samples will be analyzed for the

parameters shown on Table 7-1 on an expedited laboratory turnaround time of not more than five days. The protocol for obtaining the hand auger samples is provided in Section 5.4.2.

- Five hand auger borings will be advanced to approximately the water table (not to exceed 12 feet bgs). The locations will be dependent upon the results of the soil gas survey (discussed in Section 4.4 of the work plan). The actual boring locations will be recommended by LAW with concurrence from the client after reviewing the soil gas survey results. As the borings are advanced, soil samples will be collected approximately every 2 feet. A description of each sample will be made in the field to include visual observations, odor, and PID/OVA headspace readings. Based on the field observations two soil samples will be selected by the site chemist from each boring to be sent to the laboratory for analyses. These ten soil samples will be analyzed for the parameters shown in Table 7-1. The protocol for sampling is provided in Section 5.4.2.

5.3.3 Monitoring Well Installation Location and Rationale

Four ground-water monitoring wells will be installed at the site in the upper portion of the surficial aquifer. The locations of the ground-water monitoring wells will be based on the results of the soil gas survey.

5.3.4 Concrete Sample Location and Rationale

Four concrete samples will be collected from the concrete pad in order to determine the waste characterization and proper disposal of the structure. The sampling locations will be determined in the field based on site conditions and visual observations. The protocol which will be used to collect these samples is provided in Section 5.4.2. The samples will be analyzed for the parameters shown on Table 7-1.

5.4 SAMPLING, SAMPLE HANDLING AND PRESERVATION PROCEDURES

The soil (30) and concrete (4) samples will be collected from up to 21 locations. Ground-water samples will be collected at 13 locations. Tables 5-2 and 5-3 provide the numbers of field samples, QC samples, and parameters for the FTA. Care will be taken to maintain sample integrity throughout the sampling and shipping activities. The following subsections describe the procedures for soil and ground-water sampling, sampling equipment decontamination, and sample preservation.

5.4.1 Concrete Sampling Procedure

Four concrete samples will be collected from the 6,400 square foot concrete pad. The samples will be collected using a decontaminated carbide tipped core drill. Concrete cores through the entire depth of the pad will be collected. The collected cores will be placed in new plastic bags and labelled as described in Section 5.5. The collected cores will be preserved by placing the labelled samples in a cooler with ice sufficient to bring the temperature to 4 degrees Celsius.

5.4.2 Procedure for Soil Sampling

Soil sampling is conducted in a manner to minimize interaction of the sample with the surface environment. Hand auguring will be used to obtain samples at the required depth. A 3-inch diameter decontaminated stainless steel hand auger will be used to recover sufficient soil for analysis.

Volatile samples will be removed from the auger immediately upon collection using a decontaminated stainless steel spoon. The spoon will be utilized to place the soil into the sample container such that minimum headspace remains. The remaining will be placed into a decontaminated stainless steel bowl and mixed thoroughly with a decontaminated stainless steel spoon. Aliquots of the homogenized sample will then be placed in the appropriate containers.

TABLE 5-2

ANALYTICAL REQUIREMENTS FOR SOIL/CONCRETE SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

			ANALYTICAL PARAMETERS			
SAMPLE TYPE	NO. LOCATIONS	SAMPLES PER LOCATION	RCRA METALS	VOCs 8240	SVOCs 8270	TPH 8015
Monitoring Well Borings	4	2	8	8	8	8
Soil Borings (3)	6 - 10	1 - 2	12	12	12	12
Soil Borings (4)	5	2	10	10	10	10
Concrete	4	1	4	4	4	4
Subtotal			34	34	34	34
Field Duplicates (2-Soil,			4	4	4	4
Rinsates			2	2	0	2
Tripblanks (VOA only)			[Not required for soils]			
MS: (2-Soil, 1-Sediment)			3	3	3	3
MSD: (2-Soil, 1-Sediment)			3	3	3	3
Total Field and QC Samples			30	30	30	30
QA Samples						
Soil			2	2	2	2
Sediment			1	1	1	1

NOTES:
(1) Soil samples only
(2) EPA Method of Analysis
(3) Ten foot borings associated with remedial design of concrete pad
(4) Twelve foot borings

VOC = Volatile Organic Compounds
SVOC = Target compound list semi-volatile organic compounds
TPH = Total petroleum hydrocarbons
RCRA Metals = Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver

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TABLE 5-3

ANALYTICAL REQUIREMENTS FOR GROUND-WATER SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

	ANALYTICAL PARAMETERS			
	RCRA Metals	VOCs 8240 (b)	SVOC 8270	TPH 8015 (med)
Field Locations	13	13	13	13
Field Duplicates	1	1	1	1
Rinsates	0	0	0	0
Trip Blanks (VOA only)	0	1	0	0
MS:	1	1	1	1
MSD:	1	1	1	1
Total Field and QC Samples	16	17	16	16
QA Samples	1	1	1	1

NOTES:
(b) EPA Method of Analysis
VOC - Target Compound list Volatile organic compounds
SVOC - Target Compound list Semi-volatile organic compounds
TPH - Total petroleum hydrocarbons
RCRA Metals - Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver

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Appropriate sample containers, amounts, and preservation are presented in Section 5.4.5. Samples will be labeled as described in Section 5.5. Field screening of headspace will follow the standard operating procedure provided in Appendix A-2.

5.4.3 Ground-Water Sampling Procedure

Rapid and significant changes can occur in ground-water samples upon exposure to ambient conditions at the surface (exposure to sunlight, temperature, and pressure changes). Therefore, ground-water sampling is conducted in a manner to minimize interaction of the sample with the surface environment. The equipment and protocol for collecting ground-water samples are described in the following paragraphs. Decontamination procedures for field equipment, including ground-water sampling equipment, are described in Section 5.4.5 of this document.

a. Measure Water Level - Using clean, non-contaminating equipment (i.e., an electronic level indicator or a fiberglass tape) determine the water level in the well and calculate fluid volume in the casing and screen. If an organic phase exists, it will be separated and collected in a 40 mL vial. The CESAS-EN-GH should be contacted for further instructions regarding these samples.

b. Purge Well - Remove at least five well volumes with a Teflon® bailer or by pumping. Ground water will be tested for pH, temperature and specific conductance before, during, and after purging. Sample collection will begin after field parameters have stabilized (readings differing plus or minus ten percent between successive well volumes). If the well goes dry during purging, then it will be sampled as soon as sufficient recharge has occurred to allow collection of a sample.

c. Collect Sample - Lower the Teflon® bailer slowly until it contacts the water surface and allow the bailer to sink to the desired depth and fill with a minimum of surface disturbance. Care will be taken so that the sample is collected from the screened portion of the well and not from the overlying riser section or the underlying sand-sump section of the well. Slowly withdraw the bailer, being careful to prevent contact of the bailer line with the ground. Tip the bailer and slowly discharge the contents into the appropriate container. The process will be repeated as necessary to fill each container to the required volume. Samples to be analyzed for volatile organics will be collected first to minimize the effect of disturbance of the water surface in the well on the volatile analysis. Sample containers will be filled completely leaving no air space above the liquid portion to minimize volatilization. The remainder of the parameters will then be collected in the appropriate containers as indicated in Table 5-4.

5.4.4 Soil Gas Sampling Procedure

The passive soil gas samples will be collected using the following procedures. An approximately one-half inch diameter hole (3-feet deep) is installed using a slide hammer. The Gore-Sorber™ device is inserted in the hole with the special insertion tool. The hole is plugged with a stopper and flagged for later survey and recovery. The Gore-Sorber™ is left in the ground for approximately 2 to 3 weeks. The Gore-Sorber™ modules are retrieved and shipped to the gore analytical laboratory for analysis in the containers provided.

5.4.5 Sample Preservation Procedures

Samples will be preserved following USACE protocols (USACE, 1990) to maintain sample integrity. Samples will be collected in containers provided by the laboratory that are pre-cleaned as appropriate for the environmental analysis. All sample containers have Teflon®-lined lids. All samples will be cooled to 4 degrees Celsius as soon as possible after sampling. Tables 5-4 and 5-5 provide the appropriate sample containers, amounts and preservations.

TABLE 5-4

SAMPLE CONTAINERS, AMOUNTS, AND PRESERVATION/ GROUND-WATER SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

PARAMETER	SAMPLE CONTAINERS[a,b]	AMOUNT	PRESERVATION
RCRA Metals	1 - 1 L. Polyethylene	Full	HNO_3 to pH<2; Ice to 4°C
Semi-Volatile Organic Compounds	2 - 1 L. Amberglass	Full	Ice to 4°C
Volatile Organics	3 - 40 mL glass VOA	Full; No headspace	Ice to 4°C HCl to pH <2
Total Petroleum Hydrocarbons	2 - 1 L. Amberglass	Full	Ice to 4°C HCl to pH <2

a All containers to have Teflon®-lined lids; VOA vials to have Teflon®-lined septa.
b Samples chosen for QA/QC analyses require double the number of containers indicated.

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TABLE 5-5

SAMPLE CONTAINERS, AMOUNTS, AND PRESERVATION/ SOIL SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

PARAMETER	SAMPLE CONTAINERS[a,b]	AMOUNT	PRESERVATION
Volatile Organics	Two 2-oz. wide-mouth glass jars	Full, No Headspace	Cool to 4°C
Semi-Volatile Organic Compounds	One 8-oz. wide-mouth glass jar	Full	Cool to 4°C
Total Petroleum Hydrocarbons	One 8-oz. wide-mouth glass jar	Full	Cool to 4°C
RCRA Metals	One 8-oz. wide-mouth glass jar	Full	Cool to 4°C

a All containers to have Teflon®-lined lids; VOA vials to have Teflon®-lined septa.
b Samples chosen for QA/QC analyses require double the number of containers indicated.

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CHECKED/DATE: 7/28/95

5.4.6 Field Equipment Decontamination

The following decontamination procedures will apply to split spoons, hand augers, stainless steel bowls and spoons, and ground-water bailers. The decontamination steps are as follows:

1. Hand wash with a bristle brush and a solution of Alconox (or equivalent).
2. Rinse thoroughly with tap water.
3. Spray-rinse with spectroscopic grade methanol.
4. Rinse thoroughly with tap water.
5. (Teflon bailers only) Spray-rinse with 10 percent nitric acid, then rinse thoroughly with tap water.
6. Final rinse with deionized water.
7. Air dry.
8. Wrap in aluminum foil.

The sampling equipment will be cleaned prior to each use in accordance with this procedure. Field personnel will use clean disposable gloves to handle all decontaminated sampling equipment.

All decontamination solutions will either be containerized in storage tanks on site or allowed to drain into the a designated storm sewer; all liquid investigation-derived waste (IDW) will be delivered to a sanitary sewer (City of Savannah).

5.5 FIELD DOCUMENTATION

Field sampling personnel must properly identify all samples taken in the field by using the sample label affixed around the sample container. The sample label must contain the site name; sample identification number; project number; the date, time, and location of sample collection; designation of the sample as either grab or composite; notation of the type of sample (e.g., ground water, soil, surface water); identification of any preservative(s) added; and the signature of the sampler. The sample labels are to be placed on the bottles so as not to obscure any QA/QC data on the bottles; sample identification information must be printed in a legible manner using indelible ink. Field identification information must be sufficient to enable cross-reference with the field notebook. The bound field notebook will have pre-numbered pages, and entries will be made in indelible ink. The site manager will prepare a Daily Quality Control Report (DQCR) as shown on Figure 5-1. The DQCR will include weather information at the time of sampling, samples taken, field instruments and calibrations and will reflect any problems that occurred in the field.

5.6 CORRECTIVE ACTION

The field analytical methods specified and sampling procedures are designed to prevent problems before they occur. Whenever a problem occurs, corrective action must be taken. Problems that cannot be corrected on site will be communicated to the CESAS Project Manager within 24 hours of their occurrence. This will be followed up with a written record of the problem containing a discussion of the corrective actions taken, their effectiveness, and the qualitative and quantitative effect on the quality of the data. This written record will be provided to LAW project team for use in their data evaluation. CESAS-EN-GH will be notified of any problems which occur which cannot be corrected without compromising sample integrity.

FIGURE 5-1

DAILY QUALITY CONTROL REPORT

REPORT No. ____________ CONTRACT No. ____________ DATE ____________

LOCATION OF WORK ____________

DESCRIPTION OF WORK ____________

WEATHER ____________ RAINFALL (INCHES) ________ TEMPERATURE ________ MIN ________ MAX

WIND DIRECTION ____________

1. WORK PERFORMED ____________

2. SAMPLES COLLECTED ____________

3. PERSONNEL AND VISITORS AT SITE ____________

SITE MANAGER: ____________

HF

6.0 SAMPLE PACKAGING, SHIPPING, AND DOCUMENTATION OF CUSTODY

After collection, the samples will be transported to the A-E Laboratory in such a manner as to preserve their integrity. Field samples will be sent to the laboratory by an overnight courier service within 24 hours of their collection or as soon as possible. This section presents the procedures to be used to maintain sample integrity during shipment to the laboratory. The samples to be collected are expected to be low-concentration environmental samples rather than hazardous or high concentration samples. The following sections present the procedures to be used for sample packaging, sample transportation, and documentation of sample custody during shipment.

6.1 SAMPLE PACKAGING AND SHIPPING

Sample shipment will be performed according to the protocols provided in the CESAD protocols (USACE, 1990). The samples will be shipped to the A-E laboratory by an overnight courier service. No sample shall remain on site for more than 24 hours after collection unless previous arrangements have been made with the laboratory, i.e., weekend sampling. Sample containers for low concentration samples will be placed inside sealed plastic bags as a precaution against cross-contamination due to leakage or breakage. They will be placed in coolers supplied by the A-E laboratory in such a manner as to eliminate the chance of breakage during shipment. Ice in plastic bags will be placed in the coolers to keep the samples at 4 degrees Celsius throughout shipment. Special arrangements will be made with the laboratory's point-of-contact for samples that are to be delivered to a laboratory on a Saturday so that hold times and/or sample preservations are not compromised.

All field samples shall be sent to Lancaster Laboratories, at the following address:

Lancaster Laboratories, Inc.
2425 New Holland Pike
Lancaster, PA 17601-5994
(717) 656-2301

The split samples will be sent to the USACE South Atlantic Division Lab. CESAS will be notified by telephone at least one week prior to the projected arrival of QA samples. Saturday arrival of samples will be cleared in advance with CESAS Lab. The QA samples will be sent to:

Blaise Willis
U.S. Army Engineer, South Atlantic Division
Attention: CESAD
611 South Cobb Drive
Marietta, Georgia 30060-3112
(404) 421-5295

In order to demonstrate that the samples and coolers have not been tampered with during shipment, custody seals will be used. Custody seals are adhesive labels that are placed across the sample lids and the cooler seals in such a manner that they will be visibly disturbed upon opening of the sample container or cooler. The seals will be initialed and dated by the samplers. Upon receipt at the laboratory, the sample custodian will note the condition of custody seals.

6.2 DOCUMENTATION OF SAMPLE CUSTODY

Documentation of the chain-of-custody of the samples is necessary to demonstrate that the sample integrity of the samples has not been compromised between collection and delivery to the laboratory. Each cooler will be accompanied by a chain-of-custody (COC) record to document the transfer of custody from the field to the A-E laboratory. Figure 6-1 presents an example of the form to be used. All information requested by the COC record will be

LAW ENVIRONMENTAL, INC.
NATIONAL LABORATORY
7215 PINE FOREST ROAD
PENSACOLA, FL 32526
(904) 944-9772

FIGURE 6-1

CHAIN OF CUSTODY RECORD

4636

SAMPLING INFORMATION

NAME OF FACILITY: ____________________

STREET ADDRESS: ____________________

CITY/STATE: ____________________ **ZIP:** __________

PROJECT NAME | **JOB NO.**

SAMPLERS (SIGNATURE)

SAMPLING DATE

TIME	GRAB	COMP.	SOURCE CODE*	SAMPLE STATION DESCRIPTION	TOTAL NO. OF CONTAINERS	CONTAINER TYPE																						
						40 ml G VOA HCl	1 L G - AMBER	8 oz. G, W/M	2 oz. G, W/M	1 L G (H_2SO_4)	500 ml - AMBER	1 L, PL (HNO_3)	1 L G, PL (H_2SO_4)	1 L, PL (NaOH+Ascorbic Acid)	1 L, PL (Zn Acetate + NaOH)	1 L, PL	4 oz. PL W/M	250 ml PL	1 L, TEFLON									

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED AT LABORATORY: (SIGNATURE)

DISTRIBUTION: ORIGINAL AND PINK COPIES ACCOMPANY SAMPLE SHIPMENT TO LABORATORY.
PINK COPY RETAINED BY LABORATORY. YELLOW COPY RETAINED BY SAMPLERS.

REMARKS: ____________________

* SOURCE CODES:
- RECOVERY WELL - RW
- RCRA MONITORING WELL - MW
- SOIL/SEDIMENT - SO
- SLUDGE - SL
- NPDES DISCHARGE - ND
- DRINKING WATER - DW

HF

completed. In addition, the airbill number assigned by the overnight courier will be listed on the COC record. One copy of the COC form (usually pink) will be retained by the samplers. The remaining pages will be sealed in a plastic bag and placed inside of the cooler. Upon receipt at the A-E laboratory, the COC forms will be completed. The laboratory shall also complete a Cooler Receipt as shown in Figure 6-2 to document sample integrity upon receipt.

6.3 SAMPLE RECEIPT

Samples received at Lancaster are delivered immediately to the Sample Control Center. All shipping containers and security seals, when appropriate, are inspected for physical damage or evidence of tampering.

The samples are unpacked in the sample receiving area by the sample custodian. The method of shipment, shipping container, integrity of the security seal, and accompanying documentation are noted. Sample identification is verified against custody documents. The COC forms, when required, are completed. The temperature (and pH of samples preserved by acids and/or bases) is checked on receipt and the condition noted on the Cooler Receipt Form. If any problems are detected, clients are notified to determine further action.

6.4 CORRECTIVE ACTION

Sample packaging and shipment will conform to the protocols in the CESAS (USACE, 1990). These protocols are designed to preclude problems before they occur. Any problems that cannot be corrected will be documented and communicated by the laboratory Client Service Coordinator to the lab QA officer and to the LAW project manager within 48 hours of their occurrence. This will be followed up with a written record of the problem(s) including a discussion of the action taken and its effectiveness in resolving the problem. This written record will be provided to the LAW project team for use in their data evaluation. CESAS-EN-GH will be notified of any problems which occur which cannot be corrected without compromising sample integrity.

FIGURE 6-2
COOLER RECEIPT FORM

Contractor Cooler ______________

MRD Cooler # ______________

Number of Coolers ______________

LIMS# __________

PROJECT: ____ Date received ____________________

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS

A. PRELIMINARY EXAMINATION PHASE: Date cooler was opened: __________________

by (print) ______________________________ (sign) ______________________________

1. Did cooler come with a shipping slip (air bill, etc.) ? .... YES NO

If YES, enter carrier name & air bill number here: ______________________________

2. Were custody seals on outside of cooler ? .... YES NO

How many & where: ____________________, seal date: __________, seal name ______________

3. Were custody seals unbroken and intact at the date and time of arrival? .... YES NO

4. Did you screen samples for radioactivity using the Geiger Counter? .... YES NO

5. Were custody papers sealed in a plastic bag & taped inside to the lid? .... YES NO

6. Were custody papers filled out properly (ink, signed, etc.)? .... YES NO

7. Did you sign custody papers in the appropriate place? .... YES NO

8. Was project identifiable from custody papers? If YES, enter projects name at the top of this form. YES NO

9. If required, was enough ice used?.......... Type of ice: ______________ .... YES NO

10. Have designated person initial here to acknowledge receipt of cooler: ______________ (date) ______________

B. LOG-IN PHASE: Date samples were logged-in: ______________

by (print) ______________________________ (sign) ______________________________

11. Describe type of packing in cooler: ______________________________

12. Were all bottles sealed in separate plastic bags? .... YES NO

13. Did all bottles arrive unbroken & were labels in good condition? .... YES NO

14. Were all bottle labels complete (ID, date, time, signature, preservative, etc.) ?.................................... YES NO

15. Did all bottle labels agree with custody papers? .... YES NO

16. Were correct containers used for the tests indicated? .... YES NO

17. Were correct preservatives added to samples? .... YES NO

18. Was a sufficient amount of sample sent for tests indicated? .... YES NO

19. Were bubbles absent in VOA samples? If NO, list by QA# ______________________________ YES NO

20. Was the project manager called and status discussed? If YES, give details on the back of this form. YES NO

21. Who was called? ______________ by whom? ______________ (date) ______________

7.0 LABORATORY CHEMICAL ANALYSIS

The purpose of this section is to present the analytical program. The acquisition of chemical data is the focus of the field investigations. The information gathered will be the basis for the evaluation of the nature and extent of the contamination and for the subsequent decisions concerning remediation of the site. Analyses will be performed at Lancaster Laboratories, Inc.; the analytical methods with the associated detection limits and QC procedures to be followed are presented in the following sections. Reporting, evaluation of data quality, and corrective action are also discussed in the following sections. A summary of Internal QC procedures and QC acceptance criteria calibration and QC analysis with associated corrective actions are provided in Appendix A-3.

7.1 DEFINITIONS

The following sections provide definitions for some of the terms utilized with respect to the chemical analysis procedures and the associated QC procedures to be performed.

7.1.1 Method Blank

The method blank is a blank sample created by the laboratory that is carried through all stages of the sample preparation and analysis procedures. It is designed to demonstrate that contamination of the samples by the laboratory is under control. Possible sources of such an analytical bias are reagents, glassware, and/or the analytical system itself.

7.1.2 Matrix Spike/Matrix Spike Duplicate

The matrix spike and matrix spike duplicate (MS/MSD) are QC samples prepared by the laboratory to assess accuracy and precision. During sample preparation, two additional aliquots of a field sample are spiked with known amounts of specified analytes. The sample, MS, and MSD are then prepared and analyzed as any other sample. Bias can be assessed by calculating the amount of the analyte spiked that is recovered. Precision can be assessed by calculating the relative percent difference (RPD) between the results for the spiked analytes in the MS and MSD.

7.1.3 Surrogate Spike

A surrogate spike is similar to a matrix spike in that a known amount of an analyte is added to the sample during sample preparation. For those analyses for which surrogate spikes are performed (organic analyses utilizing gas chromatography), each sample is spiked with a compound that behaves in a similar manner to that of the analytes of interest. Surrogate recoveries are calculated and are used to evaluate the sample preparation and analysis procedures.

7.1.4 Method Of Standard Additions

The method of standard additions (MSA) is a calibration technique which allows the analysis of analytes in sample matrices that ordinarily would degrade the accuracy of the data. The performance of the MSA consists of preparing two or more aliquots of a sample. Known amounts of the analyte are added to all but one of the aliquots. The results of the spiked aliquots can be used to establish a second calibration curve. If this new calibration curve has the same slope as the original, then the analysis is free from interferences. If the new calibration curve's slope is different, then an interference has occurred and the new curve can be used to calculate the amount of the analyte present in the sample.

7.1.5 Laboratory Operations

Laboratory operations for Lancaster are described in the following subsections.

7.1.5.1 Sample Custody - Samples are unpacked and inspected in the sample receipt area. At this time, the samples are examined for breakage and agreement with the associated client paperwork. The cooler temperatures will be checked upon receipt and recorded. As the samples are unpacked, the sample label information will be compared to the chain-of-custody record and any discrepancies or missing information will be documented. If necessary, the cooler will be closed and placed in cold storage until instructions and resolution of any discrepancies are received from the client.

A member of our Sample Administration Group will act as sample custodian for the project. To ensure accountability of our results, a unique identification number is assigned to each sample as soon as possible after receipt at the laboratory. When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented, with the exception of samples designated for volatile analysis. Samples requiring refrigeration will be stored in our walk-in cooler which is maintained at 4 degree Celsius plus or minus 2 degrees Celsius. The use of our computer system in tracking samples (by the Lancaster sample number assignment) will control custody of the sample from receipt until the time of its disposal. The security system on our laboratory building allows us to designate the entire facility as a secure area since all exterior doors are either locked or attended. Therefore, hand-to-hand chain of custody is not required.

7.1.5.2 Sample Identification - Upon receipt of samples by the laboratory, each field sample is assigned a unique laboratory sample identification number.

7.1.5.3 Sample Custody Records - All samples leaving the field must at a minimum be accompanied by a chain of custody prior to arrival at the laboratory. Incoming samples should be accompanied by a Chain-of-Custody (Figure 6-1) and an Analytical Request Form completed in the field. In the event that this form does not accompany the incoming samples, the Lancaster

Sample Custodian will inform the Lancaster COE Project Manager who will initiate a telephone call to the LEGS Project Manager for corrective action.

7.1.6 Parameters for Off-Site Geotechnical Analysis

During drilling, two soil samples will be collected from approximately 20 percent of the boreholes for geotechnical testing. In each sampled boring, one sample will be collected rom above the water tables, a second sample will be collected from below the water tables. Sampling will be performed using a split spoon sampler using standard sampling techniques (ASTM D 1586-84; ASTM D 1587-83). Samples will be stored in plastic or glass jars pending analysis. All samples will be visually classified according to the Unified Soil Classification System (USCS). Geotechnical analytical parameters are described below.

7.1.6.1 Grain Size Distribution Analysis (ASTM D 421-85 and 422-63) - This analysis classifies each sample as to its lithology and degree of sorting. The grain size analysis is one factor used in determining hydraulic conductivity. The sample is prepared for size determination by air drying and sieving with a No. 10 sieve. The distribution of particle size larger than 75 μm is determined by sieving, while the distribution of particle size smaller than 75 μm is determined by a sedimentation process using a hydrometer.

7.1.6.2 Moisture Content (ASTM D 2216-80) - This analysis determines the percentage of water in the soil. Moisture Content is useful in estimating soil consistency, compressibility and strength. A test specimen is dried in an oven to a constant mass. The loss of mass due to drying is considered to be water. The water content is calculated using the mass of water and the mass of the dry specimen.

7.1.6.3 Atterberg Limits (ASTM D 423 and 424) - This analysis includes liquid limit (moisture content at which a soil becomes liquid), plastic limit (moisture content at which a soil becomes plastic), and plasticity index (the difference between the liquid limit and the plastic limit). The determination of Atterberg Limits assists in confirming the visual classification of soils, indicates soil consistency, and provides correlation to compressibility and strength.

7.2 CHEMICAL ANALYSIS PROCEDURES

The following sections are presented as brief summaries of the chemical analysis requirements for Hunter AAFTA. Table 7-1 provides analytical methods and holding times. Appendix A-3 contains a summary of calibration, QC analyses, and corrective actions. Table 7-2 through 7-4 provide method reporting limits. Further information on methodology can be obtained by referencing the stated method(s) in SW-846, 3rd Edition.

7.2.1 Method Procedures

7.2.1.1 Method 6010 - EPA Method 6010 is used to analyze for barium and chromium. This method uses an inductively-coupled plasma spectrometer (ICP) to measure element-emitted light by optical spectrometry. Water samples will be acid digested for ICP and flame AA spectrophotometers using Method 3005. Soil and sediment samples will be digested by Method 3050.

7.2.1.2 Method 7060, 7421 and 7740 - EPA Methods 7060, 7421 and 7740 are used to analyze for arsenic, lead and selenium, respectively. This method uses a graphite furnace with Zeeman background correction. A representative aliquot of a sample is placed in the graphite tube, evaporated to dryness, charred to break down any complex matrix components, and atomized. The analyte then absorbs the source radiation which is measured by a photosensitive device.

TABLE 7-1

LABORATORY ANALYTICAL METHODS AND HOLDING TIMES
Hunter Army Airfield FTA
Savannah, Georgia

PARAMETER	METHOD (a)	HOLDING TIME (b)
SOIL/CONCRETE		
Volatile Organics	8240	14 days
Semi-Volatile Organic Compounds	8270	14 days/40 days
RCRA Metals	6000/7000	6 months; 28 days for Hg
TPH	8015 (mod)	28 days
GROUND WATER		
RCRA Metals(c)	6000/7000	6 months; 28 days for Hg
Semi-Volatile Organic Compounds	8270	7 days
Volatile Organics	8240	7 days
Total Petroleum Hydrocarbons	8015 (mod)	28 days

NOTES:
(a) Reference: SW-846, 3rd Edition, November 1986 (as revised)
Hg = Mercury

PREPARED/DATE: JMJ 7/28/95
CHECKED/DATE: DB 7/28/9

TABLE 7-2

DETECTION LIMITS FOR ANALYTES OF INTEREST
RCRA METALS
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTE	ANALYTICAL METHOD		PQL for Water (μg/L)	PQL for Soil (mg/kg)
	Aqueous Matrix	Non-Aqueous Matrix		
Arsenic	SW 7060	SW 3050/7060	10	2
Barium	SW 3005/6010	SW 3050/6010	20	10
Cadmium	SW 3005/6010	SW 3050/6010	10	2
Chromium	SW 3005/6010	SW 3050/6010	20	4
Lead	SW 3020/7421	SW 3050/7421	5	5
Mercury	SW 7470	SW 7471	0.1	0.1
Selenium	SW 7740	SW 3050/7740	1	1
Silver	SW 3005/6010	SW 3050/6010	20	2

NOTES: PQL = Practical Quantitation Limit
μg/L = Micrograms per liter

PREPARED/DATE: 7/28/95
CHECKED/DATE: 7/28/95

TABLE 7-3

DETECTION LIMITS FOR ANALYTES OF INTEREST FOR VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 5030/8240

Hunter Army Airfield FTA
Savannah, Georgia

ANALYTE	ANALYTICAL METHOD	PQL for Soil (μg/kg)	PQL for Water (μg/L)
Acetone *	EPA 5030/8240	10	100
Benzene *	EPA 5030/8240	5	5
Bromodichloromethane *	EPA 5030/8240	5	5
Bromoform *	EPA 5030/8240	5	5
Bromomethane *	EPA 5030/8240	10	5
2-Butanone (Methyl ethyl ketone) *	EPA 5030/8240	10	100
Carbon Disulfide *	EPA 5030/8240	5	5
Carbon Tetrachloride *	EPA 5030/8240	5	5
Chlorobenzene *	EPA 5030/8240	5	5
Chloroethane *	EPA 5030/8240	10	5
Chloroform *	EPA 5030/8240	5	5
Chloromethane *	EPA 5030/8240	10	5
Dibromochloromethane *	EPA 5030/8240	5	5
1,1-Dichloroethane *	EPA 5030/8240	5	5
1,2-Dichloroethane *	EPA 5030/8240	5	5
1,1-Dichloroethene * (Total)	EPA 5030/8240	5	5
1,2-Dichloroethene *	EPA 5030/8240	5	5
1,2-Dichloropropane *	EPA 5030/8240	5	5
cis-1,3-Dichloropropene *	EPA 5030/8240	5	5
Ethyl Benzene *	EPA 5030/8240	5	5
2-Hexanone *	EPA 5030/8240	10	50
Methylene Chloride *	EPA 5030/8240	5	5
4-Methyl-2-pentanone *	EPA 5030/8240	10	50
Styrene *	EPA 5030/8240	5	5
Tetrachloroethene *	EPA 5030/8240	5	5
Toluene *	EPA 5030/8240	5	5
trans-1,3-Dichloropropene *	EPA 5030/8240	5	5
1,1,2,2-Tetrachloroethane *	EPA 5030/8240	5	5
1,1,1-Trichloroethane *	EPA 5030/8240	5	5

TABLE 7-3

DETECTION LIMITS FOR ANALYTES OF INTEREST FOR VOLATILE ORGANIC COMPOUNDS
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTE	ANALYTICAL METHOD	PQL for Soil (μg/kg)	PQL for Water (μg/L)
1,1,2-Trichloroethane *	EPA 5030/8240	5	5
Trichloroethene *	EPA 5030/8240	5	5
Vinyl Chloride *	EPA 5030/8240	10	5
Xylenes (Total) *	EPA 5030/8240	5	5

NOTES:
PQL = Practical Quantitation Limit
μg/L = Micrograms per liter
μg/kg = Micrograms per kilogram
* = Compounds appearing on Target Compound List (TCL), 3/90 S.O.W.

Detection limits are highly matrix dependent. Sample size will be adjusted when necessary to meet the detection limit criteria.

PREPARED/DATE: JMJ 7/28/95
CHECKED/DATE: 7/28/95

TABLE 7-4

DETECTION LIMITS FOR ANALYTES OF INTEREST FOR BASE NEUTRAL AND ACID EXTRACTABLE ORGANICS
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTE	ANALYTICAL METHOD Non-Aqueous Matrix	PQL for Soil (μg/kg)	PQL for Water (μg/L)
Acenaphthene *	EPA 3550/8270	330	10
Acenaphthylene *	EPA 3550/8270	330	10
Anthracene *	EPA 3550/8270	330	10
Benzo(a)anthracene *	EPA 3550/8270	330	10
Benzo(a)pyrene *	EPA 3550/8270	330	10
Benzo(b)fluoranthene *	EPA 3550/8270	330	10
Benzo(g,h,i)perylene *	EPA 3550/8270	330	10
Benzo(k)fluoranthene *	EPA 3550/8270	330	10
bis(2-Chloroethoxy)methane *	EPA 3550/8270	330	10
bis(2-Chloroethyl)ether *	EPA 3550/8270	330	10
bis(Chloroisopropyl)ether	EPA 3550/8270	330	10
bis(2-Ethylhexyl)phthalate *	EPA 3550/8270	330	10
4-Bromophenyl-phenylether *	EPA 3550/8270	330	10
Butylbenzylphthalate *	EPA 3550/8270	330	10
4-Chloroaniline *	EPA 3550/8270	330	10
4-Chloro-3-methylphenol * (para-chloro-meta-cresol)	EPA 3550/8270	330	10
2-Chloronaphthalene *	EPA 3550/8270	330	10
2-Chlorophenol *	EPA 3550/8270	330	10
4-Chlorophenyl-phenyl ether *	EPA 3550/8270	330	10
Carbazole	EPA 3550/8270	330	10
Chrysene *	EPA 3550/8270	330	10
Dibenz(a,h)anthracene *	EPA 3550/8270	330	10
Dibenzofuran *	EPA 3550/8270	330	10
1,2-Dichlorobenzene *	EPA 3550/8270	330	10
1,3-Dichlorobenzene *	EPA 3550/8270	330	10
1,4-Dichlorobenzene *	EPA 3550/8270	330	10
3,3'-Dichlorobenzidine *	EPA 3550/8270	660	25
2,4-Dichlorophenol *	EPA 3550/8270	330	10
Diethylphthalate *	EPA 3550/8270	330	10
Di-n-butylphthalate *	EPA 3550/8270	330	10

TABLE 7-4

DETECTION LIMITS FOR ANALYTES OF INTEREST FOR BASE NEUTRAL AND ACID EXTRACTABLE ORGANICS
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTE	ANALYTICAL METHOD Non-Aqueous Matrix	PQL for Soil (μg/kg)	PQL for Water (μg/L)
Di-n-octylphthalate *	EPA 3550/8270	330	10
2,4-Dimethylphenol *	EPA 3550/8270	330	10
Dimethylphthalate *	EPA 3550/8270	330	10
4,6-Dinitro-2-methylphenol *	EPA 3550/8270	1,700	25
2,4-Dinitrophenol *	EPA 3550/8270	1,700	25
2,4-Dinitrotoluene *	EPA 3550/8270	330	10
2,6-Dinitrotoluene *	EPA 3550/8270	330	10
Fluoranthene *	EPA 3550/8270	330	10
Fluorene *	EPA 3550/8270	330	10
Hexachlorobenzene *	EPA 3550/8270	330	10
Hexachlorobutadiene *	EPA 3550/8270	330	10
Hexachlorocyclopentadiene *	EPA 3550/8270	330	10
Hexachloroethane *	EPA 3550/8270	330	10
Indeno(1,2,3-cd)pyrene *	EPA 3550/8270	330	10
Isophorone *	EPA 3550/8270	330	10
2-Methylnaphthalene *	EPA 3550/8270	330	10
2-Methylphenol (o-cresol) *	EPA 3550/8270	330	10
3-Methylphenol (m-cresol) *	EPA 3550/8270	--	10
4-Methylphenol (p-cresol) *	EPA 3550/8270	330	10
2-Nitroaniline *	EPA 3550/8270	1,700	10
3-Nitroaniline *	EPA 3550/8270	1,700	10
4-Nitroaniline *	EPA 3550/8270	1,700	10
2-Nitrophenol *	EPA 3550/8270	330	10
4-Nitrophenol *	EPA 3550/8270	1,700	25
Naphthalene *	EPA 3550/8270	330	10
Nitrobenzene *	EPA 3550/8270	330	10
N-Nitroso-di-n-dipropylamine *	EPA 3550/8270	330	10
N-nitrosodiphenylamine *	EPA 3550/8270	330	10
2,2'-oxybisbis (1-Chloropropane) *	EPA 3550/8270	330	10
Pentachlorophenol *	EPA 3550/8270	1,700	25
Phenanthrene *	EPA 3550/8270	330	10

TABLE 7-4

DETECTION LIMITS FOR ANALYTES OF INTEREST FOR BASE NEUTRAL AND ACID EXTRACTABLE ORGANICS
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTE	ANALYTICAL METHOD Non-Aqueous Matrix	PQL for Soil (μg/kg)	PQL for Water (μg/L)
Phenol *	EPA 3550/8270	330	10
Pyrene *	EPA 3550/8270	330	10
1,2,4-Trichlorobenzene *	EPA 3550/8270	330	10
2,4,5-Trichlorophenol *	EPA 3550/8270	1,700	10
2,4,6-Trichlorophenol *	EPA 3550/8270	330	10

NOTES:
PQL = Practical Quantitation Limit
μg/L = Micrograms per liter
μg/kg = Micrograms per kilogram
* = Compounds appearing on Target Compound List (TCL), 3/90 S.O.W.

Detection limits are highly matrix dependent. Sample size will be adjusted when necessary to meet the detection limit criteria.

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Lead may be analyzed by SW 6010 if the lead concentration is greater than 10 times the ICP instrument detection limit (IDL).

7.2.1.3 Method 7470 and 7471 - EPA Methods 7470 and 7471 will be used to measure mercury in waters and soils respectively. These methods measure mercury by aerating elemental mercury from the sample and passing it through a cell positioned in the light path of an atomic absorption spectrometer. The method includes the sample preparation procedures. An aliquot of sample is acidified and then undergoes and heated, oxidative digestion with potassium permanganate and potassium persulfate. To measure the mercury content of the digested sample, stannous chloride, a reducing agent, is added to form elemental mercury.

7.2.1.4 Method 8240 - Analyses for volatile organics will be performed using EPA Method 8240. The method is performed by purging the volatile organic compounds of the sample and capturing them using a purge and trap apparatus. The volatile organics are then desorbed from the trap into the gas chromatograph (GC) where they are qualitatively separated and quantitatively detected using a mass spectrometer.

7.2.1.5 Method 8270 - Semi-volatile organics include base-neutral and acid (BNA) extractable organic compounds and will be analyzed using Method 8270. The preparation utilizes EPA Methods 3510 for waters and 3550 for soils. In EPA Method 3510, one liter of aqueous sample is placed into separating funnel, adjusted to a specified pH, and serially extracted with organic solvent. In EPA Method 3550, 2 to 30 grams of soil sample, depending on the expected concentration, is mixed with anhydrous sodium sulfate to form a free-flowing powder. This solvent is extracted one to three times using sonication. The extract is separated from the sample by vacuum filtration. The extract for both liquids and soils is then dried with sodium sulfate, and concentrated. This sample extract is directly injected into a GC in which the semi-volatile organics are qualitatively separated and quantitatively detected with a mass spectrometer.

7.2.1.6 Method 8015 (modified) - Analysis for extractable petroleum hydrocarbons will be performed using a modified EPA Method 8015. The method is performed by extracting the petroleum hydrocarbons from the sample and injecting them onto a gas chromatograph equipped with a flame ionization detector. The petroleum hydrocarbons are separated on the gas chromatographic column and quantitated by the flame ionization detector.

7.2.2 Detection Limits and Quantification Criteria

7.2.2.1 Terminology - Each analytical parameter concentration will be reported as a specific number or less than the Limit of Quantitation (LOQ). Water values will be reported in parts per billion (ppb, μg/L) concentrations for organics and in parts per million (ppm, mg/L) for inorganics. Soil values will be reported in ppb (μg/Kg) for the organic analyses, and in parts per million (ppm, mg/Kg) for the metals analyses. The Method Detection Limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the value is above zero.

7.2.2.2 Procedures - The following procedures are used by Lancaster to establish limits of detection and quantification.

Method Detection Limits (MDLs) are established using the required EPA procedure specified in 40 CFR Part 136 Appendix B. This procedure is described in the following section. A data pool of at least seven standards analyzed at a concentration approximately 3 times the anticipated MDL is generated. The standard deviation of the seven standards is calculated using the following equation:

$$S = \left(\frac{1}{n-1} \left[\sum_{i=1}^{n} X_i^2 - \left(\sum_{i=1}^{n} X_i \right)^2 / n \right] \right)^{1/2}$$

where

X_i; i = 1 to n, analytical results in the final method reporting units obtained from the n sample aliquots and Σ refers to the sum of the X values from i = 1 to n

The MDL is estimated by employing the "t" distribution with a 99 percent confidence interval by the following equation:

$$MDL = (t)(S) \text{ where}$$

t - is a factor for n-1 degrees of freedom at the 99 percent confidence factor
S - is the standard deviation (see previous definition) of the data pool

Instrument Detection Limits (IDL) are established by the EPA CLP protocol by generating a data pool by analyzing a minimum of seven standards at 3 times the anticipated IDL on three non-consecutive days. The standard deviation (S) of the seven data points for each of the three days is calculated and the IDL established by the following equation:

$$IDL = S1 + S2 + S3$$

Practical Quantitation Limits (PQL) in the common sense are a function of sample matrix but in the limit of a matrix devoid of any interferences. PQL is calculated as follows:

$$PQL = 10 * S$$

where S is the standard deviation of the data used to determine MDL

The matrix used for these studies is spiked reagent water processed through the appropriate analytical procedure.

7.2.2.3 Values - The laboratory established detection and quantitation limits for Lancaster are listed in Tables 7-2 through 7-4.

7.2.3 Method Calibration

The calibration procedures, preparation of calibration standards, and frequency of initial and continuing calibration checks as performed by Lancaster are described for each analytical method in the following subsections. A summary of the calibration and internal quality control procedures is in Appendix A-3.

7.2.3.1 Volatile and Semi-Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS) - Analyses performed on the GC/MS will follow EPA Methods. This includes the following calibration procedure:

1. Instrument calibration will be performed every 12-hour time period. The GC/MS will be tuned to meet ion abundance criteria given in Tables 7-5 and 7-6 for Bromofluorobenzene (BFB) and 4- decafluorotriphenylphosphine (DFTPP), respectively.

2. Initial calibration will be performed on calibration standards at five concentration levels containing each compound of interest and each surrogate standard.

   The relative retention time (RRT) of each compound in each calibration run should agree within 0.06 RRT units. The average relative response

TABLE 7-5

BFB KEY IONS AND ABUNDANCE CRITERIA[a]
Hunter Army Airfield FTF
Savannah, Georgia

MASS	ION ABUNDANCE CRITERIA
50	15-40% of mass 95
75	30-60% of mass 95
95	base peak, 100% relative abundance
96	5-9% of mass 95
173	less than 2% of mass 174
174	less than 50% of mass 95
175	5-9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5-9% of mass 176

[a] EPA Method 8240, SW-846, 3rd Edition, November 1986.

Note: Adapted from Lancaster Laboratories QAPP

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TABLE 7-6

DFTPP KEY IONS AND ABUNDANCE CRITERIA[a]
Hunter Army Airfield FTA
Savannah, Georgia

MASS	ION ABUNDANCE CRITERIA
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

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[a] J.W. Eichelberger, L.E. Harris, and W.L. Budde. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectrometry," Analytical Chemistry, 47, 995 (1975).

Note: Adapted from Lancaster Laboratories QAPP factor (RRF) and percent relative standard deviation (%RSD) is calculated for each compound. The RRF for the System Performance Check Compounds (SPCC) (Volatiles: Chloromethane, 1,1-Dichloroethane, Bromoform, 1,2,2-Tetrachloroethane, Chlorobenzene; and Semi-volatiles: N-nitroso-di-n-propylamine, Hexachlorocyclopentadiene, 2,4-Dinitrophenol, 4-Nitrophenol) must be greater than or equal to 0.300 (0.250 for Bromoform) for volatiles and must be greater than or equal to 0.050 for semi-volatiles. The %RSD for the Calibration Check Compounds (CCC) (Volatiles: Vinyl chloride, 1,1-Dichloroethene, Chloroform, 1,2-Dichloropropane, Toluene, Ethylbenzene; Semi-volatiles Base/Neutrals: Acenaphthene, 1,4-Dichlorobenzene, Hexachlorobutadiene, N-Nitroso-di-n-phenylamine, Octylphthalate, Fluoranthene, Benzo(a)pyrene; Semi-Volatile Acids: 4-Chloro-3-methylphenol, 2,4-Dichlorophenol, 2-Nitrophenol, Phenol, Pentachlorophenol, 2,4,6-Trichlorophenol) must be less than 30 percent. The %RSD for the other compounds should be less than 30 percent. If not, a notation is made in the sample documentation.

3. After the preparation of each new initial five-point calibration curve and after tune criteria are met for each 12-hour time period, the initial calibration is verified (using a midpoint calibration standard containing all analytes) prior to running any samples. This initial calibration verification (ICV) must satisfy the above SPCC criteria. In addition, the percent difference (%D) for the CCC must be less than or equal to 25 percent for the volatiles and less than or equal to 30 percent for the semi-volatiles. If these criteria are not met for any single CCC, corrective action must be taken or a new five point calibration must be performed.

4. Internal standards for GC/MS volatiles will be added to each sample, standard and reagent water blank. The final concentration of each internal

standard will be 50 μg/L for SW8240 and 10 μg/L for SW8260. The internal standards are as follows:

- Bromochloromethane
- 1,4-Difluorobenzene
- Chlorobenzene-d_5

Table 7-7 presents the volatile analytes quantitated by each internal standard.

Internal standards for GC/MS semi-volatiles will be added to each sample, standard, and reagent water blank. The final concentration of each internal standard will be 40 nanograms per microliter (ng/μL). The internal standards are as follows:

- 1,4-Dichlorobenzene-d_4
- Naphthalene-d_9
- Acenaphthene-d_{10}
- Phenanthrene-d_{10}
- Chrysene-d_{12}
- Perylene-d_{12}

Table 7-8 presents the semi-volatile analytes quantitated by each internal standard.

7.2.3.2 Metals by Inductively Coupled Plasma (ICP) - Metal analyses on the ICP will follow current EPA SW846 method procedures. Instrument must be calibrated daily or once every 24 hours and each time instrument is set up. This includes the following calibration procedure:

TABLE 7–7

VOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED FOR QUANTITATION
Hunter Army Airfield FTA
Savannah, Georgia

BROMOCHLOROMETHANE	1,4–DIFLUOROBENZENE	CHLOROBENZENE–d5
Acetone	Benzene	Bromofluorobenzene*
Bromomethane	Bromodichloromethane	Chlorobenzene
2–Butanone (metylethyl ketone)	Bromoform	Ethylbenzene
Carbon disulfide	Carbon tetrachloride	2–Hexanone
Chloroethane	2–Chloroethyl vinyl ether	4–Methyl–2–pentanone (methyl isobutyl ketone)
Chloroform	Dibromochloromethane	Styrene
Chloromethane	1,2–Dichloropropane	1,1,2,2–Tetrachloroethane
1,1–Dichloroethane	cis–1,3–Dichloropropene	Tetrachloroethene
1,2–Dichloroethane	trans–1,3–Dichloropropene	Toluene
1,2–Dichloroethane–d4*	1,1,1–Trichloroethane	Toluene–d8*
1,1–Dichloroethene	1,1,2–Trichloroethane	Xylenes, total
trans–1,2–Dichloroethene	Trichloroethene	
Methylene chloride	Vinyl acetate	
Vinyl chloride		

* Surrogate

Note: Information adapted from Lancaster Laboratories QAPP

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TABLE 7-8

SEMI-VOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED FOR QUANTITATION

Hunter Army Airfield FTA
Savannah, Georgia

1,4-DICHLOROBENZENE-D4	NAPHTHALENE-D8	ACENAPHTHENE-D10	PHENANTHRENE-D10	CHRYSENE-D12	PERYLENE-D12
Phenol	Nitrobenzene	Hexachlorocyclopentadiene	4,6-Dinitro-2-methylphenol	Pyrene	Di-n-octyl Phthalate
bis(2-Chloroethyl)ether	Isophorone	2,4,6-Trichlorophenol	N-nitrosodi-phenylamine	Butylbenzyl Phthalate	Benzo(b)fluoranthene
2-Chlorophenol	2-Nitrophenol	2,4,5-Trichlorophenol	1,2-Diphenylhydrazine	3,3'-Dichlorobenzidine	Benzo(k)fluoranthene
1,3-Dichlorobenzene	2,4-Dimethylphenol	2-Chloronaphthalene	4-Bromophenyl Phenyl Ether	Benzo(a)-anthracene	Benzo(a)pyrene
1,4-Dichlorobenzene	Benzoic acid	2-Nitroaniline	Hexachlorobenzene	bis(2-ethylhexyl)Phthalate	Indeno(1,2,3-cd)pyrene
Benzyl Alcohol	bis(2-Chloroethoxy)methane	Dimethyl Phthalate	Pentachlorophenol	Chrysene	Dibenz(a,h)anthracene
1,2-Dichlorobenzene	2,4-Dichlorophenol	Acenaphthylene	Phenanthrene	Terphenyl-d14*	Benzo(g,h,i)perylene
2-Methylphenol	1,2,4-Trichlorobenzene	3-Nitroaniline	Anthracene		
bis(2-Chloroisopropyl)ether	Naphthalene	Acenaphthene	Di-n-butyl Phthalate		
4-Methylphenol	4-Chloro-3-methylphenol	2,4-Dinitrophenol	Fluoranthene		
N-nitroso-Di-n-propylamine	2-Methylnaphthalene	4-Nitrophenol			
Hexachloroethane	Nitrobenzene-d5*	Dibenzofuran			
2-Fluorophenol*		2,4-Dinitrotoluene			
Phenol-d6*		2,6-Dinitrotoluene			
		Diethyl Phthalate			
		4-Chlorophenyl phenyl ether			
		Fluorene			
		4-Nitroaniline			
		2-Fluorobiphenyl*			
		2,4,6-Tribromo Phenol*			

* - Surrogate

Note: Information adapted from Lancaster Laboratories QAPP

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1. Verify instrument is operating satisfactorily by checking automatic gain setting and optical alignment.

2. Calibrate instrument with matrix matched mixed standards at four concentration levels and a blank. The correlation coefficient must be greater than or equal to 0.995.

3. Verify the calibration with a second source Initial Calibration Verification (ICV) standard. The observed result must be plus or minus 10 percent of the expected value.

4. Verify the calibration blank. The observed result must be less than three times the detection limit.

5. Verify low-level standard calibration.

6. Every 10 samples, a Continuing Calibration Verification (CCV)/Continuing Calibration Blank (CCB) pair is run which must be plus or minus 10 percent of expected value and less than three times detection limit, respectively.

7. Check for interferences. An interference check solution must be analyzed at the beginning and at the end of the run (or at least every eight hours); refer to EPA Methods for acceptable limits which are plus or minus 20 percent. The interference check solution contains aluminum, calcium, iron, and magnesium.

7.2.3.3 Metals by Graphite Furnace Atomic Absorption (GFAA) - Metal analyses performed on the GFAA will follow current EPA SW 846 Methods. Instrument must be calibrated daily or once every 24 hours and each time the instrument is set up. This includes the following calibration procedures:

1. The lamp must be peaked for position and for wavelength (the temperature of the furnace is automatically calibrated at 2,600 degrees centigrade).

2. After the proper conditions for each element are programmed for furnace operation, distilled water is injected and run as a sample. This is done several times until the instrument response produces a steady base line absorbance.

3. Verify instrument is operating satisfactorily by checking the energy output of the lamp and by checking the characteristic mass on the midpoint standard, which must be plus or minus 10 percent of the true value for that standard.

4. Calibrate instrument with four standards and a calibration blank. The calibration curve must have a correlation coefficient of greater than or equal to 0.995.

5. Verify the calibration with a second source Initial Calibration Verification (ICV) standard. The observed result must be within plus or minus 10 percent of the expected result.

6. Verify the calibration blank. The blank must be less than three times detection limit.

7. Verify low level standard calibration.

8. Every 10 samples, a Continuing Calibration Verification (CCV) and Continuing Calibration Blank (CCB) pair is run and must be plus or minus 10 percent of expected value and less than three times the detection limit, respectively.

7.2.3.4 Cold-Vapor Atomic Absorption (CVAA) - Mercury analyses performed on the CVAA will follow current EPA SW846 methods. Instruments must be calibrated daily or once every

24 hours and each time the instrument is set up. This includes the following calibration procedure.

1. Optimize instrument setting and alignment by maximizing the energy setting.

2. Align cell minimizing absorbance reading.

3. Calibrate instrument with standards at five concentration levels and a blank. The correlation coefficient must be greater than or equal to 0.995.

4. Verify calibration by running an ICV standard and an initial calibration blank (ICB). The observed result of the ICV must be within plus or minus 10 percent of the expected value and the observed result of the calibration blank must be less than the detection limit.

5. Analyze a CCV/CCB pair every 10 samples. The response must be within 20 percent of the initial response and less than the detection limit, respectively.

7.2.3.5 Gravimetric Analyses - The total suspended solids and total dissolved solids analyses fall into this category. Each analysis depends greatly on the accuracy of the balance used. for this reason, balances are calibrated weekly. The recorded weight must agree within 0.1 percent of the expected value.

7.3 DATA REDUCTION, VALIDATION, AND REPORTING

The following section describes the reduction, validation, and reporting of data employed after samples are analyzed.

Raw analytical data generated in the laboratories is collected on printouts from the instruments and associated data system or manually inbound notebooks. Analysts review data as it is generated to determine that the instruments are performing within specifications. This review includes calibration checks, surrogate recoveries, blank checks, retention time reproducibility. If problems are noted during the analytical run, corrective action is taken and documented.

Each analytical run is reviewed by a chemist for completeness and accuracy prior to interpretation and data reduction. The following calculations are used to reduce raw data to reportable results.

GC/MS calculation used by the data system to determine concentration in extract for semi-volatiles or in the sample itself for volatiles:

$$Q = (Ax)\,(Is)\,/\,(AIs)\,(RRF)\,(Vi)$$

where:

AX = peak area
Is = internal standard peak area
RRF = relative response factor
Vi = volume of extract injected (μl) or volume sample purged (ml)

The extract concentration is further reduced by considering the initial sample weight or volume and the final extract volume:

$$Concentration = (Q)\ (D)\ (F)\ (1000)\ /\ (I)$$

where:

Q = concentration determined by the data system

D = dilution factor if needed

F = final extract volume (ml)

I = initial sample weight (grams) or volume (ml)

Results are reported in μg/l for water samples and μg/kg for solid samples. Solid samples are reported on a dry-weight basis. The results are reported on LLI Analysis Report Forms.

For Volatiles by GC, a five-point external calibration procedure is used. The resulting point-to-point calibration curve is used by the data system to calculate analyte concentrations. The equations that the data system uses for calculating analyte concentrations are shown below.

A. When analyte peak height, Hx, falls between the peak heights of two calibration points, Hn and Hn + 1, the analyte concentration is calculated as follows when using a point-to-point calibration curve:

$$Concentration = ([(Hx - Hn)\ /\ S] + An)\ x\ (DF)$$
$$S = (Hn + 1 - Hn)\ /\ (An + 1 - An)$$

where:

Hx = analyte peak height

Hn + 1 = analyte peak height in the n + 1 calibration level

S = slope between the n and n + 1 calibration points for the analyte

An = the concentration of the analyte in the nth calibration level

An + 1 = the concentration of the analyte in the n + 1 calibration level

DF = dilution factor

B. When the analyte peak height is below the peak height for the lowest calibration standard, the analyte concentration is calculated as follows when using a point-to-point calibration curve with extrapolation to zero:

$$Concentration = [(Hx) \times (AI / HI)] \times (DF)$$

where:

Hx = analyte peak height
AI = concentration of analyte in the first calibration level
HI = analyte peak height in first calibration level
DF = dilution factor

Results are reported in μg/l for water samples and in μg/kg for solid samples. Soil samples are reported on a dry-weight basis.

The results for the Pesticide/PCBs analysis are calculated using the following equation:

$$Concentration = (Ax)(Is)(Vt)(DF) / (As)(Vi)(Vs)$$

where:

Ax = peak height for the parameter being measured
Is = amount of standard injected (ng)
Vt = volume of total extract (μl)
DF = dilution factor, if needed
As = peak height for the external standard
Vi = volume of extract injected (μl)
Vs = volume (ml) or weight (gm) of sample extracted

The results for inorganic analyses are calculated using the following equation:

$$Concentration = (A)\,(D)\,(E)\,/\,(F)$$

where:

A = the concentration determined by AA, ICP, or FTIR using calibration data programmed into the instrument (mg/l)
D = dilution factor if needed
E = final extract volume (ml)
F = initial sample volume (ml) or weight (gm)

Results are usually reported in mg/l for water samples and in mg/kg for solid samples. Soil samples are reported on a dry-weight basis. The results are reported on LLI Analysis Report Forms.

The principle criteria used to validate data will be the acceptance QC criteria and protocols specified in laboratory SOPs. Following review, interpretation, and data reduction by the analyst, data is transferred to the laboratory sample management system either by direct data upload from the analytical data system or manually. This system stores client information, sample results, and QC results. A security system is in place to audit trail for information changes. The data is again reviewed by the group leader or another analyst whose function is to provide an independent review and verified on the sample management system. The person performing the verification step reviews all data including quality control information prior to verifying the data. Any errors identified and corrected during the review process are documented and addressed with appropriate personnel to ensure generation of quality data. The laboratory will complete the appropriate Data Package forms summarizing the quality control information, and transfer copies of all raw data (instrument print-outs, spectra, chromatograms, laboratory notebooks, etc.) to the Data Package Group. This group will combine the information form the various analytical groups and the analytical reports from the laboratory sample management system into one package in the U.S. Army COE format. This package is reviewed by the Quality Assurance Department for conformance with SOPs and to ensure that all QC goals have been met. Any analytical problems are discussed in the case narrative, which is also included with the data package deliverables.

The validation of the data by the Quality Assurance Department includes spot checking raw data versus the final report, checking that all pertinent raw data is included and does refer to the samples analyzed, review of all QC results for conformance with the method, and review of the case narrative for description of any unusual occurrences during analysis. This validation is performed using techniques similar to those used by the Sample Management Office for the USEPA's Contract Laboratory Program. The validation performed by the laboratory does not address useability of the data, which usually requires some knowledge of the site.

The laboratory sample management system is programmed to accept and track the results of quality control samples including blanks, surrogates recoveries, duplicates, controls, and reference materials. The computer is programmed with the acceptance criteria for each type of QC sample and will display an out-of-spec message if the data is not within specifications. All data outside of specifications appears on a report to the Quality Assurance Department on the next working day. These are reviewed by the Quality Assurance Department for severity of the problems and trends in the data. The reports are then sent to the analytical groups for the purpose of documenting the corrective action taken. The sample management system also produces control charts and has searching capabilities to aid in data review. The flow of data from the time the samples enter the laboratory until the data is reported are summarized in Table 7-9.

Any data recorded manually will be collected inbound notebooks. All entries will be in ink, with no erasures or white-out being permitted. Any changes in data will be made using a single lien to avoid obliteration of the original entry and will be dated and signed. Any data resulting from instrument printouts will be dated and will contain the signature and/or identification of the analyst responsible for its generation. After copies of the data are incorporated into the data package deliverables, the originals will be stored in locked archives at the laboratory for a period of five years.

TABLE 7-9

SAMPLE AND DATA ROUTING AT LANCASTER LABORATORIES, INC.
Hunter Army Airfield FTA
Savannah, Georgia

Action	Personnel Involved
Sample received at Lancaster	Sample Administration
Sample is entered onto sample management system (lab ID number assigned, analyses scheduled, chain of custody started, storage location assigned)	Sample Administration
Sample stored in assigned location (refrigerator, freezer, etc.)	Sample Support
Acknowledgement sent to client	Sample Administration
Removed from storage for analysis; necessary aliquot taken and sample returned to storage	Technical Personnel
Analysis is performed according to selected analytical method; raw data recorded, reviewed, and transferred to computer by chemist or technician*	Technical Personnel
Computer performs calculations as programmed according to methods	Data Processing
Chemist or supervisor verifies raw data	Technical Personnel
Data package deliverables are assembled	Data Package Group
Data packages are reviewed prior to mailing	Quality Assurance Department Laboratory Management

* Analyses requiring the chemist's interpretation may involve manual data reduction prior to entry onto the computer.

Project files will be created per client/project and will contain chain-of-custody records, analysis requirements, and laboratory acknowledgements which document samples received, laboratory sample number assignment, and analysis requested. Raw data is filed per batch number assignment and laboratory sample number which correlates to the sample receipt documents. When the project is complete, all documentation is archived in a limited access area and retained for ten years.

Laboratory Quality Control Procedure and Acceptance Limits

Appendix A-3 presents tables which summarize the internal QC procedures for the analytical methods planned for this project.

7.4 PERFORMANCE AND SYSTEM AUDITS

System audits are conducted on each department at Lancaster by members of the Quality Assurance Department. The audits include checks on methodology, reagent preparation, equipment calibration and maintenance, quality control results, and training of personnel. The results of the audits and corrective action, where necessary, are communicated to laboratory personnel and management by means of a written report. Audits by outside organizations including clients, regulatory personnel, and the USEPA are permitted by arrangement with the Quality Assurance Department.

The Quality Assurance Department reviews summaries of the quality control data entered into the computerized sample management system by analysts. Control charts and statistics are reviewed for trends which may indicate problems with the analytical data. In this way, small problems are identified before they have any significant impact on laboratory results.

Performance audits consist of both intralaboratory and interlaboratory check samples. Blind samples containing known amounts of target analytes are prepared by the Quality Assurance

Department and submitted to the laboratories under fictitious client names. In addition, QC samples from commercial suppliers are analyzed quarterly to assess laboratory accuracy. Lancaster also participates in a number of interlaboratory performance evaluation studies which involve analysis of samples with concentrations of analytes that are known to the sponsoring organization, but unknown to the laboratory. Inorganics, pesticide/herbicides, trihalomethanes, volatile organic compounds, semi-volatile organic compounds, and traditional wet chemistry analyses are analyzed by Lancaster for studies conducted by the USEPA and the New York Department of Health and the U.S. Army Corps of Engineers.

7.5 PREVENTIVE MAINTENANCE

In order to ensure timely production of data, Lancaster schedules routine preventive maintenance of instruments based on manufacturer's recommendations. Maintenance of the laboratory instruments is the responsibility of the technical group using the equipment in conjunction with our in-house Equipment Maintenance Group. A schedule of routinely performed instrument maintenance tasks is attached as Table 7-10. All preventive maintenance, as well as maintenance performed as corrective action, is recorded in instrument logs.

Critical spare parts are kept in supply at the laboratory by the Equipment Maintenance Group. Most items not kept in stock at the laboratory are available through overnight delivery from the manufacturer. In addition, Lancaster maintains multiple numbers of most of the critical instruments used in our laboratory operations. Because Lancaster is a large laboratory with redundant capacity, the problems or instrument downtime are minimized.

7.6 FIELD AND LABORATORY PROCEDURES USED TO ASSESS DATA QUALITY INDICATORS

The methods and definitions of quality control/quality assurance procedures are described in the following text.

TABLE 7-10

PREVENTIVE MAINTENANCE SCHEDULE
Hunter Army Airfield FTA
Savannah, Georgia

Instrument	Preventive Maintenance	Frequency
GC/MS	Change septum	Weekly or AN*
	Check fans	Monthly
	Check cool flow	Monthly
	Clean source	Bimonthly or AN
	Change oil in vacuum pump	Semiannually
	Change oil in turbo pump	Semiannually
GC Volatiles	Check propanol level	Semiweekly or AN
	Check all flows	Prior to calibration or AN
	Conductivity Detector Maintenance	AN
	Clean cell	AN
	Change reaction tube	AN
	Change Teflon line	AN
	Change resin	AN
	Replace trap	AN
	Column Maintenance	AN
	Change PID Lamp	AN
	Precalibration instrument	Prior to each calibration
	settings check	Prior to each calibration
GC	Septum change	Each run
	Column maintenance	AN
	Clean detector	AN
	Vacuum filters	Semiannually
	Leak check ECDs	Semiannually
Flame AA and Hydride Generation AA	Rinse burner head, chamber, and trap	AN: Minimum weekly
	Clean nebulizer	Weekly
	Inspect tubing and O-rings	Monthly
	Replace lamp	AN
GFAA	Rinse workhead assembly	Weekly
	Clean windows	Weekly
	Replace probe tubing	AN
	Check rinse bottle and drain	Daily
Cold Vapor AA	Change drying tube	Daily
	Replace pump tubing	AN: Minimum weekly
	Lubricate pump head	Weekly
	Lubricate autosampler	Weekly
	Inspect optical cell and windows	Monthly
		Clean AN

TABLE 7-10

PREVENTIVE MAINTENANCE SCHEDULE
Hunter Army Airfield FTA
Savannah, Georgia

Instrument	Preventive Maintenance	Frequency
ICP	Clean torch	Weekly
	Clean nebulizer and spray chamber	Weekly
	Replace pump winding	Check Daily
	Lubricate autosampler	Monthly
	Check mirror	Monthly
	Checking tubing to torch	Daily
	Check fan filters, clean if needed	Weekly
	Check cool flow, clean if needed	Weekly
	Check water filter, replace if needed	Quarterly
Autoanalyzer	Clean sample probe	AN
	Clean proportioning pump	Weekly
	Inspect pump tubing, replace if worn	AN
	Clean wash receptacles	Monthly
	Inspect condition of distillation head	Monthly
Infrared Spectrometer (FTIR)	Check on-demand diagnostics	Quarterly
	Check wavenumber with polystyrene film	Quarterly
	Change dessicant	Quarterly
Total Organic Carbon Analyzer	Check IR zero	AN
	Check for leaks	AN
	Check acid pump calibration	Bimonthly
	Check persulfate pump calibration	Bimonthly
	Inspect 6-port rotary valve	AN
	Inspect sample pump head	AN
	Wash molecular sieve	AN
	Check sample loop calibration	Monthly
	Clean gas permeation tube	AN
	Inspect digestion vessel O-rings	AN
	Check activated carbon scrubber	AN
	Dust back and clean circuit boards	AN
	Check IR cell	AN
Total Organic Halogen Analyzer	Polish counter electrode	Daily
	Polish sensor electrode	Biweekly
	Clean loaders and pistons	Biweekly
	Replace agar bridge	Monthly

* AN means as needed. Any of these items may be performed more frequently if response during operation indicates this is necessary.

Note: Information adapted from Lancaster Laboratories QAPP

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7.6.1 Formulas

Accuracy - Accuracy is a measure of the bias in a system. Accuracy is defined as the degree of agreement of a measurement with an accepted reference or true value. To determine the accuracy of an analytical method, a sample spiking program will be conducted. The results of sample spiking will be used to calculate the quality control parameter for accuracy evaluation, the Percent Recovery (%R). The Percent Recovery is defined as the observed concentration, minus the sample concentration, divided by the true concentration of the spike, multiplied by 100.

$$\%R = \frac{X - T}{K} \times 100$$

where

X = Analytical result from the spiked sample

T = Analytical result from the unspiked aliquot

K = Known value of the spike

%R = Percent Recovery

To determine accuracy, surrogate, matrix spike and matrix spike duplicates (MS/MSD), and internal standards will be analyzed. The control limits will be based on the mean percent recovery plus or minus 3 standard deviations of the mean using a population of 20 recovery values.

Precision - Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of standard deviation or Relative Percent Difference (RPD) Precision is inferred through the use of duplicate samples. RPD for each component is calculated using the following equation:

where: $$RPD = \frac{A - B}{(A + B)/2} \times 100$$

A = Replicate Value 1

B = Replicate Value 2

RPD = Relative Percent Difference

The calculated Percent Recovery and RPD will be summarized. The RPD data will be used to evaluate the long term precision of the analytical method.

To determine precision, matrix spikes and matrix spike duplicates will be analyzed. The control limits will be based on a population of 10 RPD values. They are calculated by determining the mean RPD plus 3 times the standard deviation for the upper limit and zero as the lower limit.

Completeness - Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct or normal conditions. The result is expressed as a percentage.

$$\text{Percent complete} = \frac{\text{Number of valid measurements}}{\text{Total number of measurements}} \times 100$$

The percent completeness goal for this project is 90 percent.

7.6.2 Data Quality Assessment

Statistical techniques can be used to evaluate the comparability of different sets of existing data and to evaluate the need to obtain additional data. The most commonly used statistical approach is the interpretation of accuracy and precision information. Another statistical approach is the use of geostatistical information which characterizes the location of the samples and the size of the site. LAW will use accuracy and precision information to assess the confidence in the reported values and geostatistics of the validated data to identify contamination plumes.

The statistical treatments of data by LAW are generally in accordance with current scientific concepts elucidated in standard references. Precision is a statistical term which describes the closeness of agreement between individual measured values of a given analyte in a given matrix at a given concentration of analyte using a specified analytical method. Precision is normally expressed in statistical terms, such as the standard deviation of the values about their mean, or as the coefficient of variation (CV), which is the standard deviation of the mean expressed as a percentage of the mean. Bias is similarly a statistical parameter which describes the deviation, with algebraic sign, of the mean values of many determinations of the analyte from its "true" value. This true value must either be known independently or determined by another independent method which is known to have no bias itself.

The precision and accuracy of environmental sample analysis are greatly dependent on the sample matrix and the level of analyte concentration, both of which determine what values of precision and accuracy (bias) are acceptable for the use intended. This dependence of precision and accuracy descriptors in analyses upon matrix and concentration requires the chemists involved to use professional judgement as to the range of values acceptable for repeat determinations of the same sample. Horwitz, Kamps, and Boyer (1980) have shown this precision vs. concentration relationship to hold for a large number of methods, matrices, and analytes involved in regulatory programs.

All data generated within established concentration ranges for a particular analyte will be compared to developed Shewhart Control Charts, and they must meet pre-established quality control criteria for accuracy and precision.

7.7 CORRECTIVE ACTION

Whenever any of the data generated falls outside of the established acceptance criteria outlined for instrument tune and calibration and Internal QC, the cause of this irregularity must be investigated, corrected, and documented. The documentation will be used to prevent a recurrence of the problem and to inform management of the situation.

If the results are not within acceptance criteria, the appropriate corrective action will be initiated. This may include, but is not limited to, checking calculation and instrument performance, reanalysis of the associated samples, examining other QC analyzed with the same batch of samples, and qualifying results with a comment stating the observed deviation.

A standard operating procedure is in place which outlines the procedures to be followed when quality control data for an analysis falls outside of previously established acceptance limits. All QC data must be entered onto the computerized QC system promptly after its generation and daily "out-of-spec" data is reported via this system. Any data outside the acceptance criteria will be reviewed by the Quality Assurance Department. Where appropriate, the Quality Assurance Department will place outliers in one of three categories:

A. Marginal Outlier - Data that are outside the 95 percent confidence interval but within the 99 percent confidence interval. This category may also be used for QC samples subject to matrix interferences or sample inhomogeneity.

B. Outlier - Data outside the 99 percent confidence interval and/or observable trends such as a shift in mean and standard deviation.

C. Extreme Outlier - Such data would indicate the system is out of control and no results should be reported to clients; an example would be more than one reference or control falling outside the 99 percent confidence interval.

The daily out-of-spec reports are then distributed to group leaders or their QC coordinator who will check supporting data and document their findings and any corrective action taken. Documentation of QC data will be filed in the departmental QC notebook. In the case of outliers or extreme outliers, the Quality Assurance Department may issue a formal request for investigation and corrective action (see sample form that follows). The Quality Assurance Department is responsible for initiating the corrective actions, insuring that the actions are taken in a timely manner, and that the desired results are produced. The QA Department will circulate all completed Investigation and Corrective Action forms to the appropriate manager.

The Quality Assurance Department is also responsible for conducting periodic audits which ensure compliance with laboratory SOPs and assist in identifying and correcting any deficiencies. These audits may entail observation as procedures are carried out or a review of records to demonstrate traceability and compliance with all documented record keeping procedures. The QC Department will then issue a written report which summarizes the audit. The technical centers must respond in writing to the audit report within 30 days of report receipt. The response will address the corrective action that needs to be taken along with an expected completion date. Audit results and the corresponding response are communicated to laboratory personnel and management. Follow-up audits verify that proper corrective action has bene taken for the identified discrepancy.

7.8 QUALITY ASSURANCE REPORTS

The management is informed of QA activities in three ways: (1) by immediate verbal notification of QA problems, (2) by interim QA reports, and (3) a written final QA report.

7.9 EVALUATION OF DATA QUALITY

The parameters of PARCC are indicators of data quality (USEPA, 1987a). Establishing goals for these parameters serves to guide the choice of the analytical methodology. It also establishes a strategy for the evaluation of the data once they have been acquired to determine whether the goals of the project have been met. Upon their receipt from the laboratory, the chemical analysis data will be evaluated by experienced personnel against pre-determined criteria to determine whether their quality meets the requirements of the project. The laboratory quality control (QC) data and the field QC data will be evaluated to objectively ascertain the level of quality of the data. Any issues requiring clarification by the laboratory or the samplers will be identified and pursued at this point. The data quality level will then be compared to that required by the project. If problems are found, qualification of the affected data points will be recommended. Upon determination of the level of quality for each data point, interpretation of the data can then be performed. The following sections describe the data quality evaluation and data qualification processes.

7.9.1 Data Quality Evaluation

The objective of the evaluation of the quality of the chemical data is to determine if qualifications of the data are necessary. This evaluation will be based upon the evaluation of the laboratory QC data, the field QC data, and the project DQOs presented in Section 3.0. The first step will be to perform an evaluation of the laboratory QC data, a process often termed "data validation." This will provide a rating of the quality of each data point produced by the laboratory. The second part will provide an overall rating of each data point based upon the field QC data. The final step in the evaluation will compare the quality of the data acquired to the project's DQOs to determine whether the data are useful. These three steps are described in the following sub-sections. Each step will be completely documented. The overall goal of the data quality evaluation is to determine whether the data can be used to satisfy the objectives of the project.

7.9.1.1 Evaluation of Laboratory QC Data - All laboratory QC data for an analytical parameter fall within one of eight categories for evaluation purposes. These categories are listed in Table 7-11 in the order in which they will be considered. All QC data provided will be evaluated against the criteria established by each method, the USEPA (USEPA, 1986; USEPA, 1983) after modification as presented in this document to achieve the objectives of this project.

TABLE 7-11

DATA EVALUATION CATEGORIES: LABORATORY QC
Hunter Army Airfield FTA
Savannah, Georgia

CATEGORY	QC DATA EVALUATED
1. Sample Integrity	Sample container condition; preservation performance and applicability; condition upon receipt at laboratory; holding times;
2. Instrument Set-up/Method Applicability	Correct method; detection/quantitation limits achieved; method applicability for analytes and matrix, instrument set-up
*3. Calibration Accuracy and Precision	Standard preparation; accuracy verification, precision achieved
*4. Calibration Stability	Stability verification; frequency of performance
5. Laboratory Contamination	Laboratory blanks
6. Method Accuracy and Precision	Method accuracy and precision data
7. Sample Preparation	procedures; holding times
8. Sample Analysis	Procedures and sequences; sample-specific accuracy and precision; interferences; dilutions; surrogate recovery

*These categories are assumed to be correct and will not be provided for evaluation.

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Each review will be completely documented to indicate the criteria used and the results and recommendations of the evaluation. For this project, calibration accuracy, precision, and stability will be assumed to be correct because these data will be provided for evaluation.

7.9.1.2 Evaluation of Field QC Data - All field QC data for an analytical parameter fall within one of eight categories for evaluation purposes. These categories are listed in Table 7-12 in the order in which they will be considered. All QC data provided will be evaluated to assure the objectives of this project are achieved. Each review will be completely documented to indicate the criteria used and the results and recommendations of the evaluation. For this project, no blind QC samples or performance evaluation data will be provided. Split sample data will not be available for review during the evaluation.

7.9.1.3 Usability Determination - Once the laboratory and field QC data have been evaluated, the uncertainty associated with each data point can be estimated. The estimated accuracy and precision of each data point can then be compared to the data quality objectives of the project to determine its usefulness for evaluating the site. Recommendations for the qualification of a data point can also be made when necessary.

Precision will be determined by evaluation of the RPDs for the laboratory and field duplicates. The laboratory and field blank data, MS/MSD and surrogate (if applicable) recoveries, and all other applicable QC data will be used to determine the accuracy of the data. The evaluator will use their judgement based upon established principles and the guidelines established in this document in the assignment of qualifications to the data. All data are to be used if at all possible.

The completeness parameter will be evaluated after the determination of the usability of each data point; it will be expressed in quantitative terms and then compared to the project objectives to determine whether enough data were collected. Representativeness will be determined

TABLE 7-12

DATA EVALUATION CATEGORIES: FIELD QC
Hunter Army Airfield FTA
Savannah, Georgia

	CATEGORY	QC DATA EVALUATED
1.	Sample Integrity	Sample container condition; preservation performance and applicability; condition prior to shipment; custody
2.	Location Installation	Sampling location installation
3.	Sampling Procedures	Sampling protocols
4.	Contamination From Sampling	Rinsates
5.	Contamination From Shipping	Trip blanks
6.	Sampling Precision	Field duplicates
*7.	Miscellaneous	Blind QC samples; performance evaluation data; split sample data

*No blind QC samples or performance evaluation data will be provided. Split sample data will not be available for review during the evaluation.

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through an evaluation of sampling procedures and locations utilized and will be expressed in qualitative terms. Comparability will be determined by the evaluation of data quality and will also be expressed in qualitative terms.

7.9.2 Data Qualification

Each data point will essentially be graded as falling into one of the following categories:

- usable as reported;
- usable with qualifications; or
- unusable.

These categories correspond to the three established for the DQOs in Section 3.0. Data for which the laboratory and field QC data are all within acceptance limits will be assigned the grade "usable as reported." Data for which slight QC problems are indicated but the QC data are still within the action limits will be assigned the grade "usable with qualifications." These data may still be used if the QC problems are not excessive. Data for which the corresponding QC data are outside the action limits will be assigned the grade "unusable" and will not be used. Each data point will receive a flag indicating its level of quality. The flags to be used are presented in Table 7-13.

TABLE 7-13

DATA QUALIFICATIONS
Hunter Army Airfield FTA
Savannah, Georgia

FLAG	POSITIVE RESULTS	NEGATIVE RESULTS
FLAGS FOR DATA WITHIN ACCEPTANCE LIMITS (Usable as Reported)		
(no flag)	{Use datum without qualification}	{Use datum without qualification}
FLAGS FOR DATA WITHIN ACTION LIMITS (Usable With Qualifications)		
J	Estimated quantitation based upon QC data	Estimated quantitation based upon QC data
FLAGS FOR DATA OUTSIDE OF ACTION LIMITS (Unusable)		
R	Datum rejected based upon QC data: do not use	Datum rejected based upon QC data: do not use

[a]Applicable to GC/MS data only

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8.0 CHEMICAL DATA QUALITY MANAGEMENT DELIVERABLES

The chemical data quality management (CDQM) deliverables are reports concerning the quality of the data acquired. These reports will be prepared for submittal to CESAS-EN-GH as required by the Scope of Work and/or by reference to USACE guidance (USACE, 1990). These CDQM deliverables are listed in the following sections.

8.1 DAILY QUALITY CONTROL REPORTS

DQCRs will be prepared by LEGS during the field activities only. These reports will briefly summarize the activities performed and the associated QC activities. It will also provide a description of any problems encountered, the corrective actions taken, and the effectiveness of the corrective actions.

8.2 DEPARTURE FROM APPROVED PLANS

In general, LEGS will not deviate from these plans after they have been approved. In the event that a departure from these plans is determined to be necessary, LEGS will contact the CESAS-EN-GH and request written permission for the change. Should time be a factor, verbal approval will be requested with written approval to be prepared at a later date.

8.3 QUALITY CONTROL SUMMARY REPORT

The Quality Control Summary Report (QCSR) is a report that summarizes the QC performed and the results. The QCSR should include the following information:

- Project Description
- Laboratory Quality Control Activities
- Field Quality Control Activities
- Data Presentation and Evaluation
- Lessons Learned
- DQCR Consolidation

The QCSR will be prepared and included as an Appendix of the CSR.

8.4 ANALYTICAL DATA REPORT

The chemical data will be provided to the CESAS laboratory for evaluation. This report will be provided upon completion of the data quality evaluation to be performed by LAW. A cover letter will be provided which will include the project name, a table identifying field splits and identifying numbers for comparison. The USACE project chemist will also be provided with a copy of this cover letter.

8.5 AUDIT REPORTS

Auditing of the Chemical Data Quality Management Deliverables will occur only if there is sufficient reason to believe that situations exist where results appear to be unusual or questionable.

APPENDIX A-1

RESUMES

F. DAVID SHIVER

Principal Design Engineer

Civil Engineer

Master Business Administration, 1973
Master of Engineering, 1968
B.S. in Civil Engineering, 1967

Professional Engineer in Georgia, Alabama, South Carolina, North Carolina, Florida

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

Society of American Military Engineers, American Defense Association

CAREER SUMMARY

Mr. Shiver is currently manager of the Engineering Group for the Government Services Division for Law Environmental, Inc. He has managed that position since January, 1991. The objective of the program is to provide engineering and design services to Law Environmental Federal Government clients. Mr. Shiver is a principal civil engineer with experience in environmental remedial design, transit design, highway design, bridge design, retaining structures and slope stability.

SUB-SPECIALTY EXPERIENCE

Environmental Experience

Mr. Shiver's diversified, 27 year engineering career encompasses managerial and technical positions in environmental and civil engineering. As a principal engineer for Law Environmental, he has managed a number of environmental projects from site investigation through remedial design and Title II services. He has been responsible for remedial design at a number of RCRA and CERCLA hazardous waste sites and is familiar with federal regulations and statutes. Remedial designs have included UST closures, landfill closures, in-situ bioremediation, ex-situ bioremediation, ground-water extraction and treatment, and thermal treatment at hazardous waste sites. He also has experience in providing construction services including shop drawings, plant start-ups, maintenance and operation, and construction management.

Transit Project Experience

Mr. Shiver has managed the design of a number of transit projects including subway line sections, at-grade line sections, at-grade and aerial stations, and maintenance facilities. He served as project manager for LAW's efforts for the Westside Light Rail Road Project in Portland, Oregon. He served as project manager for the preliminary design of two aerial stations and approximately one mile of aerial structure for the Houston Transit Authority. He served as project manager for the design of the MARTA Lakewood Station which included an at-grade station, Train control ancillary facility, bus transfer facility, and pedestrian bridges. He has served as project structural engineer for the design of the MARTA Civic Center Station which included an aerial structure with cut-and-cover and segments. He was also the project structural engineer for the Laredo bus maintenance facility for MARTA. He served as a project engineer on the MARTA East Line track work and assisted in writing specifications for the MARTA rail direct fastener.

Highway Project Experience

Mr. Shiver has managed the design of a number of major highway design projects. Mr. Shiver's highway experience has included collection of field data, preparation of conceptual, preliminary and final design, preparation of contract documents, and field inspection. He served as project manager for the Williams Street Interchange in downtown Atlanta and a project manager for the I-85 viaduct near downtown. He was assistant project manager for segment IV-B which included widening and relocation of I-85 near downtown Atlanta. While managing a Raleigh, N.C. highway design office, Mr. Shiver was responsible for the preparation of contract documents for a number of highway projects in North and South Carolina. These projects included widening, relocation, and new construction of state and interstate highway projects.

Bridge Project Experience

In his 20 years of design experience, Mr. Shiver has participated in the design of more than 50 highway and railroad bridges. Bridge designs include numerous types such as post-tension concrete box girders, steel box girders, pre-stressed concrete box girders, steel trusses, pre-stressed concrete flat slabs, reinforced concrete inverted I-beams, orthotopic steel plate decks, curved steel girders and others. Mr. Shiver served as project manager for the design of twin 4,500 feet long bridges on I-85 near Atlanta. Alternative designs were prepared which included steel I-girders, pre-stressed concrete AASHTO I-girders, and segmental post-tensioned concrete box girders. He served as project structural engineer for the design of seven bridges on the Williams Street interchange in downtown Atlanta. Served as project structural engineer for the design of seven bridges on segment IV-B of I-85 near Atlanta. He served as project manager for the design of several bridges over I-20, near Atlanta, including a CSX railroad bridge, and as project design engineer for the widening of seven bridges on Interstate I-75 in Cobb County, Georgia. He served as project design engineer for the design of five bridges on Interstate I-40 near Wilmington, North Carolina, for the North Carolina Department of Transportation. Served as project engineer for the design of widening of twin bridges over Thompson Creek on U.S. 1 for the South Carolina Department of Highways and Public Transit.

Railroad Project Experience

Mr. Shiver has been involved in the design of numerous railroad projects for various railroads and state departments of transportation. He is a member of American Railway Engineering Association and is familiar with A.R.E.A Design Specifications. Some of Mr. Shiver's projects included the design of a CSX railroad Bridge over I-20, near Atlanta, Georgia; a utility tunnel under Southern Railroad; a city street bridge over Southern Railroad for Norfolk Southern Railroad; and tow tunnels under I-85, near Atlanta, for the Norfolk Southern Railroad tracks.

Retaining Structures and Slope Stability

Mr. Shiver has participated in the design of most types of retaining walls. Projects have included the traditional types of retaining walls such as gravity walls, cantilevered walls, counterfort walls, and tie back walls, as well as state-of-the-art type walls systems such as reinforced ground, soil nailing, post-tensioned caisson walls, slurry walls, soil anchors, and rock anchors. Mr. Shiver's experience included the design of permanent walls, temporary walls, underpinning of adjacent structures, slope stability, and others. Projects have included both temporary and permanent wall design for highways projects, transit cut-and-cover projects, building sites, and others.

CAREER HISTORY

1987 - Law GeoConsult
1989 - Law Environmental

LANGUAGE CAPABILITY

	Speaking	**Reading**	**Writing**
English	Excellent	Excellent	Excellent

RANDY A. KNOTT

Assistant Vice President/Chief Engineer
Principal Geotechnical Engineer
Principal Environmental Engineer

M.S., Civil Engineering, Mississippi State University
N.S., Civil Engineering, Georgia Institute of Technology

Registered Professional Engineer in Florida, Georgia and South Carolina

CAREER SUMMARY

Mr. Knott has been responsible for planning, coordinating, conducting, and reporting field and laboratory investigations to determine soil and rock static and dynamic properties for use in foundation design and re-design (hardening to resist dynamic forces) of military facilities. He has conducted foundation construction inspection and evaluations of distressed structures as well as performed monitoring of vibrations generated by construction activities and evaluated their effects on adjacent structures and human perceptibility. Primarily from 1981 to 1987, Mr. Knott's responsibilities included planning, coordinating and reviewing geotechnical assignments with project geotechnical engineers for the complex geotechnical studies at the Naval Submarine Base at Kings Bay, Georgia. In 1985, Mr. Knott was designated the Chief Engineer for the Jacksonville Operations. As such, he is responsible for planning, coordinating and reviewing geotechnical, environmental, and other engineering assignments with project and senior geotechnical, environmental, materials and construction engineers, geologists, and scientists.

SUB-SPECIALTY EXPERIENCE

Mr. Knott has been involved in a variety of earth slope embankment and retaining wall stability analyses since 1970. These projects have involved conventional cast-in-place concrete walls, proprietary reinforced earth or other pre-manufactured wall systems, and precast concrete or steel sheet pile walls and bulkheads. He has experience with a wide variety of soil conditions, particularly those soils found in the South Atlantic Coastal Plain geologic province in Florida and Georgia. His work with retaining systems and earth embankments has been with transportation and waterfront projects, water and industrial waste containment and control structures, and temporary bracing and shoring for construction excavations. Mr. Knott's more recent experience includes supervising and reviewing the work of other geotechnical engineers. These engineers use computer programs for detailed analysis, selecting material properties, generating earth pressure calculations, and evaluating critical points of analysis and minimum factors-of-safety, including both internal and external stability of retaining systems. Some of these applications have included underwater earth slopes and seismic induced loadings.

CAREER HISTORY

Not applicable

LANGUAGE CAPABILITY

	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent

JACK C. PENG, C.I.H., PH.D.

Corporate Consultant
Technical Director - Environmental Training Center

Certified Industrial Hygienist

Comprehensive Practice (1983)
Industrial Hygienist
Bachelor of Science (1970)
Master of Science (1974)
Doctor of Philosophy (1978)

Certification #2679

CAREER SUMMARY

Jack Peng is the Technical Director for Law Companies Environmental Training Center (LAW). Dr. Peng's EPA training courses include 16-hour hazardous waste management training, 36-hour environmental sampling workshop, and 8-hour environmental and safety regulations overview and 32-hour lead-based paint training. The OSHA training courses include 40-hour health and safety for hazardous waste operations initial course, 8-hour annual refresher course, 8-hour supervisor course, 24-hour treatment/storage/disposal course, 24-hour emergency response course, and 24-hour process safety management workshop. In the past five years, they have taught more than three hundred sessions of various subjects throughout the United States, Germany, England, and South Korea with the number of students exceeding 8,000. Clients include sectors from industry, labor unions, and government. LAW has been chosen by U.S. Army Corps of Engineers to be the worldwide training center for the OSHA 40-hour and 8-hour health and safety course for hazardous waste operations under a three year contract.

Dr. Peng and his staff conduct comprehensive industrial hygiene and indoor air surveys which include hazards recognition, evaluation, and control for commercial buildings, laboratories and manufacturing facilities.

Prior to joining LAW, Dr. Peng was Industrial Hygiene Manager for the International Paper Company, a six billion dollar company. He was responsible for all aspects of industrial hygiene for the corporation, and provided technical direction and supervision to a staff of five Industrial Hygienists. They conducted industrial hygiene surveys on lead and other heavy metals, silica, asbestos, and different organic compounds at various laboratories, manufacturing and mining sites. They were responsible for 110 facilities in the United States and Venezuela. Dr. Peng directed the development of company-wide policies and regulatory guidelines on lead, asbestos, chlorine, hydrogen sulfide, pentachlorophenol, hazard communication, respiratory protection and confined space entry. He has lectured in various technical and trade associations and universities on subjects such as lead, asbestos, formaldehyde, PCB, wood dust, confined space, process safety management and hazard communication in both the U.S. and the People's Republic of China.

SUB-SPECIALTY EXPERIENCE

Environmental, Health, & Safety Training

- National training center for OSHA 40-hour and 8-hour health and safety courses concerning hazardous waste operations for U.S. Department of Defense through a contract from U.S. Army Corps of Engineers, Huntsville, Alabama.
- National training center for OSHA 40-hour health and safety courses concerning hazardous waste operations for U.S. Army Corps of Engineers, Huntsville, Alabama.
- National training center for OSHA 40-hour health and safety courses concerning hazardous waste operations for U.S. Army's Environmental Center, Environmental Hygiene Agency, and Technical Escort Unit at Aberdeen Proving Ground, Maryland.
- National training center for OSHA 40-hour health and safety courses concerning hazardous waste operations for U.S. Department of Agriculture, Farmers Home Administration, Washington, D.C.
- National training center for OSHA 40-hour health and safety courses concerning hazardous waste operations for U.S. Postal Service, Washington, D.C.
- National training center for OSHA 40-hour health and safety courses concerning hazardous waste operations for Union Pacific Railroad, Omaha, Nebraska.
- National training center for OSHA 24-hour emergency response course for Kimberly Clark Corporation, Atlanta, Georgia.
- National training center for OSHA 24-hour emergency response course for Southwire Corporation, Carrollton, Georgia.
- Eastern regional training center for OSHA 24-hour emergency response course for Texeco (Star Enterprise), Atlanta, Georgia.
- Conducted OSHA 24-hour emergency response course for Sony Corporation, Carrollton, Georgia.
- Conducted OSHA 24-hour emergency response course for GTE, New Jersey.
- Conducted OSHA 24-hour and annual 8-hour refresher Treatment, Storage and Disposal Courses for Searle facility, Augusta, Georgia.
- Conducted OSHA/EPA/DOT 8-hour regulation course for Brown & Williamson Tobacco facility, Macon, Georgia.
- Conducted EPA/OSHA/DOT 16-hour regulation course for Union Pacific Western operations, Los Angeles, California.
- Conducted OSHA 24-hour and 8-hour refresher emergency response courses for Glidden.

- Conducted OSHA EPA/OSHA/DOT 24-hour hazardous materials and hazardous waste regulations course for Tennessee National Guard, Nashville, Tennessee.

- Conducted EPA/COE 32-hour environmental sampling course for U.S. 7th Army, Seoul, Korea.

- Conducted EPA/COE 32-hour environmental sampling course for U.S. Army Environmental Center and Technical Escort Services, Aberdeen Proving Ground, Maryland.

- Conducted EPA/HUD/OSHA 16-hour lead based paint course for U.S. Army Corps of Engineers, Fort Worth, Texas.

Industrial Hygiene/Indoor Air Quality

Industrial hygiene and indoor air quality projects that Dr. Peng has principled for Law Environmental include:

- An indoor air screening survey to evaluate total hydrocarbon vapor concentrations at 419 residential/commercial locations at a former petroleum refinery site. Over 36,000 FID readings were made during 4,000 separate surveys at these locations. Assisted client with state environmental quality agency negotiations on work plans and attended public meeting on behalf of client.

- Air monitoring surveys for cellulose dust and paraffin wax fume at manufacturing plants for separate clients in the paper converting industry.

- A comprehensive industrial hygiene survey at a U.S. Army facility where missiles are assembled by a Department of Defense contractor.

- An air monitoring survey to assess pentachlorophenol and creosote exposures and conducting an audit of the health and safety programs at four hazardous waste/groundwater treatment facilities for a pressure-treated wood products manufacturer.

- Annual health and safety compliance audits at six school bus manufacturing plants in the United States and Canada.

- Health & Safety Plan (HASP) reviews for various commercial and government hazardous waste site assessment and remediation projects.

- Comprehensive industrial hygiene and process safety management review on the total reduced sulfur recovery system in a major pulp manufacturing facility.

- Indoor air quality survey and HVAC system evaluation, at a major office complex in Puerto Rico. Carbon monoxide, carbon dioxide, formaldehyde, hexane, vinyl chloride, bacteria and fungi were sampled and analyzed under various environmental conditions.

- Expert witness on a major lawsuit by 100 or so office occupants against the two insurance companies who insured the office complex. The plaintiffs alleged that their respiratory illnesses and allergies were caused by the chemical and microbial contaminants in the building.

CAREER HISTORY

Technical Director/Corporate Consultant in Industrial Hygiene (1987-1994) Law Environmental, Inc., Kennesaw, GA.

Corporate Manager, Industrial Hygiene (1984-1987) International Paper, Norcross, GA.

Field Coordinator, Industrial Hygiene (1981-1984) International Paper, Norcross, GA.

Field Industrial Hygienist (1978-1981) International Paper, Mobile, Alabama.

Adjunct Assistant Professor (1982-present), Industrial Hygiene, University of Alabama School of Public Health, Birmingham, Alabama.

Instructor in Environmental Services (1977-1978) McNeese State University, Lake Charles, Louisiana.

DEEPAK R. GHOSH

Senior Environmental Engineer

Engineer

M.S. Environmental Systems Engineering, 1991
B.E. Chemical Engineering, 1987

Registered Professional Engineer (Georgia)

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

American Institute of Chemical Engineers
Water Environment Federation (Member of Program Committee, Toxic Substances Committee, and Pollution Prevention Work Group)
Georgia Water and Pollution Control Association
International Association on Water Quality

CAREER SUMMARY

Mr. Ghosh is a senior environmental engineer with the Government Services Division of Law Environmental. He is assigned to the engineering group within the division and specifically in the Process Treatment and Construction Management program. The objective of this group is to provide environmental engineering technical services at facilities owned by the U.S. Government. Treatability studies, process evaluation, treatment system design, remediation design, construction management, and O&M services are the primary focus of this group.

Mr. Ghosh has six years of broad experience in performing and managing chemical process and environmental management projects. Before joining Law Environmental, Inc., Mr. Ghosh was employed at Engineering-Science, Datastream Systems, and Balmer Lawrie & Co. Ltd. Mr. Ghosh's experience includes bench- and pilot-scale treatability studies; feasibility studies; conceptual and detailed design; cost estimating; project management; and marketing.

Mr. Ghosh has performed projects in industrial and municipal wastewater treatment; industrial and municipal stormwater treatment; CSO treatment and control; industrial hazardous and toxic wastes (RCRA/CERCLA, etc.); federal sites (RCRA/CERCLA, etc.); feasibility studies; process/design and construction of chemical and petrochemical facilities; energy management systems investigation, design, and construction; and design of software for wastewater treatment plant/energy recovery data management.

Mr. Ghosh is very active in committees and work groups in several national professional organizations and has organized conferences and chaired sessions on environmental engineering topics. He has authored several technical papers and made presentations at national conferences as listed below.

1. Ghosh, D.R., "Effect of Clay Mineralogy on Surfactant Remediation of Aquifers," M.S. Thesis, Clemson University, Clemson, South Carolina, 1990.

2. Ghosh, D.R., and Boner, M.C. "Treatment of Combined Sewer Overflows in a Vortex Separator," presented at the Water Environment Specialty Conference on Wet Weather Water Quality Problems, June 1-3, 1992.

3. Ghosh, D.R., and Keinath, T.M. "Effect of Clay Mineralogy on the Adsorption of Hydrophobic Organic Compounds onto Aquifer Soils," presented at the 65th Annual Water Environment Federation Conference & Exposition, September 24-27, 1992.

4. Ghosh, D.R., Boner, M.C., Atere-Roberts, S.O., Street, W.B., Haas, D.L., and Arnett, C.J. "Treatment of Combined Sewer Overflows in the Chattahoochee River," presented at the 65th Annual Water Environment Federation Conference & Exposition, September 24-27, 1992.

5. Ghosh, D.R., and Keinath, T.M. "Effect of Clay Mineralogy on the Adsorption/Desorption of Hydrophobic Organic Compounds from Aquifer Soils," presented at the Annual Meeting of the American Institute of Chemical Engineers, November 1-6, 1992.

6. Ghosh, D.R., Boner, M.C., Hides, S.P., Turner, B.G., "High Rate Treatment of Combined Sewer Overflows in Columbus, Georgia," presented at the Sixth International Conference on Urban Storm Drainage, organized by the IAWQ, September 12-17, 1993.

7. Ghosh, D.R., and Keinath, T.M. "Effect of Clay Minerals Present in Aquifer Soils on the Adsorption and Desorption of Hydrophobic Organic Compounds," to be included in a Special Issue of Environmental Progress (American Institute of Chemical Engineers), 1994.

8. Ghosh, D.R., Boner, M.C., Harper, S.R., and Turner, B.G. "Modified Vortex Separator and UV Disinfection for CSO Treatment," to be presented in Flotation Process in Water and Sludge Treatment organized by the IAWQ, IWSA, and AWWA, Orlando, Florida, April 26-28, 1994.

9. Ghosh, D.R., WEF Policy Statement on Pollution Prevention prepared for the United Nations by the WEF Pollution Prevention Work Group Committee, January 1995.

SUB-SPECIALTY EXPERIENCE

Industrial Waste

Mr. Ghosh has been heavily involved with the chemical, petrochemical, food, and metal finishing industries. He has evaluated process alternatives, performed treatability studies, developed basis of design and performed detailed design of several wastewater treatment plants. The following is a listing of selected project experience:

Mr. Ghosh was involved in performing treatability studies and the design of a leachate treatment system at an industrial hazardous waste landfill contaminated with pesticides and herbicides. The system consisted of a filtration-carbon adsorption process train.

Mr. Ghosh was involved in a wastewater treatment plant upgrade at a pulp and paper facility to implement algae removal from wastewater using deep bed sand filters. In this project he performed field scale pilot studies and evaluated coagulation/filtration/disinfection for treatment of wastewater using sand filters. He also performed process design, sized major equipment, prepared a Basis of Design Report, and participated in negotiations with the state of Alabama to renew the facility NPDES permit.

Mr. Ghosh has performed process and detailed design for wastewaters generated from pigment and paint industries. These projects involved treatment for removal of BOD_5, metals, ammonia, and sodium hypophosphite. Other activities in this project included preparing Basis of Design Reports, and assisting client in obtaining an NPDES permit after negotiations with Georgia EPD.

Mr. Ghosh assisted a major bulk chemicals manufacturer to develop, market and distribute a new hypochlorous acid-based disinfectant for water treatment application and its delivery systems. He performed bench and pilot tests to determine the disinfection efficiency of the new product and compare it with commonly available disinfectants. He designed a pilot plant for evaluating the new disinfectant and assisted client in standardizing design of disinfectant storage and handling systems and selecting materials of construction.

Mr. Ghosh has performed several stormwater management projects for industrial facilities in the United States. These projects were performed for industrial landfills, jet engine manufacturing and testing facilities, automotive parts manufacturing industries, and chemical processing facilities. In these projects, he has performed site surveys, assessments, detection of non-stormwater discharges, sampling and flow monitoring, prepared site drainage maps, and assisting clients in preparation of individual and group permits.

Municipal Wastewater/CSO

Mr. Ghosh has been involved in municipal wastewater treatment process and design evaluation for several facilities. On behalf of utility companies, he has evaluated the process and treatment capabilities of several plants in the state of Florida. During this project he evaluated several unit process such as aerobic biological processes, anaerobic sludge digestion, clarification, disinfection coagulation/flocculation, and sludge disposal.

Mr. Ghosh also has been heavily involved in the conceptual and detailed design of combined sewer overflow (CSO) treatment facilities for the cities of Atlanta and Columbus, Georgia. He served as the lead engineer for performing process and detailed design of the $20 million CSO treatment facilities at Columbus. For the Columbus project, Mr. Ghosh piloted the use of a vortex separator for disinfection and solids removal which was an unique application. He has developed and evaluated innovative CSO treatment processes (dissolved air flotation and UV disinfection) working with State, Federal and other Research agencies.

Hazardous Waste

Mr. Ghosh has been involved in several hazardous waste studies and remediation projects for the Government and industry to solve RCRA and CERCLA-related problems including studies on innovative treatment technologies under the USEPA SITE Program. Mr. Ghosh has performed remedial investigations, feasibility studies, treatability studies, and remedial design for several Installation Restoration Program (IRP) sites of the Department of Defense and the Air National Guard. Some of the sites where Mr. Ghosh was involved include Chanute Air Force Base (AFB), Volk AFB, Eglin AFB, Edwards AFB, and Langley AFB. In these projects he has performed remedial investigation, risk assessment, contaminant fate and transport analysis, treatability study data review, feasibility studies, and remedial design. He has prepared RI/FS reports and USEPA Technical Memoranda. Recently at Langley AFB, he has performed design of soil vapor extraction and ground-water recovery and treatment systems and prepared O & M Manuals. Mr. Ghosh has prepared a RCRA Part B permit for the Fort Leavenworth Military Reservation in Kansas.

Recently, Mr. Ghosh has managed a project and construction specifications for remediation of six UST sites at Fort Bliss, Texas. Mr. Ghosh is in charge of remedial design for a fire training area at Hunter Army Airfield in Savannah, Georgia. The work includes preparation of construction drawings, specifications, and design analysis. Mr. Ghosh is the lead engineer for remediation of two solid waste management units at England AFB in Louisiana. He will be involved in preparation of RCRA corrective measure studies, conceptual and detailed design.

Mr. Ghosh has also performed and managed remedial investigations, treatability studies, feasibility studies, and remedial design at five industrial CERCLA sites on behalf of Potentially Responsible Parties (PRPs). These sites include: Cleve Reber site (Louisiana), Monroe Auto Pit (Arkansas), Stringfellow (California), Beulah Landfill (Florida), Fort Dix Landfill (New Jersey), and DeRewal Chemical Company (New Jersey). In these projects he was involved in selecting and designing treatment systems for wastewater, stormwater, sludges, contaminated soils, leachate and air. The contaminants evaluated included organics, metals, pesticides, and herbicides. Mr. Ghosh has evaluated the following unit processes for wastewater and leachate treatment: oil and grease removal, clarification, metals precipitation, air and stream stripping, carbon adsorption, and aerobic and anaerobic biological systems. For contaminated soils and sludges, Mr. Ghosh has evaluated incineration, bioremediation, stabilization/solidification, soil washing, soil/vapor extraction, and thermal desorption techniques in several projects. He has also been involved in incineration and scrubbing process for air pollution control. He has prepared RI/FS reports, USEPA Technical Memoranda, workplans, treatability evaluation reports, and predesign reports. He has also prepared drawings and specifications for treatment systems and participated in negotiations with the USEPA.

Chemical Process Design

Mr. Ghosh has been involved in multi-discipline projects to design and construct chemical process industries for industrial and automotive grease production, lubricating oil blending, and spent oil recycling facilities. He has prepared P and IDs, process and equipment specifications, bid documents, performed equipment inspection, supervised construction, and prepared O & M manuals. He has also performed energy audits for chemical, petrochemicals, and mineral processing units. He has performed detailed audits followed by proposal submission, process, and detailed design of alternative systems followed by turnkey construction and O&M.

CAREER HISTORY

Law Environmental, Inc., Kennesaw, Georgia: 1993 to present. Senior Environmental Engineer
Engineering-Science, Atlanta, Georgia: 1990 to 1993. Senior Engineer/Project Manager
Datastream Systems, Inc., Greenville, South Carolina: 1989 to 1990. Software Engineer
Balmer Lawrie & Co. Ltd., Calcutta, India: 1987 to 1988. Chemical Engineer

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LANGUAGE CAPABILITY

	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent
Bengali	Excellent	Excellent	Excellent
Hindi	Good	Fair	Good

LYNNE W. CLEM

Senior Scientist
Program Manager - Risk Assessment

Scientist

BA, 1985, Biology

Registered Hazardous Substance Professional

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

National Environmental Health Association
Society for Risk Analysis

CAREER SUMMARY

Ms. Clem is currently the manager of the Environmental Health Sciences Program. She is responsible for the preparation of human health and environmental exposure and risk assessments and for the development of health and safety plans. In addition, she also serves as project and task manager for risk assessment projects.

Ms. Clem joined Law Environmental in 1989 as an environmental scientist. She worked extensively on government and commercial projects involving exposure and risk assessments. She has written health and safety plans for site investigations and participated in field sampling teams collecting ground-water, surface water, and sediment samples for chemical analyses. Ms. Clem is versed in both RCRA and CERCLA formats used in preparing remedial investigation documentation.

In 1990 Ms. Clem assumed the position of project scientist and began managing projects including remedial investigations and risk/exposure assessments. In 1991, Ms. Clem became a department manager for the Risk Assessment Program and in 1992 she became the manager for that program and a senior scientist. She serves as one of Law's senior consultants for exposure and risk assessment services.

SUB-SPECIALTY EXPERIENCE

Defense Installation Restoration Program

Ms. Clem has served on the project team for numerous investigations at defense installations including Langley AFB, Ft. Jackson, Myrtle Beach AFB, Ft. Riley, Griffiss AFB, Craig AFB, Ft. Knox, Shaw AFB, Defense Depot - Memphis, Tennessee, Defense General Supply Center, and Coast Guard Air Station, Borinquen, Puerto Rico. Her responsibilities have included field sampling, project management, work plan preparation, health and safety plan preparation, and performance of exposure/risk assessment.

Health and Safety Plans

Ms. Clem has prepared or reviewed health and safety plans for numerous site investigation projects. Constituents of concern at these sites have included fuels, oils, solvents, metals, dioxins, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs).

Risk Assessments

Ms. Clem has written and/or managed numerous qualitative and quantitative exposure and risk assessments for both commercial and governmental cliental, including the U.S. Air Force, the U.S. Coast Guard, and the U.S. Army Corps of Engineers. Her assessments have included sites in Alabama, Florida, Georgia, New York, Puerto Rico, South Carolina, Tennessee, and Virginia and have been reviewed by both state regulatory agencies and the U.S. Environmental Protection Agency. These risk assessments have been conducted for a variety of purposes such as the determination of baseline risks at sites, the determination of clean-up levels, in support of clean closure demonstrations, and in support of recommendations for "no action" at sites.

CAREER HISTORY

Florida Department of Environmental Regulation, 1988-1989, Central Florida District, Orlando, Florida, RCRA Compliance Inspector

Seminole County, Public Health Department, 19985-88, Seminole County, Florida, Sanitarian

LANGUAGE CAPABILITY

	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent

JAMES LEE BEAVER, JR.

Project Geologist

Geologist

Master of Science: 1982
Bachelor of Science: 1980

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

National Ground Water Association

CAREER SUMMARY

Mr. Beaver is currently a geologist in the Government Services Division, Studies and Analysis Group in Kennesaw, Georgia. The Groups' primary responsibilities include hydrogeologic assessment, risk assessment/toxicology, environmental chemistry, and project management. Mr. Beaver has extensive experience in investigations conducted at Department of Defense installations, Superfund sites, and commercial/industrial facilities. His key areas of experience include task and site management, installation and abandonment of monitoring and production wells, aquifer testing, tank removal, collection of soil and ground water samples, and preparation of RCRA and CERCLA planning documents and reports.

Mr. Beaver joined Law Environmental in 1990 as a geologist with the Environmental Design/Construct Branch. He worked on a variety of sites used for the storage and transportation of petroleum products, and participated in the field investigation of two Superfund sites. Mr. Beaver had previously worked for several years as a petroleum geologist in the southwestern U.S.

In 1991, Mr. Beaver joined the Government Services Branch. His responsibilities initially included geological oversight and site management for investigations of U.S. Air Force and Army installations, and a Superfund site. Additional responsibilities now include preparation of RFI, and RI/FS planning documents and technical reports; cost estimating; contract negotiating, and training of entry and junior-level geologists.

SUB-SPECIALTY EXPERIENCE

Defense Installation Restoration Program

Mr. Beaver has participated in a variety investigations dealing with hazardous waste sites falling under the Installation Restoration Program (IRP). His experience includes installations on the Base Realignment and Closure (BRAC) list and National Priority List (NPL), along with installations involved in ongoing weapons system research, deployment, and maintenance. Mr. Beaver is familiar with security and safety protocol required for working on Federal facilities.

Ground Water Monitoring

Mr. Beaver has been involved in numerous studies of shallow to deep aquifer systems in a variety of hydrogeologic settings. Studies have included the installation of monitoring wells, piezometers, and recovery wells for ground water monitoring and aquifer testing (both in-situ and pumped); well development and sampling, monitoring the influence of water supply well pumping and stream levels on aquifer behavior; free product recovery, and water well surveys. Mr. Beaver is experienced in subsurface investigative methods including hollow-stem augering, solid-stem augering, hand-augering, mud rotary, air rotary, rock coring, sidewall coring, and borehole geophysics. His geographic areas of experience include the Atlantic and Gulf coastal plains, Piedmont, Appalachian Valley and Ridge, Appalachian Plateau, Mississippi embayment, basin and range, and interior lowlands (both glaciated and non-glaciated areas).

Mapping

Mr. Beaver has prepared a wide variety of maps and related exhibits from geological, geophysical, remotely-sensed, and engineering data. Mr. Beaver participated as senior geologist for the analysis and evaluation of ground-water data collected over a four quarter period from a basewide study conducted at an Air Force base. Examples of other maps prepared include depiction of stratigraphic facies, depositional environments, aquifer properties and distribution, soil/groundwater sampling results, surface topography, subsurface structure, petroleum production trends, faulting, unconformities, and land/water use. Mapping has been used in hazardous waste site investigation reports, exploration for petroleum and minerals, and academic studies. Mr. Beaver has also used computer mapping systems to analyze geologic and engineering data.

Cost Estimating

Mr. Beaver has generated numerous cost estimates for use in private and government assessment projects. His most significant cost estimating involved generating costs for complex, multimillion dollar investigations at U.S. Air Force bases and Superfund sites. Mr. Beaver has also provided independent cost estimates for a subsurface investigation at a major nuclear weapons complex (DOE) facility.

Petroleum Exploration

Mr. Beaver worked for several years as a geologist in the exploration and development departments of a major oil company. Project involvement included subsurface geologic and geophysical mapping for generating onshore exploratory and development prospects; reservoir description, reserve calculation, wellsite monitoring and evaluation, analysis and optimization of enhanced oil recovery units, economic analysis of proposed drilling projects, computer mapping, and evaluation of marginally economic properties prior to divestment. Mr. Beaver prepared and successfully defended two applications for new field discoveries to a state oil and gas regulatory board. Mr. Beaver also worked in geothermal energy and petroleum exploration with two major oil companies prior to graduation.

CAREER HISTORY

Law Environmental: 1990 to present, Project Geologist, Kennesaw, GA
Activities: Hydrogeologic assessment of hazardous waste sites on government, commercial, and industrial facilities

Mobil Exploration & Producing U.S.: 1985 to 1989, Senior Geologist, Midland, TX
Activities: Subsurface geologic analysis for generation of onshore drilling prospects

Superior Oil Company: 1982 to 1984, Exploration Geologist, Midland, TX
Activities: Subsurface geologic analysis for generation of onshore drilling prospects

LANGUAGE CAPABILITY

	Speaking	**Reading**	**Writing**
English	Excellent	Excellent	Excellent

Jeffrey M. Lorrain

Senior Chemist

Chemist

B.A., 1983, Chemistry
Math & Chemical Engineering (Post-Baccalaureate): 1985-1986

Certified Hazardous Material Manager, Master Level - 1992
Certified Quality Manager, American Society for Quality Control - 1991

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

Academy of Certified Hazardous Materials Managers
American Society for Quality Control

CAREER SUMMARY

Mr. Lorrain is currently a senior chemist in Law Environmental, Inc., Government Services Division (LAW). As a senior chemist, his duties include the preparation and/or review of cost proposals and work plans, as well as oversight and facilitation of field activities and subcontracted sample analysis. Additional responsibilities include the execution and/or supervision of analytical data quality review and interpretation as well as report preparation.

Before joining LAW, Mr. Lorrain was the quality assurance manager at ERM-South, Inc., from 1989 through 1994. His responsibilities included the development of a company-wide Quality Assurance Program as well as the oversight of data generation activities for high visibility or potentially litigious projects including CERCLA/RCRA-related investigations, and the development of a program of field screening analysis by gas chromatography, wet chemical, and physical methods.

From 1987 to 1989, Mr. Lorrain was the laboratory director of Delta Corporation, Architects, Engineers, and Planners, Inc. As director, Mr. Lorrain had overall responsibility for profitability, quality and expansion of the commercial analytical chemistry laboratory. In addition to his responsibilities as laboratory director, Mr. Lorrain provided environmental consulting services to industrial and governmental clients in the areas of surface water quality, wastewater treatment, and property transfers.

From 1979 through 1987, Mr. Lorrain provided support to EPA's Office of Research and Development through Northrop Services, Inc., and the Acurex Corporation. Mr. Lorrain worked as a research chemist on a number of research/development projects related to air pollution, sampling, modeling, and control.

SUB-SPECIALTY EXPERIENCE

Air Pollution/Air Quality

Mr. Lorrain has extensive experience in the development/evaluation/implementation of air pollution sampling, analysis, and control methods. He contributed to the development of several EPA reference methods for air quality sampling and analysis. Mr. Lorrain made significant contributions to the development of limestone injection technologies to control SOx in coal-fired utility boilers.

Environmental Testing and Analysis

Mr. Lorrain has extensive experience in environmental sampling, testing, and analysis. Mr. Lorrain has designed monitoring/assessment plans for all environmental matrices. He has significant experience and commercial implementation of analytical methods for most environmental media.

Environmental Site Assessments

Mr. Lorrain has performed or supervised numerous environmental site assessments ranging in size from small commercial sites to major industrial sites. Site assessment clients have included banks, merger/acquisition teams, attorneys, and commercial clients.

Forensics

Mr. Lorrain has assisted in the resolution of a number of disputes related to environmental impact issues involving civil and criminal litigation and alternative resolution techniques. His clients have included manufacturers, attorneys, and commercial enterprises.

RCRA/CERCLA Compliance/Closure

Mr. Lorrain has participated in numerous RCRA compliance/closure projects for manufacturers and service companies. He has contributed to several remedial investigation/feasibility studies for potentially responsible parties as well as governmental clients.

Training

Mr. Lorrain has significant experience in both formal and informal training in the fields of environmental sampling, analysis, and assessment as well as quality control and quality management.

CAREER HISTORY

Northrop Services, Inc., Research Triangle Park, North Carolina, 1979-1984
Acurex Corporation, Research Triangle Park, North Carolina, 1984-1987
Delta Corporation, Architects, Engineers, and Planners, Inc., Tampa, Florida, 1987-1989
ERM-South, Inc., Tampa, Florida, 1989-1994
Law Environmental, Inc., (Government Services Division), Kennesaw, Georgia, 1994 to present

LANGUAGE CAPABILITY

	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent

EDWIN EARL LEDFORD
Department Manager

Civil Engineer

B.S. Civil Engineering, 1963

Professional Engineer in Illinois, Kentucky and Georgia
Land Surveyor in Kentucky and Georgia

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

National Society of Professional Engineers
Georgia Society of Professional Engineers
Cobb County Society of Professional Engineers

CAREER SUMMARY

Mr. Ledford has worked in the consulting engineering business for over 30 years. His experience has included both technical and administrative responsibilities for a variety of civil engineering projects. He has a broad range of experience that has included the remedial design of both RCRA and CERCLA regulated HTRW type sites, landfill permitting and design, construction of major highways, streets, storm drainage facilities, sanitary sewers, and industrial rail service. These projects have included the preparation of plans and specifications as well as planning, design, permitting, and construction supervision. Other areas of experience include project management, scheduling, estimating, and earthwork evaluations and computations.

Mr. Ledford has worked on a major projects that included interim removal action designs, closure and post-closure care plans for sanitary landfills, identification and disposal requirements of contaminated soil, landfills, storm-water design, PRP investigation and erosion and sedimentation controls. Mr. Ledford also has experience on major projects that include highway design in Kentucky and Georgia, municipal public works for local and county governments, construction of a power tunnel for hydroelectric plant, and site engineering for industrial parks. Responsibilities on these projects have included surveying, route selection, conceptual design, site selection, grading, erosion control and drainage design.

Responsibilities have also included the implementation, use of, and training programs for computer work stations utilizing AutoCAD, Microstation, Softdesk, Haested Methods, and other computer aided drafting and design software packages. Specialization has been in application for plan preparation and earthwork computations.

SUB-SPECIALTY EXPERIENCE

Landfill Design

Mr. Ledford has been responsible for the design and preparation of drawings and specifications for a RCRA landfill in New Jersey, a hazardous waste site in West Virginia, closure/post-closure management of a sanitary landfill in Alabama and permit documents for demolition and sanitary landfills in Tennessee. A portion of the landfill design included an impermeable cap for 45 acres, infiltration, detention, and sedimentation ponds.

Construction Management

Mr. Ledford has experience as a construction manager on such projects as the 500-acre Westfork Industrial Park, the 200-acre Norfolk Southern, Duluth, Georgia, rail-served industrial park, 142-acre CSX Auto Distribution Center, and a 3.5 mile four-lane highway design in Gwinnett County, Georgia.

CAREER HISTORY

1963-1966	Kentucky Department of Highways /Assistant Resident Engineer, Resident Engineer /Lexington, KY, Berea, KY, Lawrenceburg, KY
1966-1967	Fenix & Scission /Field Engineer /London, KY
1967-1984	Watkins & Associates, Inc. /Project Engineer, Senior Engineer, Principal /Louisville, KY
1984-1991	Riley, Park, Hayden & Associates, Inc. /Senior Engineer, Associate
1991-Present	Law Environmental, Inc. /Senior Engineer /Atlanta, GA

LANGUAGE CAPABILITY

	Speaking	**Reading**	**Writing**
English	Excellent	Excellent	Excellent

WILLIAM CRAIG
Staff Scientist

Environmental Chemist

BS, State University of New York, College of Environmental Science and Forestry

CAREER SUMMARY

Mr. Craig is currently the site manager at a large explosive manufacturing plant in Kansas assessing soil and ground-water contamination of 52 sites. His responsibilities include supervision and guidance of fellow employees and subcontractors to delineate areas of contamination. Field tasks will include background searches, soil gas surveys, delineation of lead contaminated soil, monitoring well installations and sampling, and soil and surface water testing.

Mr. Craig joined Law Environmental in 1991 and has worked on many projects. His responsibilities as site manager, sampling team leader, project chemist, and health and safety officer have given him experience in many field techniques, as well as, the preparation of plans and reports for a variety of projects and clients.

SUB-SPECIALTY EXPERIENCE

Environmental Site Assessment

Mr. Craig has been involved in many stages of risk assessments at several sites on the East coast. He participated in the planning stages of site assessment projects and preparation of planning documents. He is involved in the mobilization of field crews and subcontractors to complete field work. He supervises all stages of field work including sampling point selection, sample collection and handling, and field date interpretation.

Ground-Water Monitoring

Mr. Craig has participated in several ground-water monitoring programs at military installations. He is proficient with most ground-water sampling techniques and protocols.

Municipal Landfills

Mr. Craig has been involved in the investigation of several landfills for the USACE at a site in New York. His responsibilities as project chemist, site manager, and health and safety officer include supervision of subcontractors, laboratory coordination, collection of field samples, and all aspects of site health and safety including air monitoring. Mr. Craig will also be responsible for validating the data and preparing the site investigation report.

Mr. Craig has also been involved in the investigation of landfills for the USACE and AFCEE in Tennessee and Kansas. Mr. Craig is currently investigating an Air Force base in Georgia.

Leaking Underground Fuel Storage Areas

Mr. Craig served as project chemist on a project for the USACE in Kentucky investigating 13 underground fuel storage tanks. Responsibilities included the collection of environmental samples, data validation, and the preparation of the quality control summary report.

LANGUAGE CAPABILITY

	Speaking	Reading	Writing
English	Excellent	Excellent	Excellent

MICHAEL H.S. HUGHES

Senior Environmental Planner

Land Use and Environmental Planning

B.S. in Urban Planning, 1986

Certified Planner (AICP), United States

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

American Planning Association-
Federal Planners Division
Georgia Planning Association
Urban Land Institute

CAREER SUMMARY

Mr. Hughes has nine years of land use and environmental planning, specializing in zoning, subdivision administration, and environmental impact analysis. Before joining Law Environmental, Inc., he was an Urban Planner (Parks and Urban Design) for the City of Atlanta - Department of Planning and Development. Prior to joining the City of Atlanta, Mr. Hughes was employed as a Senior Planner responsible for providing technical planning assistance to cities in Cobb County, Georgia. He has also worked as an Associate City Planner in Los Angeles and Pasadena, California, responsible for zoning and subdivision administration, growth management, and environmental impact analysis.

SUB-SPECIALTY EXPERIENCE

Land Use and Environmental Planning

Mr. Hughes has extensive experience in the development and implementation of land use plans as they relate to state planning requirements. He has prepared comprehensive plans, as required by the Georgia Planning Act, for cities in Cobb County, Georgia and the city of Atlanta, Georgia, resulting in their designation as Qualified Local Governments. He has also been responsible for reviewing and evaluating land use entitlement requests involving use permits, variances, and subdivisions. His activities typically involved conducting site assessments, environmental reviews, and the development and presentation of staff recommendations.

Other related project experience include:

- Employment forecasts and building conditions/land use assessments related to redevelopment feasibility studies;
- Stormwater Management Program - National Pollutant Discharge Elimination System (NPDES) Program Part 2;

- Greenway Trails Plan -- Open Space and Greenways Plan;
- Housing and Land Use Element Update for General Plan; and
- Flood Recovery Plan (Tropical Storm Alberto 1994)

State EAs and EISs

Mr. Hughes has extensive experience related to the application of state environmental legislation. He has been responsible for revising the environmental review guidelines and procedures for evaluating all development proposals in Pasadena, California to ensure compliance with the California Environmental Quality Act (CEQA). Mr. Hughes was also conducted environmental evaluations pursuant to the requirements of the Georgia Environmental Policy Act (GEPA) for such state agencies as Georgia Public Telecommunications Commission and the Georgia Department of Education, and the Georgia Department of Corrections.

Federal EAs and EISs (National Environmental Policy - NEPA)

Mr. Hughes has conducted numerous Environmental Assessments and Environmental Impact Statements following NEPA guidance. Some of these projects included removal and replacement of a Viaduct in a major urban area; treatment and disposal of contaminated soils and groundwater at a military installation; and an alternative analysis for siting a surface water impoundment.

Project Management

Mr. Hughes has extensive experience in managing complex multi-discipline projects. These projects include, managing environmental impact studies involving the coordination of several technical disciplines and serving as a data layer Task Manager for a statewide evaluation screening study using a Geographic Information System (GIS).

CAREER HISTORY

Law Engineering and Environmental Services Inc.:	February 1993 - Present; Atlanta, GA.; Senior Environmental Planner
City of Atlanta:	1 year; Atlanta, Ga.; Urban Planner II
Cobb County, Georgia:	1.5 years; Cobb County, Ga.; Senior Planner
City of Pasadena:	6 months; Pasadena, Ca.; Associate Planner

City of Los Angeles: 3.5 years; Los Angeles, Ca.; City Planning Assistant
City Planning Associate

Willdan Associates: 1 year; Industry, Ca.; Planning Technician

SUE ANN MCCUSKEY, PH.D.

Principal Environmental Scientist

Ph.D. Environmental Science 1978
M.S. Environmental Scientist 1975
M.A.T. Teaching of English 1970
B.A. English Literature 1968

Ecological Society of America,
Certified, Habitat Evaluation Procedures
OSHA 29 CFR 1910.120 Hazardous Materials Handling 40 Hour Course

PROFESSIONAL MEMBERSHIPS & ASSOCIATIONS

Ecological Society of America,
Association of State Wetland Managers,
National Association of Environmental Professionals

CAREER SUMMARY

Dr. McCuskey is currently a Principal in the Natural Resources Program of Law Engineering and Environmental Services, Inc. The objective of this program is to provide assessment services in protected species surveys, wetland delineation, wildlife management, cultural resource evaluations and site restoration for permit requirements generally related to greenfield sites or facility expansions. Alternative site assessments, needs analysis, evaluation of baseline ecological conditions, description of impacts and mitigation of environmental impacts are services provided. Dr. McCuskey has 16 years of experience in environmental consulting, specializing in permitting issues associated with wetland impacts, solid waste landfills, corridor analysis and environmental impact statements.

Dr. McCuskey joined Law Environmental in 1990 as a Senior Environmental Scientist. In 1991 she became a Principal and Program Consultant in Natural Resources. She works with commercial and industrial developers, solid waste companies, power generation companies, attorneys and governments. Dr. McCuskey has made presentations at conferences throughout the U.S. describing National Environmental Policy Act (NEPA) agreements and wetland regulations, permitting, and mitigation. She regularly conducts training programs on NEPA and wetland regulations for Law Environmental employees.

Prior to joining Law Environmental, Dr. McCuskey was a Senior Terrestrial Ecologist at other consulting firms from 1978 to 1990. She studied baboon behavior in Kenya and surveyed avian populations on the Virginia barrier islands prior to entering the field of environmental consulting.

Environmental Assessments/Impact Statements

Environmental Impact Statement: Water Supply Reservoir. Lamar County, Alabama. Documented need for additional water sources, identified alternatives, evaluated alternatives and offered wetland mitigation to off-set unavoidable impacts. 1993-ongoing.

Environmental Assessment: Kentucky Highway 17. Hazard, Kentucky. Kentucky Department of Transportation. Evaluated impacts to protected species, caves, wetlands, cultural resources, socioeconomic issues and other resources from widening of an existing highway in mountainous terrain. 1993-1994.

Environmental Assessment: Old Madison Pike. Alabama. Alabama Department of Transportation. Prepared all sections of an EA to evaluate this road extension. 1993-1994.

Environmental Assessment: Four Mile Post Road, Alabama. Alabama Department of Transportation. Prepared all sections of an EA to assess impacts from construction for a new road over steep terrain near Huntsville. 1993-1994.

Environmental Assessment: Wood Chipping Facility. Bridgeport, AL, Donghae Pulp of Alabama, Inc. 1990 (coordinated wetland assessment, vegetation and wildlife impact assessment portions).

Saltwater Wetlands for Wastewater Management Environmental Assessment (EPA 904/10-84). Southeastern U.S., Region IV U.S. Environmental Protection Agency, 1984.

Environmental Impact Statement: Martin County Coal-Fired Power Plant. Martin County, FL, Florida Power & Light Company. 1978-1981 (coordinated biological assessments, water quality studies, and endangered species surveys).

Environmental Assessment: Oil and Brine Pipeline Revegetation. Hackberry, LA, Department of Energy, Strategic Petroleum Reserve, 1985.

Environmental Assessment of Visitor Impacts: Assateague Island. Assateague Island, MD, National Park Service, 1984.

Site Selection Studies

Site Characterization: Low-Level Radioactive Waste Disposal Facility. North Carolina. Chem-Nuclear. Following preliminary site identification, conducted extensive literature review and field sampling on two proposed 1200-acre sites. Conducted studies under full DOE quality assurance/quality control procedures, met with regulatory agencies and the public. 1990-1994.

Site Characterization: Low-Level Radioactive Waste Disposal Facility. Pennsylvania. Chem-Nuclear. Evaluated maps throughout the state to identify environmentally sensitive areas to avoid in the site selection process. Developed wetland identification criteria, met with state agencies and the public. 1991-ongoing.

Analysis of Alternative Sites for Solid Waste Facility. Chatham County, South Carolina. Waste Management. Using Geographic Information System technology, identified 17 sites for evaluation.

Selected one site, based on environmental and practicability criteria, and conducted field assessments to obtain permits for this solid waste landfill. Key issues were wetlands and protected species. 1991-1993.

Analysis of Alternative Sites for a Coal-Fired Power Plant. Halifax and Mecklenburg Counties, VA, MC^2 (an independent power company), 1987-88.

Alternative Site Evaluation Methodology for Underground Storage of High-Level Radioactive Waste. Eastern and Southeastern U.S., U.S. Department of Energy, Office of Crystalline Repository Development, 1985-87 (project terminated by D.O.E.; no final report).

Nassau County, Florida: Proposed Site for the Superconducting Super Collider. Nassau County, FL, State of Florida's submittal to U.S. Department of Energy, 1987-88 (prepared sections on wetlands, endangered species, characterization of vegetation and wildlife).

Selected Wetland and Mitigation Studies

Wetland Permit Application, Alternative Analysis and Mitigation Plan for Inner-Perimeter Road. Lowndes County, GA, Kilpatrick and Cody, 1990-92.

Wetland Permit Application, Alternative Analysis and Mitigation Plan for Sawmill Place Mall. Columbus, OH, JMB Urban Development, Co., 1990-92.

Action Plan for Settlement of an Administrative Order at the Rossville Farm. Rossville, TN, United Foods, Inc., 1990-93.
Wetland Delineation of Proposed Waste Disposal Site. Central Pennsylvania, Confidential Client, 1988.

Mapping of Submerged Aquatic Bed Wetland Vegetation on the Upper Hudson River. Ft. Edward to Troy, NY, Confidential Client, 1990-91.

Section 404 Permit Application, Alternative Analysis and Mitigation Plan for Proposed North Atlanta Mall, Atlanta, GA, Cousins Properties, Inc., 1990.

Wetland Delineation and Mitigation Plan for Proposed Recreation Ballfields. Coweta County, GA, Coweta County Board of Commissioners, 1990.

Third-Party Review of Proposed Ware Creek Water Supply Reservoir Impacts and Mitigation. James City County, VA, McSweeney, Burtch & Crump, 1988-89.

Wetland Delineation of Twelve County Parks. DeKalb County, GA, DeKalb County Parks and Recreation, 1988-89.

Wetland Delineation and Restoration Plan. Upson County, GA, Southern Mills, 1988.

Reservoir Studies

Proposed Water Supply Reservoir: Hall County, Georgia. Glades Woodland Farm. Evaluated 1500-acre site for potential impacts to wetlands, protected species and cultural resources from proposed 800-acre reservoir. Met with agencies and county representatives to discuss permitting. 1993 - ongoing.

Assessment of Impacts and Mitigation for Proposed Expansion of a Water Supply Reservoir. Monroe County, GA, City of Monroe, 1989.

Assessment of Impacts from Proposed Multi-Reservoir Development. Martin and West Palm Beach Counties, FL, MacArthur Foundation, 1987-88.

Site Selection Study for a Regional Water Supply Reservoir: Upper Oconee River Basin. Jackson County, GA, Northeast Georgia Reservoir Group, 1988.

Site Selection Study for a Northwest Georgia Regional Water Supply Reservoir. Harralson, Paulding, Carroll and Douglas Counties, GA, Georgia Department of Natural Resources, 1988-89.

Federal Energy Regulatory Commission (FERC) Reports

Hydro-Power Re-Licensing Reports for Two Facilities. McCormick and Edgefield Counties, SC, South Carolina Electric & Gas Company, 1988 (prepared sections on terrestrial ecology, wetlands, and protected species).

Environmental Report: Gas Pipeline System Expansion. Nashville, TN, East Tennessee Natural Gas, 1987.

Ocean State Power Project: Draft and Final Environmental Impact Statement. Burrillville, Rhode Island, Ocean State Power and Tennessee Gas Pipeline Company, 1987-1988.

Environmental Report: Settlement Expansion Project. Pennsylvania, West Virginia and Virginia natural gas pipeline route, Columbia Gas Transmission Corporation, 1988-89.

Pumped Storage Hydroelectric Project: Preliminary Consultation Package. North Georgia, Oglethorpe Power Company, 1985.

Pumped Storage Hydroelectric Project: Pre-feasibility Reports (for three sites) and Initial Consultation Package: Pickens County Site. Walker, Dade and Pickens Counties, GA, Oglethorpe Power Company, 1987 (Project Manager for terrestrial and aquatic ecology, cultural resources and socio-economic studies).

Protected Species

Protected Species Survey and Eagle Habitat Management Plan. Jacksonville, FL, Julington Creek/General Development Co., 1986-87.

Endangered Species Monitoring Program: Bald Eagles and Wood Storks. FP&L central Florida power plants, Florida Power & Light Company, 1981-1986.

PUBLICATIONS

McCuskey, S.A., A.W. Conger, and H.O. Hillestad. 1994. Design and implementation of functional wetland mitigation: case studies in Ohio and South Carolina, in Proceedings of the Southern Appalachian Man and the Biosphere Conference on Wetlands. Journal of Water, Air, and Soil Pollution (in press).

McCuskey, S.A., J.W. Little, and T.E. Simpson. 1989. Impacts of SO2 on Spartina alterniflora. Proceedings of the Sixth Symposium on Coastal and Ocean Management, American Society of Civil Engineers, Vol. II: 1178-1199.

Williams-Walls, N., S.A. McCuskey, W. Marion, and J. R. Wilcox. 1986. Productivity and changes in nest utilization in four central Florida bald eagle nesting territories. Florida Field Naturalist. Vol. 14, No. 2: 19-52.

McCuskey, S.A. 1978. Avian community organization - Habitat-niche selection in ecotones. Ph.D. dissertation. University of Virginia.

Altmann, J., S.A. Altmann, G. Hausfater, and S.A. McCuskey. 1977. Life cycle of yellow baboons: infant mortality, physical development, reproductive parameters. Primates 18 (2): 315-330.

Dueser, R.D., W.C. Brown, S.A. McCuskey, and G. S. Hogue. 1976. Vertebrate zoogeography of the Virginia barrier islands. A final report submitted to the Nature Conservancy, as a contribution to the Virginia Coast Reserve Study.

McCuskey, S.A., and R. D. Dueser. 1976. Distribution and abundance of land bird species on the Virginia barrier islands. Paper presented at the Southeastern Regional Meetings of the Animal Behavior Society, Charlottesville, Virginia.

McCuskey, S.A. 1975. Demography and behavior of one-male groups of yellow baboons (Papio cynocephalus). M.S. thesis. University of Virginia.

CAREER HISTORY

Law Environmental 1990 to present.
Kennesaw, Georgia
Principal Environmental Scientist, Program Consultant, Natural Resources Program Manager

Dames & Moore 1985 to 1990
Atlanta, Georgia
Southeast Wetlands Coordinator

Applied Biology, Inc. 1978 to 1985
Atlanta, Georgia
Director of Terrestrial Ecology

APPENDIX A-2

STANDARD OPERATING PROCEDURES
FOR FIELD SCREENING ANALYSES

B.1 Field Screening of Soils for Volatile Organic Compounds by Photoionization Detector (PID)

B.1.1 Scope and Application

A PID will be used in the field to screen samples for the presence of volatile organic compounds. The PID is useful as a general survey instrument at hazardous waste sites. A PID is capable of detecting and measuring real-time concentrations of many organic and inorganic vapors in the air, but is unable to respond to low molecular weight hydrocarbons (ex. methane and ethane).

B.1.2 Start-up Procedure

- Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug interface. Do not use excessive force.

- Turn the function switch to the "battery check" position. The needle on the meter should be within or above the green battery arc on the scale; if not, recharge the battery. If the red indicator light comes on, the battery needs recharging. When recharging the battery the probe must be attached.

- Turn the function switch to any range setting. Look into the end of the probe to see if the lamp is on. If it is on, it will omit a purple glow. Do not stare into the probe any longer than 3 sec. Long-term exposure to UV light will damage the eyes. Also, listen for the hum of the fan motor.

- To zero the instrument, turn the function switch to the "standby" position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed because this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted (if necessary). Wait 15 to 20 sec. to ensure that the zero reading is stable. If necessary, re-adjust the zero.

B.1.3 Calibration Procedure

- Follow the start-up procedure and the operational check.

- Set the function switch to the range setting for the concentration of the calibration gas.

- Remove the detector from the outer casing by loosening the screw on the bottom of the casing.

- Attach a regulator to a disposable cylinder of calibration gas. Connect the regulator to the probe of the PID with a piece of clean tygon tubing. Open the valve on the regulator.

- After 15 sec., adjust the internal calibration screw until the meter reading equals the concentration of the calibration gas used. Consult the operating manual for the location of this screw.

- If the PID does not start up, check out, or calibrate properly, notify the equipment manager immediately. Under no circumstances should work requiring monitoring with a PID be performed without a properly functioning instrument.

- Replace the detector in the outer casing.

- Obtain a logbook from the QA officer.

- Record results of the equipment check in the logbook.

- Obtain a sufficient number of the appropriate data collection forms.

- Record the calibration data.

B.1.4 Field

Upon arriving in the field, personnel should:

- Follow the start-up procedure, operational check, and calibration check.

- Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0 to 20 ppm range; adjust the range if necessary.

- With the exception of the probe's inlet and exhaust, wrap the PID in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside the instrument in the event of precipitation.

B.1.5 Measuring Organic Vapor Levels Using the PID

The following procedures are followed to obtain organic vapor readings of headspace with the PID:

- Place soil in a clean 8 ounce jar, so that jar is about 50% full.

- Seal jar with aluminum foil with the screw cap applied to secure foil.

- Agitate sample jar for 30 seconds.

- Allow a 15 minute equilibration period for headspace development.

- Following the equilibration period, the headspace shall be measured by inserting the probe through the aluminum foil and recording the maximum meter response (should be within first 2-5 seconds).

- Record headspace screening result from each sample.

B.1.6 Equipment and Supplies Checklist

_______ Photo Ionization detector (PID)
_______ Operating manual
_______ Probes: 9.5eV _____, 10.2eV _____, and 11.7eV _____
_______ Battery charger for PID
_______ Spare batteries
_______ Jeweler's screwdriver for adjustments
_______ Tygon tubing
_______ NBS traceable calibration gas (type)
_______ "T" valve for calibration
_______ Intake assembly extension
_______ Strap for carrying PID
_______ Teflon tubing for down-hole measurements
_______ Plastic bags for protecting the PID from moisture and dirt
_______ Logbook

APPENDIX A-3

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QUALITY CONTROL ACCEPTANCE CRITERIA

TABLE A-3-1

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8240	Volatile Organic Compounds	FIELD QC:			
		Trip Blank	1 for each batch of samples shipped to laboratory	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported PQL	Qualify data.
		LABORATORY QC:			
		Sensitivity Check with BFB	Every 12 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
		Mass Calibration	Every 12 hours of operation	See Method SW846	Tune instrument; repeat.
		Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; SPCCs exceed 0.300; CCCs response factor deviates < 30% from average	Recalibrate instrument.
		Continuing Calibration	Every 12 hours of operation	SPCCs exceed 0.300; CCCs response factor deviates < 25% from average of initial calibration	Rerun continuing calibration. If still out of control, recalibrate instrument.
		Method Blank	1 for every 20 samples or every day	Less than PQL	Reanalyze blank. If contamination still exists, qualify all associated data.
		Surrogate Recovery	Every sample	See Appendix M for current control limits	Reanalyze sample; flag data.
		MS/MSD	1 for every 20 samples	See Appendix M for current control limits	Analyze LCS
		LCS	If MS/MSD fails	See Appendix M for current control limits	Reanalyze LCS

TABLE ~~7-2~~ A-3-1

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 7060 **7421** **7471** **7740** **7841**	Total Arsenic Total Lead Total Mercury Total Selenium Total Thallium	<u>FIELD QC</u>:			
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC</u>:			
		ICV/CCV	ICV - prior to analysis CCV - after every 10 samples and end of analytical batch	4 pt. calibration; Measured value within 10% of true value (20% for Hg).	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
		ICB/CCB	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value < PQL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
		Prep Blank	1 per batch of samples, minimum of 1 per 20 samples	Absolute value < PQL	Redigest and reanalyze all samples less than 10X the PQL.
		Matrix Spike	1 per batch of samples, minimum of 1 per 20 samples	85-115% recovery (unless sample conc. is greater than 4x spike concentration).	Perform post digest spike and qualify all associated data.
		Duplicate	1 per batch of samples, minimum of 1 per 20 samples	20% RPD for samples greater than 5x PQL; if < 5x PQL, absolute difference between samples must be < PQL; no criteria if < PQL; (for Hg, RPD = 25% for aqueous samples and 35% for solid samples).	Qualify all associated data.
		LCS	1 per batch of samples, minimum of 1 per 20 samples.	80-120% recovery: waters Manufacturer's Limits: soil/sed.	Rerun. If still out of control, solve problem and reanalyze batch. (Not applicable to mercury according to EPA Region II guidelines)
		Post Digest Spike	For each analyte where matrix interference is suspected	See Appendix M for control limits	Reanalyze. Qualify the data.
		Serial Dilution	1 per batch of samples, minimum 1 per 20 samples (for ICP only)	Diluted values must be < 10% of the original value	Reanalyze. Qualify all associated data.
		MSA	For each analyte where matrix interference is suspected	Coefficient of correlation must be < 0.995	Qualify all associated data.

TABLE ~~7-2~~ A-3-1

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 6010 Inductively Coupled Argon Plasma (ICAP)	Total Metals	<u>FIELD QC</u>:			
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Qualify data.
		<u>LABORATORY QC</u>:			
		Initial (ICV) and Continuing (CCV) Calibration Verification	ICV - prior to sample analysis CCV - after every 10 samples and end of analytical batch	4 pt. calibration; Measured value within 10% of true value.	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
		Initial (ICB) and Continuing (CCB) Calibration Blank	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value ≤ PQL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
		Prep Blank	1 per batch of samples, minimum 1 per 20 samples	Absolute value ≤ PQL	Redigest and reanalyze all samples greater than the PQL but less than 10x the blank concentration.
		Matrix Spike	1 per batch of samples, minimum 1 per 20 samples	75-125% recover (unless sample is greater than 4x spike concentration)	Perform a post-digestion spike and qualify data appropriately.
		Duplicate	1 per batch of samples, minimum 1 per 20 samples	20% RPD for samples greater than 5x PQL; if 5x PQL absolute difference between samples must be < PQL; no criteria if < PQL	Qualify associated data.
		Laboratory Control Sample (LCS)	1 per batch of samples, minimum 1 per 20 samples	80 - 120% recovery: waters Manufacturer's Limits: sol/sed.	Rerun. If still out of control, solve problem and reanalyze batch.
		Interference Check	Beginning and end of run or per 8 hour shift	80-120% recovery	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good ICS.

TABLE ~~7-2~~ A-3-1

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA
Hunter Army Airfield FTA
Savannah, Georgia

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 · 8270 GC/MS	Base/Neutral/ Acid Extractable Organics	FIELD QC:			
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD $< 20\%$ Non-aqueous samples - RPD $< 35\%$	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reporting limit	Qualify data.
		LABORATORY QC:			
		Sensitivity Check with DFTPP	Every 12 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
		Mass Calibration	Every 12 hours of operation	See Method SW846	Tune instrument; repeat.
		Initial Calibration	Before analysis and when continuing calibration fails criteria	5 pt. calibration; SPCCs exceed 0.050; CCCs response factor deviates $< 30\%$ from average	Recalibrate instrument.
		Continuing Calibration	Every 12 hours of operation	SPCCs exceed 0.050; CCCs response factor deviates $< 30\%$ from average of initial calibration	Rerun continuing calibration; if still out of control, recalibrate instrument.
		Method Blank	1 for every 20 samples	Less than PQL. Phthalate esters less than 5x the reporting limit.	Reanalyze blank, then reextract, qualify all associated data.
		Surrogate Recovery	Every sample	See Appendix M for current control limits. Allowed one surrogate outside QC limits per fraction if greater than 10%.	If out of control, reextract, reanalyze, qualify data.
		MS/MSD	1 for every 20 samples	See Appendix M for current control limits	If out of control, qualify data.
		LCS	1 for every 20 samples	See Appendix M for current control limits	Reextract batch if MS/MSD also out of control.

(a) Reference: Methods for the Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised, March 1983 or Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.

(b) Reference: Test Methods for Evaluating Solid Waste, USEPA SW846, 3rd Edition, November 1986.

(c) Rinsates will not be collected if dedicated sampling equipment is used. Rinsates are not applicable for non-aqueous matrices.

Additional QC may be implemented per manufacturer's instructions.

PREPARED/DATE: __________
CHECKED/DATE: __________

APPENDIX B

GEOLOGIC DATA ACQUISITION PLAN

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LIST OF ACRONYMS

ASTM	American Society for Testing and Materials
CDAP	Chemical Data Acquisition Plan
CESAS	U. S. Army Corps of Engineers, Savannah District
CSR	Compliance Status Report
ESE	Environmental Science & Engineering, Inc.
FTA	Fire Training Area
GADNR	Georgia Department of Natural Resources
GDAP	Geological Data Acquisition Plan
HAAF	Hunter Army Airfield
HSP	Health and Safety Plan
HSRA	Georgia Hazardous Site Response Act
HTW	Hazardous and Toxic Waste
ID	Internal Diameter
IDW	Investigation Derived Waste
MWIP	Monitoring Well Installation Plan
NTU	Nephelometric Turbidity Unit
NWWA	National Water Well Association
OD	Outside Diameter
PID	Photoionization Detector
PVC	Polyvinyl Chloride
TOC	Top of Casing
USEPA	U. S. Environmental Protection Agency

1.0 INTRODUCTION

This document presents the Geologic Data Acquisition Plant (GDAP) for Interim Corrective Action Source Removal Design, and Site Characterization for the Hunter Army Airfield (HAAF) Fire Training Area (FTA) at Savannah, Georgia. This document is included as Appendix B of the Revised Final Work Plan for the predesign investigation at HAAF, Savannah, Georgia. The GDAP contains protocols, procedures, and/or descriptions for geotechnical sampling, location surveys and monitoring well installation. Additional information about the facility including the purpose of the investigation, site description, project management, project objectives, field activities, and regulatory requirements can be found in the revised final Work Plan. Throughout this GDAP, references are made to the Revised Final Work Plan as the Work Plan.

2.0 GEOTECHNICAL SAMPLING

Soil samples for geotechnical tests will be collected from each monitoring well boring using a split spoon sampler. One representative soil sample from the saturated zone of each well boring will be submitted to the geotechnical lab. Each soil sample will be tested for grain size distribution (ASTM D422), Atterberg Limits (ASTM D4318) moisture content (ASTM 2216).

3.0 LOCATION SURVEYS

Upon completion of the monitoring wells and soil sampling, a survey crew will locate, by standard surveying methods, each well (new and previously existing) and soil sampling location. A vertical survey will be conducted on the monitoring well locations only. The vertical control will be to the National Geodetic Vertical Datum 1929 (equivalent to the mean sea level). A ground surface elevation to within 0.1 foot and top of casing elevation to within 0.01 foot will be determined for each well. The horizontal grid coordination will be determined for each well and soil sampling location to within 1 foot and will be referenced to the State Plane Coordinate System.

The X, Y, and Z coordinates for each well, and the X and Y coordinates for each soil sampling point will be tabulated with the corresponding location identification and submitted in U. S. Army Corps of Engineers, Savannah District (CESAS) CADD deliverable standards along with a copy of the survey field notes. The original survey notes shall be furnished upon completion of the contract if requested.

4.0 MONITORING WELL INSTALLATION PLAN

This section provides the monitoring well installation protocol which will be performed for this investigation including the regulatory guidances referenced, well locations and depths, subsurface soil sampling, drilling equipment and materials, drilling procedures, well installation procedures, well development, well sampling, submittals, well abandonment, and project assignments and personnel qualifications.

4.1 INTRODUCTION AND BACKGROUND

The site characterization to be performed will be conducted in accordance with requirements of the state of Georgia Hazardous Site Response Act (HSRA). This Monitoring Well Installation Plan (MWIP) was prepared using the following documents:

- Modification No. 1 dated April 25, 1995, to the Scope of Work for the Removal Design, Interim Corrective Action, and Site Characterization for HAAF, including the Technical Requirements included with the Modification as Appendix B

- ACE "Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites" (USACE, 1994)

- USEPA "RCRA Ground Water Monitoring Technical Enforcement Guidance Document" (USEPA, 1986)

- Georgia Department of Natural Resources "Manual for Groundwater Monitoring" (GADNR, 1991)

4.2 WELL LOCATIONS AND DEPTHS

The well locations will be determined after reviewing the results of the soil gas survey. This is discussed in more detail in Section 4.5 of the Work Plan.

The wells will be installed in the upper portion of the surficial aquifer. The well borings will be advanced to approximately 10 feet below the depth ground water is encountered in order to place the screen at a depth to intercept the ground-water table. The top of the screen will be installed above the water table to account for seasonal fluctuations, and to allow for detection of free-phase hydrocarbons.

4.3 OTHER SAMPLING LOCATIONS

In addition to the new wells being installed, five hand auger borings will be advanced in the study area shown on Figure 4-1 in the Work Plan, and soil samples will be collected from around and beneath the pad. The sampling locations and rationale for these soil samples are provided in Section 4.3 of the Work Plan. The sampling protocol is provided in the Chemical Data Acquisition Plan (CDAP) which is included as Appendix A.

4.4 DRILLING EQUIPMENT AND MATERIALS

The following sections describe the specifications for the drilling rig used for drilling and installation of monitoring wells.

4.4.1 Drilling Rig

Well borings will be advanced using a 4.25-inch I.D. hollow-stem augers. Drilling of wells will be performed in accordance with the specifications outlined in Section 4.5 of this GDAP.

At a minimum, the rig will be equipped with a cathead-operated, 140-pound hammer with a 30-inch draw. The 30-inch draw distance will be marked on the hammer rod. The use of grease or petroleum oil on drill rod joints will not be permitted; however, Teflon tape will be used if necessary.

The drill rig will have the capability to collect split spoon samples in accordance with ASTM D 1586-84 procedures. Soil samples will be collected with a stainless steel split spoon.

4.5 DRILLING PROCEDURES

Drilling will be performed in a manner as to prevent aquifer contamination by the drilling equipment, to prevent inter-aquifer contamination, and to prevent vertical seepage of surface water into the borehole. The following subsections describe the drilling procedures which will be used.

4.5.1 Initial Activities

Prior to the commencement of well installations, the well locations will be inspected to identify access routes, and overhead, surface, and potential subsurface obstructions. Any preliminary activities required to safely access or conduct work at the site, and obvious signs and/or sources of contamination will also be identified and documented; and utility clearances will be verified. Utility clearance protocol is provided in Section 4.1.2 of the Work Plan. Drilling will not proceed where aboveground or overhead utilities are within 30 feet of the drill rig or where subsurface obstructions exist. Should utility locations require offsetting boring locations, the new locations chosen will be as close as possible to the originally proposed locations. Under no condition will drilling proceed without the requisite utility clearance.

If field activities occur in (or near to) roadways at HAAF, a flag-person will be required to direct traffic flow around the area of work.

4.5.2 Drilling Protocol

The following procedures will be followed for completing each well:

- Advance well boring using 4.25-inch inner diameter hollow-stem augers to the target depth.
- Monitor the breathing zone as directed by the site manager for organic vapors using a photoionization detector in accordance with the procedures contained in the Health and Safety Plan (HSP). The tops of the boreholes will be monitored as directed by the site manager for percent oxygen and combustible gases using an explosimeter and oxygen meter.
- Perform continuous split spoon sampling in all borings for soil classification and/or chemical analysis. Stainless steel split spoons will be used to obtain samples.
- Determine and record the stabilized depth to ground water following drilling.
- Manage all drill cuttings and drilling fluids as described in Section 4.6 of the Work Plan.

The use of any liquid, including water, will be avoided during drilling. If it is necessary to use water during the drilling program, clean, non-chlorinated water will be used, where possible. Clean, potable water will be used if a non-chlorinated source is not readily available. The site geologist will record the amount of water used. (Five times the amount used will be removed during well development.) Sources of water used for drilling, well installation, or decontamination will be sampled once, at the beginning of the field investigation. Additionally, one sample of the water will be collected from each water transport vehicle after the first delivery to the site, just prior to its use. These samples will be analyzed for the same parameters specified for the ground-water samples. Information regarding the source of water used and any impact on analytical results will be included in the draft and final compliance status report (CSR).

4.5.3 Soil Classification

The soil boring will be observed by a qualified geologist or geotechnical engineer. Soils will be classified using the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM D 2488-90).

4.5.3.1 Drilling Logs - The geologist/engineer will log the subsurface conditions encountered in the boring, and record the information on a Hazardous and Toxic Waste (HTW) Drilling Log (Figure B-1). Additional pertinent information concerning the boring typically recorded on the log will include, but not be limited to, the following:

- Drilling date
- Geologist name
- Location of boring
- Driller's name
- Weather conditions
- Start and completion time for each boring
- Standard penetration test blow counts per 6 inch advance
- PID, Draeger tube, and explosimeter readings above background (including depth of each reading)
- Recovery length of each sample
- Visual description of Unified Soil Classification (ASTM-D-2488-90)
- Depth at which soil sample was collected for chemical analysis
- Depth at which soil sample was collected for physical analysis
- Total number of samples taken

FIGURE B-1

HTW DRILLING LOG

		HOLE No.
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET OF SHEETS

3. PROJECT	4. LOCATION (CITY, STATE)
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	9. HOLE LOCATION (SITE) 10. SURFACE ELEVATION
8. WEATHER	11. DATE STARTED 12. DATE COMPLETED
13. OVERBURDEN THICKNESS	16. DEPTH GROUNDWATER ENCOUNTERED
14. DEPTH DRILLED INTO ROCK	17. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
15. TOTAL DEPTH OF HOLE	18. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

19. GEOTECHNICAL SAMPLES (#)	DISTURBED	UNDISTURBED	20. TOTAL NUMBER OF CORE BOXES

21. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	22. TOTAL CORE RECOVERY%

23. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	24. SIGNATURE OF INSPECTOR

25. CHECKED BY:	26. NAME OF INSPECTOR

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	1.0						
	2.0						
	3.0						
	4.0						

MRK FORM JUN 89 **55**

PROJECT NAME & NO.

HOLE No.

FIGURE B-1 (CONTINUED)

HTW DRILLING LOG		HOLE No.
PROJECT	INSPECTOR	SHEET OF SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (ppm) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h

MRK FORM JUN 89 **55-2**	PROJECT NAME & NO.	HOLE No.

- Total depth of boring
- Boring refusal
- Water losses (if applicable)
- Method of boring, and drilling equipment
- Depth, thickness, identification and description of stratum
- Water bearing strata (depth and thickness)
- Static water level before and after well development
- Elevation
- Log scale: 1 inch = 1 foot

Soil sampling will be performed continuously to boring total depth.

4.5.4 Decontamination

The following decontamination procedures will apply to split spoons, hand augers, stainless steel bowls and spoons, and ground-water bailers. The decontamination steps are as follows:

1. Hand wash with a bristle brush and a solution of laboratory grade detergent or Alconox.
2. Rinse thoroughly with tap water.
3. Spray-rinse with spectroscopic grade methanol.
4. Rinse thoroughly with tap water.
5. (Teflon bailers only) Spray-rinse with 10 percent nitric acid, then rinse thoroughly with water.

6. Final rinse with deionized water.

7. Air dry.

8. Wrap in aluminum foil.

The sampling equipment will be cleaned prior to each use in accordance with this procedure. Field personnel will use clean disposable gloves to handle decontaminated sampling equipment. Downhole drilling tools (i.e., augers and drill rods) will be steam cleaned prior to each soil boring. The drill rig will be steam cleaned prior to initial drilling. The location of the decontamination area will be determined during field mobilization. The fluids generated during decontamination will be containerized and labeled accordingly.

4.5.5 Site Restoration

Within 15 days of the completion of the field investigation, the site will be restored to a level that as closely as possible approximates its condition prior to field activities. In areas that require seeding of new grass, the 15 days is not intended to include the time required for grass to revegetate the restored area. Seed mix types and recommended seasons for planting will be obtained from the facility Civil Engineer. The restoration activities shall meet the approval of the Directorate of Engineering and Housing Office at HAAF. Photographs will be taken of the area of work both before and after field work activities to document this restoration. Copies of these photographs will be provided to the facility Environmental Coordinator within one week after they are taken.

4.6 WELL INSTALLATION

Wells to be installed during the predesign investigation will be of Type II (single-cased) design. Monitoring wells will be designed and installed in a manner to accomplish the following objectives: collect representative ground-water samples, prevent contamination of the aquifer by the drilling equipment to prevent inter-aquifer contamination, and prevent vertical seepage of surface water into the well water in-take zone.

The following sections describe well installation and construction procedures including the placement of the screen, installation of the filter pack, bentonite and grout seals, and well completions.

4.6.1 Well Casing and Screen

The monitor well risers will consist of material durable enough to retain their long-term stability and structural integrity and be relatively inert to minimize alteration of ground water and collected samples.

The monitoring well riser material will consist of new, threaded, flush joint polyvinyl chloride (PVC) pipe, with a minimum 2-inch I.D. The riser pipe will conform to ASTM D 1785 Standards for Schedule 40 pipe. Due to the potential presence of heaving sands in the surficial aquifer, monitoring wells will be installed with pre-packed well screens. Screen slot size will be 0.010 inches, as was installed in the existing wells at the site. If actual geologic conditions differ from those anticipated, the screen slot size will be adjusted accordingly.

The monitoring well screens will consist of a pre-packed assembly of 3-5/8-inch diameter. Therefore, the well screen outer diameter (O.D.) will be larger than the riser O.D. However, the well screen will be made of the same inside diameter (I.D.) and durable material as the well riser. A PVC plug will be provided for the bottom of the wells.

Selection of PVC for the monitoring well construction is based on the primary purpose of this phase of the project, which is the detection of potential contaminants. PVC has demonstrated very good chemical resistance except to high concentration of low molecular weight ketones, aldehydes and chlorinated solvents. Low concentrations of these same chemicals with long term exposure has as yet had undocumented effects (Barcelona, et al., 1983; NWWA, 1989).

The screen and riser sections will be joined by threaded flush-joint couplings to form a water-tight seal. No couplings, organic solvents or glue, lead shot or lead wool will be used in joining the riser pipe.

Borings for all wells will be advanced using hollow stem augers. The following protocol will be used to install the well casing and screen if heaving sands are not encountered in the borehole:

- Upon reaching boring total depth, install a riser pipe with a 10-foot section of 2-inch I.D., threaded, pre-packed, pre-manufactured PVC screen inside the hollow stem auger.

- Install solid riser to ground surface, plus 24- to 36-inch stickup.

If unstable borehole conditions (such as heaving sands) are encountered during auger drilling, the following protocol will be followed for installation of the well casing and screen:

- After advancing the boring to the intended total depth, remove the augers from the borehole.

- Insert a PVC plug into the bottom of the augers.

- Insert the augers back into the borehole, and advance the augers to the previously-achieved total depth.

- Insert the casing and well screen assembly into the augers. Unseat the PVC plug by pulling the augers up 1 foot off of the bottom of the borehole. Remove the augers to the top of the well screen.

All risers and screens will be set round, plumb, and true to line. The well pipe assembly will be hung in the borehole, during installation of the well casing and screen, and not allowed to rest on the bottom of the hole to keep the well assembly straight and plumb. Centralizers will be installed on all wells greater than 20 feet in depth.

4.6.2 Artificial Sand Pack

A pre-packed well screen containing a sand filter pack will be installed in monitoring wells. Filter pack design will consist of a "20 to 40" gradation or equivalent. This gradation was chosen based on previous geotechnical sampling performed at the site. Results of the geotechnical analysis indicated a significant silt fraction (ranging from 4 to 18 percent) to be present (ESE, 1993b). The filter pack will consist of clean, inert, noncarbonate silica sand. Additional sand will be tremied to 2 feet above the screened interval.

4.6.3 Bentonite Seal

A minimum 3-foot thick bentonite pellet seal will be installed above the artificial filter pack into the annular space of the wells. In wells where the screen is close to the ground surface, a minimum of 1 foot of bentonite must be placed. A 1- to 2-foot layer of fine to medium sand may be placed atop the bentonite seal if there is sufficient room, to enhance barrier resistance to downward grout migration. The bentonite seal will be allowed to hydrate approximately 1 hour prior to placement of the grout collar around the wells.

4.6.4 Grout Mixture

A non-shrinking cement-bentonite grout mixture will be placed in the annular space from the top of the bentonite seal to ground surface. The cement-bentonite mixture will consist of Portland Cement (ASTM C150) and clean water from the approved water source in the proportion of not more than 7 gallons of water per 94-pound bag of cement. Additionally, 3 percent by weight of bentonite powder will be added to the mixture to help reduce shrinkage.

4.6.5 Surface Completion

Wells will be completed as shown in Figure B-2. The well riser will be enclosed with a larger diameter capped steel security casing rising approximately 24 inches above ground level and set 3 feet below grade. The well riser will be notched or marked to provide a top of casing (TOC) control point. Drain holes will be drilled along the base of the security casing above the concrete pad. The security cap will have a hinged locking cap feature. Key-alike locks will be provided for each of the wells. Two sets of duplicate keys will be provided to appropriate installation personnel and CESAS. The steel security cap will be painted with a rust-inhibiting paint to prevent corrosion. Four 3-inch or larger diameter steel posts consisting of steel joined with angle trim to form a secure framework at a sufficient height will be embedded in grout outside the concrete pad. The posts will be painted a construction orange to make the wells more visible, and shall be painted with a brush.

Concrete will be placed in the annular space from the top of the environmental (cement-bentonite) seal to ground surface. Additionally, a 3-foot by 3-foot by 4-inch concrete pad will be installed around each well. The pads will consist of ready-mix concrete mixed in appropriate proportions of cement and water. The pad will be sloped slightly from the well to the edges of the pad to allow surface-water run-off. A brass survey medallion will be embedded in an obvious location on the cement pad.

FIGURE B-2

TYPE II MONITORING WELL INSTALLATION DIAGRAM

PROJECT NAME ______________________ PROJECT NO. ____________

WELL NO. ____________ WELL LOCATION ____________

DATE ____________ TIME ____________

GROUND SURFACE ELEVATION ____________

TOP OF SCREEN ELEVATION ____________

REFERENCE POINT ELEVATION ____________

TYPE FILTER PACK ____________ GRADATION ____________

FILTER PACK MANUFACTURER ____________

SCREEN MATERIAL ____________

MANUFACTURER ____________

SCREEN DIAMETER ____________ SLOT SIZE ____________

RISER MATERIAL ____________

MANUFACTURER ____________

RISER DIAMETER ____________

DRILLING TECHNIQUE ____________

AUGER/BIT SIZE AND TYPE ____________

BENTONITE TYPE ____________

MANUFACTURER ____________

CEMENT TYPE ____________

MANUFACTURER ____________

BOREHOLE DIAMETER ____________

LAW

FIELD REPRESENTATIVE ____________

DRILLING CONTRACTOR ____________

AMOUNT BENTONITE USED (SEAL) ____________

AMOUNT BENTONITE USED (GROUT) ____________

AMOUNT CEMENT USED (GROUT) ____________

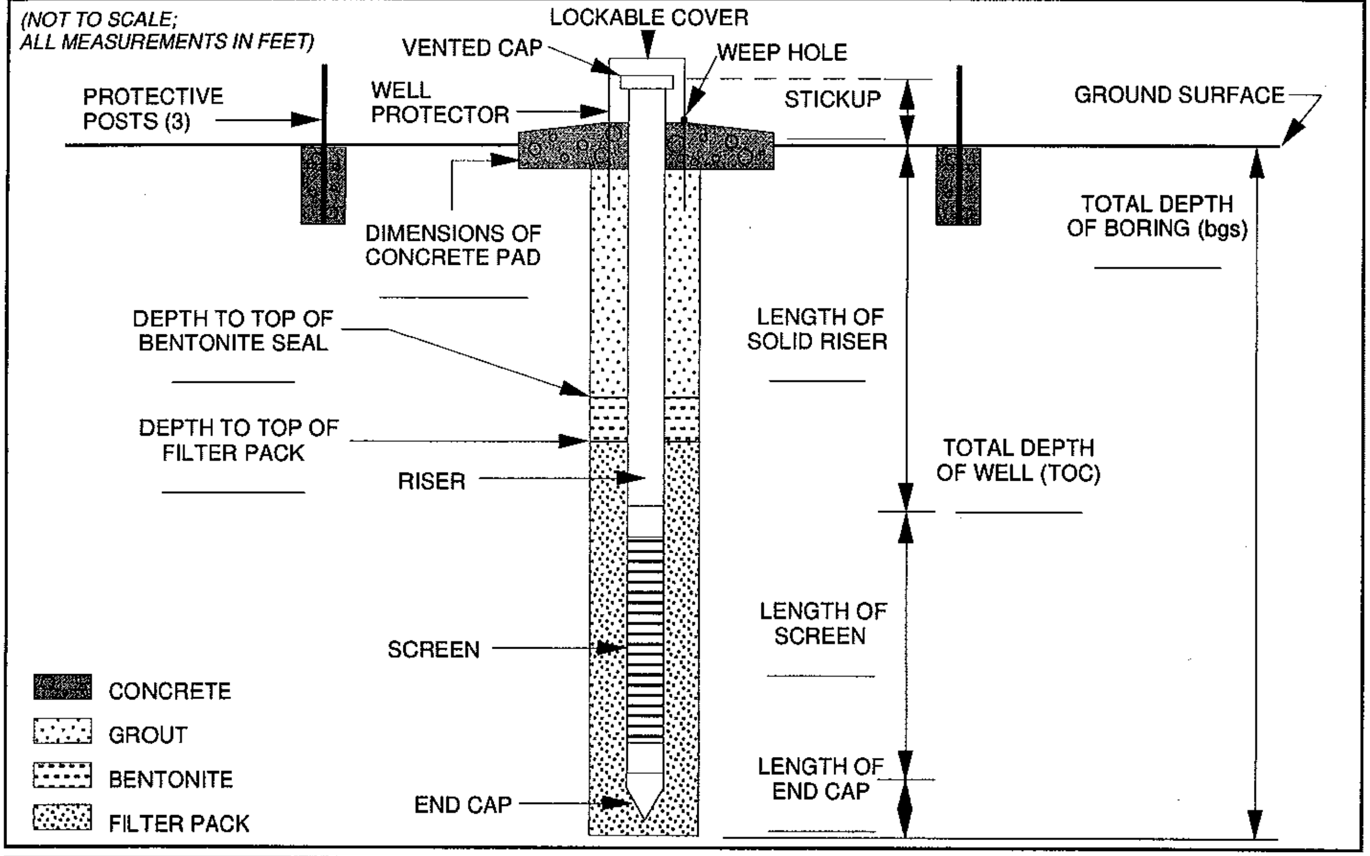
AMOUNT SAND USED ____________

STATIC WATER LEVEL (> 24 hrs. after dev.) ____________

MEASURED ON (Date/Time) ____________

REMARKS ____

(NOT TO SCALE; ALL MEASUREMENTS IN FEET)



QA / QC

DRILLER: ____________ INSPECTOR: ____________

DISCREPANCIES: ____________ CHECKED BY: ____________ DATE: ____________

Wells installed in high traffic areas will be completed flush with the land surface. The well casing will be finished to approximately 3 inches bgs and equipped with a sealed locking cap to prevent surface water from entering the well and to prevent tampering. A load-bearing steel manhole cover will be installed for protection.

The field geologist or geotechnical engineer shall maintain suitable logs detailing drilling and well construction practices. Well dimensions, amount, type and manufacture of materials used to construct each well will be recorded on the Monitoring Well Installation Diagram (Figure B-2).

4.6.6 Well Identification

Well identification numbers will be sequential to the existing nine wells at the site. The new wells will be numbered HMW-10, HMW-11, HMW-12, and HMW-13.

A metal plate with the contractor's name, registration number, well number, depth, installation date, and TOC elevation will be permanently affixed to the protective casing in a suitable location to be visible from road or path; and wells will be labeled as "Monitor Well - Not for Water Supply."

4.6.7 Investigation Derived Waste Management

The management of investigation derived wastes (IDW) is provided in Section 4.6 of the Work Plan.

4.7 WELL DEVELOPMENT

The purpose of well development is to create good hydraulic contact between the well and the aquifer, and to remove accumulated sediments from the well. The following subsections describe the procedures for well development.

4.7.1 Well Development Procedures

Each newly-installed well will be developed no sooner than 48 hours but within seven days after placement of the grout seal. The well development protocol will be as follows:

- Measure the static water level for each well.
- Measure the total well depth. Calculate the volume of water in the well and annulus.
- Development of the well shall consist of pumping and surging for a minimum of 4 hours and until the well is free of sand. If sediment is still entering the well, or the water is cloudy [greater than 50 nephelometric turbidity units (NTUs) in turbidity], then surging or pumping will continue for another 2 hours until little or no sediment enters the well. Wells that have insufficient recovery to sustain continuous purging will be pumped dry three times. In such wells, the wells will be allowed to recharge to sufficient levels at the site geologist's professional judgement between purging. A minimum of five well volumes plus five times the volume of water lost during drilling and well installation shall be removed from the wells that sustain continuous purging during development. A maximum turbidity of 50 NTUs shall be achieved at the completion of well development. If the required clarity of 50 NTUs cannot be achieved, the site geologist will contact the CESAS Project Manager assigned to the project for resolution.

The calculation for well volume is as follows:

$$V = \pi \left((r_1^2 - r_2^2)\ \phi + r_2^2 \right) x\ H\ x\ 7.48$$

Where: V = volume, in gallons

H = height of water in well screen and filter pack in feet

r_1 = radius of borehole in feet

r_2 = radius of well in feet

ϕ = porosity of filter pack, assumes 30 percent

π = 3.14

7.48 = conversion factor for cubic feet to gallons

The following is a summary of the well development procedures:

- Temperature, specific conductivity, turbidity (ASTM D-1899) and pH will be monitored before, during, and after development.

- Surging in the wells will be accomplished with a 1⅞-inch surge block attached to the development pump. Surging will be conducted manually by moving the surge block up and down along the screened interval. Well development will be accomplished with a QED-brand (or equivalent) purge pump or by hand using a bailer.

- The interior of the well casing and the entire well cap should be washed with water recovered during development. This will be performed during the development.

- Record physical characteristics of water throughout well development (i.e., color, turbidity, odor, etc.) at 30-minute intervals, minimum.

- Record the total quantity of water removed (five well volumes plus five times the volume of water lost during drilling/well installation, or to dryness three times).

- Water will not be added during development.

- Measure static water level after at least 24 hours.

- After final development, collect one liter of water from the well in a clear glass jar, label it, photograph it, (using 35 mm color print film) and submit color photographs to CESAS as part of the well development record. The photograph shall be a closeup and suitably backlit to show the clarity of the water.

- Manage development water as described in Section 4.6 of the Work Plan.

4.7.2 Well Development Records

Well development data will be recorded on Well Development Data sheets. An example is shown as Figure B-3.

4.8 WELL SAMPLING

Monitoring wells will be sampled following completion of development. The protocol for obtaining ground-water samples from the wells is provided in the CDAP (Appendix A) which is included as Appendix A the Work Plan.

4.9 IN-SITU PERMEABILITY TESTING

Hydraulic conductivity tests will be performed on the four new wells at the site following sampling. The tests to be performed are termed the "slug in" and "slug out" tests. The "slug

FIGURE B-3

WELL DEVELOPMENT DATA

PROJECT NAME ______________________ PROJECT NO. ______________________

DEVELOPED BY ________________ CHECKED BY ________________ SHEET _____ OF _____

WELL NO. ________________ SITE LOCATION ______________________

1. a. Date of installation: ________________ b. Date of development: ________________

2. Static Water Level

   a. Before development: ________________ ft. date/time ________________

   b. At least 24 hrs. after development: ________________ ft. date/time ________________

3. Organic Vapor

   a. Before development: ________________ ppm b. After development: ________________ ppm

4. Quantity of water loss during drilling, if used: ________________ gal.

5. Quantity of standing water in well and annulus before development: ________________ gal.

6. Depth from top of well casing to bottom of well: ________________ ft. (from well installation diagram)

7. a. Well diameter: ________________ in. b. Screen length: ________________ ft.

8. Minimum quantity of water to be removed: ________________ gal. (attach calculation)

9. Depth to Top of Sediment

   a. Before development: ________________ ft. b. After development: ________________ ft.

10. Physical character of water (before/after development): ________________

11. Type and size of well development equipment: ________________

12. Description of surge technique, if used: ________________

13. Height of well casing above ground surface: ________________ ft. (from well installation diagram)

14. a. Quantity of water removed: ________________ gal. b. Time for removal: ________________ hr./min.

15. a. 1-Liter water sample collected: ________________ (time) b. Water sample photographed? YES NO (circle one)

16. Final turbidity in nephelometric units: ________________ NTUs

17. Final Imhoff cone measurements < 0.75 mL/L, if applicable: ________________

FIGURE B-3

page 2 of 2

WELL DEVELOPMENT DATA (continued)

PROJECT NAME ______________________ PROJECT NO. ______________________

DEVELOPED BY ________________ CHECKED BY ________________ SHEET _____ OF _____

WELL NO. ________________ SITE LOCATION ______________________

DATE/ TIME	MINUTE DEV./ CUM. MIN. DEV.	GALS. PURGED/ CUM. GALS. PURGED	pH	TEMP.	COND.	NTUs	REMARKS

in" test involves inserting a slug (solid PVC rod) into the water column in the well to raise the water level. (The data derived from the slug-in test will be used only for wells in which the entire length of the well screen was below the water table interface at the time of testing.) The water level recovery to a static water level is recorded over time using an electronic pressure transducer. Readings will be taken logarithmically and recorded until a static water level is reached. The slug is removed for the "slug out" test and recovery of the water level to 90 percent of the original static water level is recorded over time using a data logger monitor. Upon completion of the tests, the data will be reduced and analyzed using the Bouwer and Rice, (1989) double straight-line method.

The data results of the hydraulic conductivity test are then calculated. The following formula (Bouwer and Rice, 1989) is utilized to calculate hydraulic conductivity (K):

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L_e} * \frac{1}{t} * \ln \frac{Y_o}{Y_t}$$

Where: r_c = well radius

R_e = effective radial distance over which the head difference is dissipated

r_w = radial distance between the well center and the undisturbed aquifer

L_e = height of saturated screen

Y_o = water level Y at time zero

Y_t = water level Y at time t

t = time since Y_o

4.10 SUBMITTALS

Boring logs, well installation diagrams and well development data forms will be maintained by the qualified field geologist or geotechnical engineer. Appropriate data as outlined in previous section of this GDAP will be recorded. Two copies of each of these documents with one photograph of the recovered development water will be provided to the CESAS Project Manager not later than 30 days after the survey data is received.

4.11 WELL ABANDONMENT

Should it become necessary to abandon a well, GADNR (1991) guidelines will be followed depending upon well type, depth, and construction.

4.12 PROJECT ASSIGNMENTS AND PERSONNEL QUALIFICATIONS

The project assignments, organization, and responsibilities are provided in Section 2.0 of the Work Plan.

4.13 REFERENCES

References are provided in Section 7.0 of the Work Plan.

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LIST OF ACRONYMS

ACGIH	American Council on Governmental and Industrial Hygienists
CFR	Code of Federal Regulations
CRZ	Contamination Reduction Zone
DOT	United States Department of Transportation
EMT	Emergency Medical Team
EPA	Environmental Protection Agency
FTA	Fire Training Area
H_2S	Hydrogen Sulfide
HAAF	Hunter Army Airfield
HSO	Health and Safety Officer
LEL	Lower Explosive Limit
NFPA	National Fire Prevention Association
NRC	National Response Center
NRR	Noise Reduction Rating
OSHA	Occupational Safety & Health Act
OSHA PEL TWA	OSHA Permissible Exposure Limit, Time-Weighted Average
PAH	Polynuclear Aromatic Hydrocarbons
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PPE	Personal Protective Equipment
SCBA	Self-Contained Breathing Apparatus
SOP	Standard Operating Procedure
SSHP	Site Safety & Health Plan
SSO	Site Safety Officer
STEL	Short-Term Exposure Limit
TLV	Threshold Limit Value
USACE	United States Army Corps of Engineers
WBGT	Wet Bulb Globe Temperature

1.0 PURPOSE OF SITE SAFETY AND HEALTH PLAN

The health and safety of site personnel and the public is a primary concern during investigations at potential hazardous waste sites. Thus, a comprehensive, carefully managed, and thoroughly documented Site Safety and Health Plan (SSHP) is crucial for successful project completion. This SSHP presents the conditions and hazardous substances known or anticipated to be present at HAAF Fire Training Area (FTA) and to be addressed by current site investigations. This SSHP will be used by LAW to identify and mitigate potential site and task-specific hazards, and select appropriate health and safety protective measures to be instituted for operations to be undertaken during this site investigation.

This document has been developed based on available background information pertaining to the sites. The document describes the field implementation of the SSHP, specific personnel responsibilities and training requirements, protective equipment, site operating procedures, emergency contingency procedures and medical monitoring. Its flexibility allows unanticipated site-specific conditions to be addressed to ensure adequate and suitable protection of site workers.

The SSHP will be used by the Site Safety Officer (SSO) as a field reference manual for safety, health and emergency response procedures. This SSHP contains information pertinent to specific conditions at HAAF Fire Training Area. The site-specific procedures for the FTA will be discussed with all site personnel and made available for review through the Site Manager to ensure sufficient awareness of potential hazardous conditions and safety procedures at the HAAF facility and FTA.

2.0 SCOPE OF HEALTH AND SAFETY PLAN

The SSHP addresses all phases of field operations at the site, including:

- Responsibilities of key site safety and health personnel
- Work practices and standard operating procedures
- Hazard identification and assessment, including chemical, physical and biological hazards
- Establishment of work zones [Exclusion Zone, Contamination Reduction Zone (CRZ), Decontamination Zone, Support Zone]
- Level of personal protective equipment and clothing required in each zone during each task
- Exposure monitoring/air sampling procedures
- Heat/cold stress monitoring
- Entry and exit routes
- Decontamination procedures
- Response procedures for accidents and emergencies
- Medical surveillance
- Training requirements for workers and on-site training
- Recordkeeping requirements

3.0 REGULATORY AUTHORITY

All on-site activities shall be conducted in accordance with applicable Occupational Safety and Health Administration (OSHA) and other federal, state and local regulations, including the following:

29 CFR § 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR § 1910.134	Respiratory Protection
29 CFR § 1910.1028	Benzene Standard
29 CFR § 1910	All Other Applicable Regulations
29 CFR § 1926	All Other Applicable Regulations

4.0 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

This section presents a general description of HAAF and on-site tasks associated with field investigations.

4.1 BASE DESCRIPTION

Hunter Army Airfield is located on 5,400 acres of land in Chatham County, Georgia, just southwest of Savannah (Figure 4-1). The airfield is bounded on the north by lightly populated areas, on the east and south by residential and light commercial areas, and on the west by the Little Ogeechee River. Figure 1-2 of the work plan (pocket) depicts Hunter Army Airfield and the site location.

The Fire Training Area (FTA) is in a grassy cleared area approximately 200 feet by 400 feet, bounded on the north and south by drainage ditches, by the airfield pavement on the east, and by trees on the west (see Figure 4-2). The FTA consists of a 6,400-square foot grass-covered concrete pad. the pad has a deteriorated concrete curb around the perimeter with soil bermed around it. There is a simulated aircraft constructed from a used steel storage tank in the center of the pad. Fuel (mostly JP-4) for the training fires was supplied from an aboveground storage tank through a buried pipe located approximately 100 feet north of the training pad. During training exercises, the jet fuel (JP-4) was pumped onto the surfaces of the simulated aircraft and ignited. Some of the fuel and water splashed or ran over the top of the curb and berms and contaminated adjacent soil. This has also led to the contamination of shallow ground water. Use of the FTA was discontinued in 1991. Previous investigations have taken place at the site. Tables 4-1 and 4-2 summarize the chemicals detected in ground water and soil, respectively.

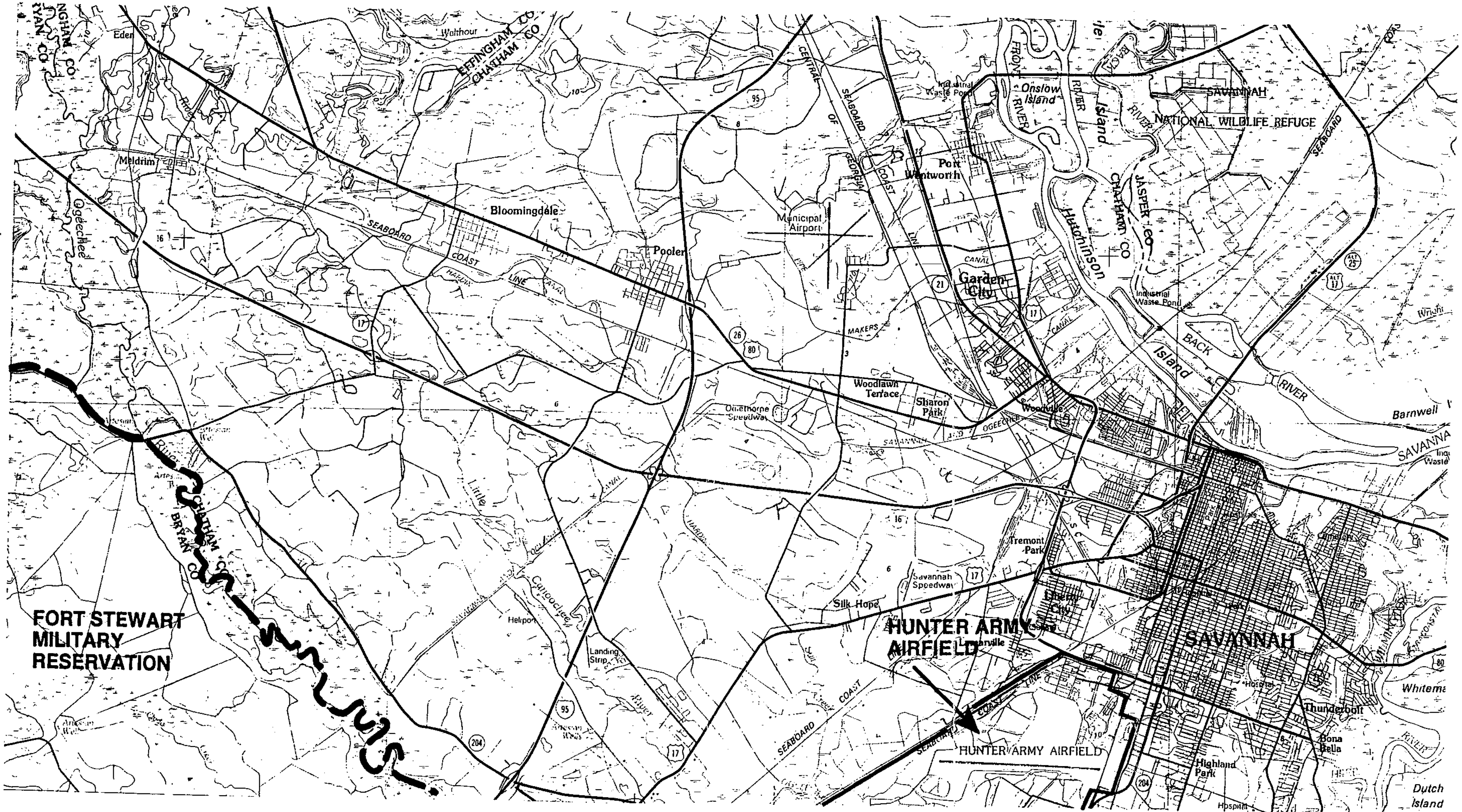
4.2 ON-SITE TASKS TO BE PERFORMED

Activities to be performed at the sites may be categorized as either intrusive or non-intrusive.

FIGURE 4-1

LOCATION MAP

HUNTER ARMY AIRFIELD, GEORGIA



LEGEND

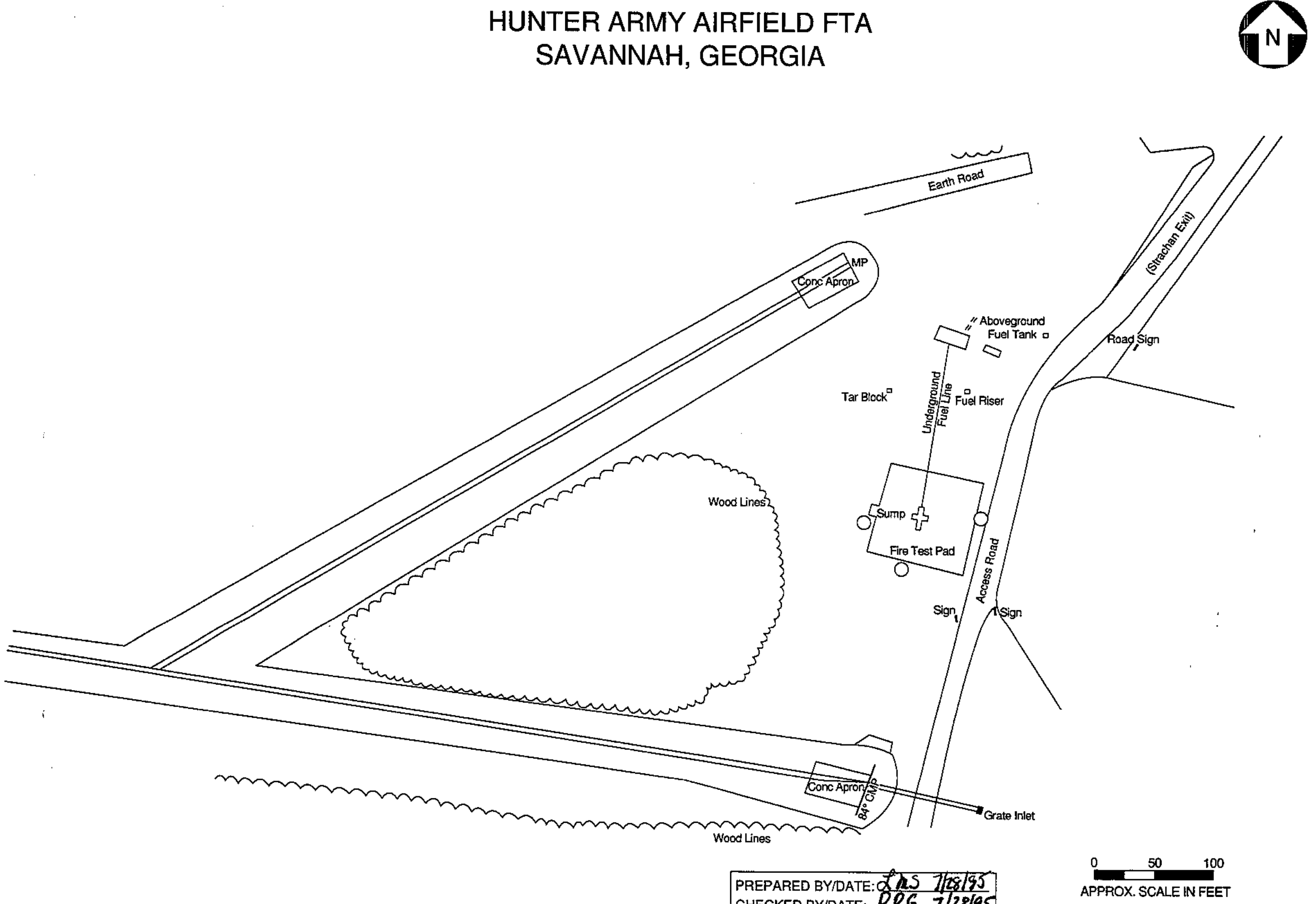
▬ ▬ ▬ FT. STEWART INSTALLATION BOUNDARY (APPROXIMATE)

Source: U.S. Geological Survey, Savannah 1:100,000 Topographic Map, 1981. Georgia Bicentennial Highway Map, 1976.

NOTE: HUNTER ARMY AIRFIELD BOUNDARY EXTENDS BEYOND THE SOUTHERN LIMIT OF MAP.

CP

FIGURE 4-2
SITE LAYOUT
HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



PREPARED BY/DATE: LMS 7/28/95
CHECKED BY/DATE: DRG 7/28/95
REVIEWED BY/DATE: ________

(BASE MAP MODIFIED FROM ESE, 1993b)

3551-0320.04

TABLE 4-1

SUMMARY OF CHEMICALS PREVIOUSLY DETECTED IN SITE GROUND-WATER SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

Chemical	Range of Detected Ground-Water Concentrations (μg/kg)
Arsenic	2.3-77.3
Barium	36.8-564
Cadmium	4
Chromium, total	12-239
Lead	28.6-337
Selenium	2.1-14.4
PAHs	
Benzo(a)anthracene	3.2
Benzo(b)fluoranthene	7
Benzo(g,h,i)perylene	2.3
Chrysene	5.3
Fluoranthene	7.3
Naphthalene	14-43
Phenanthrene	5.2
Pyrene	6.8
VOCs	
Benzene	1.9-120
1,2-Dichloroethene	3.5
Ethylbenzene	82-120
Toluene	0.74-1.8
Vinyl Chloride	12
Xylenes, total	3.3-9.4

Source: Final Significance of Contamination Report, Hunter Army Airfield Fire Training Area, Fort Stewart, Savannah, Georgia (ESE, 1993b)

PREPARED/DATE: JMS 7/28/95
CHECKED/DATE: DRG 7/28/95

TABLE 4-2

SUMMARY OF CHEMICALS PREVIOUSLY DETECTED IN SITE SOIL SAMPLES
Hunter Army Airfield FTA
Savannah, Georgia

Chemical	Range of Detected Concentrations (mg/kg)
Arsenic	590-11,980
Barium	3,830-64,400
Cadmium	1,990-3,870
Chromium, total	780-12,800
Lead	1,185-7,390
Mercury	380-790
Selenium	330-790
<u>PAHs</u>	300
Acenaphthene	210-400
Acenaphthylene	210-1,300
Anthracene	160-5,300
Benzo(a)anthracene	180-4,800
Benzo(a)pyrene	260-6,900
Benzo(b)fluoranthene	2,200
Benzo(g,h,i)perylene	150-2,700
Benzo(k)fluoranthene	170-5,300
Chrysene	1,100
Dibenzo(a,h)anthracene	77-13,000
Fluoranthene	200-720
Fluorene	570-2,900
Indeno(1,2,3-cd)pyrene	5.8-41,000
Naphthalene	0.2-8,100
Phenanthrene	140-9,400
Pyrene	
<u>VOCs</u>	39
Benzene	1.1-10,000
Ethylbenzene	1.7-240
Methylene Chloride	2.8-5.5
Toluene	7-31
Trichlorofluoromethane	60-57,000
Xylenes, total	

Source: Final Significance of Contamination Report, Hunter Army Airfield Fire Training Area, Fort Stewart, Savannah, Georgia (ESE, 1993b)

PREPARED/DATE: LMS 7/28/95
CHECKED/DATE: DRG 7/28/95

In general, intrusive activities increase the potential for exposure to hazardous materials. Non-intrusive activities, such as the geophysical survey, tend to pose a lower potential for worker exposure to chemical hazards because these activities will involve minimal contact with contaminated media. Intrusive activities, such as the installation of monitoring wells, may involve direct contact with contaminated media; therefore, the potential for exposure to hazardous materials is increased. The on-site tasks associated with field investigations at the FTA will include:

- Soil boring and sampling
- Monitoring well installation
- Soil gas sampling
- Ground-water monitoring
- Concrete boring and sampling

5.0 HAZARD ASSESSMENT/RISK ANALYSIS

The hazards associated with field investigations are unique to each site and are discussed in detail in this SSHP. This section provides a general description of potential hazards anticipated during the investigation at the FTA.

5.1 HAZARD IDENTIFICATION

The chemical, physical, and biological hazards associated with site activities are discussed in this section. Chemical hazards may arise from worker exposure to excessive levels of toxic contaminants (organic and inorganic chemicals) potentially present in the environmental media at the sites, via inhalation, incidental ingestion of soils, and/or skin contact. The physical characteristics, regulatory exposure limits, and health hazards associated with representative chemicals are provided in tables in site-specific sections.

Physical hazards that workers at HAAF may encounter are due to the physical stresses that the environmental elements (e.g., temperature, humidity, proximity to heavy machinery, etc.) may exert upon the worker's body. Biological hazards refer to plants, animals, and infectious agents that may present a potential risk to the health and well-being of workers at the site (NSC, 1988).

5.1.1 Physical Hazards

Potential physical hazards that may be encountered during work at HAAF include the following:

- Oxygen-deficient atmospheres and/or areas subject to accumulation of toxic or flammable contaminants, which have a limited means of egress in confined spaces

- Explosion and/or flammability of contaminants

- Heat or cold stress, depending on season of work

- Physical/electrical hazards associated with working in the vicinity of overhead power lines and/or underground utilities

- Physical hazards associated with the use of heavy equipment such as backhoes and drilling rigs

- Physical hazards associated with working in limited spaces

- Physical hazards associated with working in remote areas and areas of dense vegetation, such as brush and brambles

- Physical hazards associated with sampling surface-water areas (i.e., slipping, falling, drowning)

- Physical hazards associated with excessive noise level from drilling equipment or aircraft

5.1.2 Biological Hazards

Potential biological hazards that may be encountered during work at HAAF include the following:

- Contact with poisonous plants and animals (snakes)

- Contact with insects such as mosquitos, ticks, bees, wasps, hornets, chiggers, etc.

    - Personnel should be alert when working near cool and shaded areas. Packaged materials, stored clothing, steel casing, etc., also provide favorable "hiding" places for snakes and insects.

5.2 CHEMICAL INDICATORS OF HAZARD

The primary constituents of concern at this site are heavy metals (lead, arsenic, chromium, selenium), polynuclear aromatic hydrocarbons (PAHs), and petroleum fuel constituents. JP-4 jet fuel is known to have been used at this site, so its common volatile components, benzene, toluene, ethylbenzene, and xylene, will also be considered constituents of concern. Table 5-1 presents the OSHA Permissible Exposure Limits, Time Weighted Average (OSHA PEL-TWA), American Conference of Governmental Industrial Hygienists Threshold Limit Values (ACGIH TLVs), odor thresholds, ionization potentials, and symptoms of exposure for each chemical of concern.

Chemical indicators of hazard were selected from the primary constituents of concern at the site based on toxic and hazardous properties. The chemicals that have the greatest potential to cause adverse health effects at the lowest concentrations were selected as indicators in order to establish the most protective action level guidelines during field investigations. Exposure monitoring for the presence of these chemicals will be conducted during all intrusive investigative activities at this site.

Action guidelines for each chemical have been established based on regulatory or guideline exposure limits, or on toxic properties (where exposure limits are not available). These action guidelines will also protect workers from the other constituents anticipated to be encountered at the site.

The chemicals selected to serve as indicators of airborne organic vapor hazards at this site are:

- Benzene
- Naphthalene
- Dust hazards

TABLE 5-1

IMPORTANT PROPERTIES OF CONSTITUENTS OF CONCERN
Hunter Army Airfield FTA
Savannah, Georgia

Constituent	OSHA PEL (ppm)	ACGIH TLV (ppm)	IDLH (ppm)	UEL (%)/ LEL (%)	Odor Threshold (ppm)	Respirator Cartridge Breakthrough Time (min)[B]	Ionization Potential (eV)	Health Hazards (Acute/Chronic)
CLASS: PETROLEUM FUEL CONSTITUENTS								
Benzene	1 5 [ST]	10 [A2]	3000	7.9/1.3	4.68	73	9.24	Acute: Irritation of eyes, nose, or respiratory system, giddiness, headache, nausea, staggered gait, fatigue, anorexia, lassitude, dermatitis Chronic: Bone marrow depression, carcinogen
Coal tar pitch volatiles (PAHs)	0.2 mg/m³ [Ca]	0.2 mg/m³	700 mg/m³	VA	VA	VA	VA	Acute: Dermatitis, bronchitis Chronic: Lung, skin, urinary tract cancers
Ethyl benzene	100 125 [ST]	100 125 [ST]	2000	6.7/1.0	2.3	84	8.76	Acute: Irritation of eyes, mucous membrane, headache, dermatitis, narcosis, coma Chronic: Liver and kidney damage
Naphthalene	10 15 [ST]	10	500	5.9/0.9	0.084	NA	8.12	Acute: Eye and skin irritant, nausea, vomiting, headache, confusion, sweating, abdominal pain, jaundice, kidney damage Chronic: Kidney damage, cataracts

NOTES:
B : Time to reach 1% breakthrough (tested at 1000 ppm, 50% relative humidity, 22°C, and 53 L/min
C : Ceiling limit
ST : Short term exposure limit
skin : Recognized as having potential for dermal absorption
A1 : Confirmed human carcinogen (ACGIH)
A2 : Suspected human carcinogen (ACGIH)
A4 : Not classifiable as a human carcinogen (ACGIH)
Ca : Carcinogen (NIOSH)
NC : Noncombustible solid or liquid
FMP : 5 minute maximum peak in any two hours
CP : Combustible in dust or powdered form

NE : No evidence found for the existence of an IDLH (NIOSH)
NA : Not Available
NR : Not relevant
Ukn : Unknown
VA : Varies according to compound
* : Noncombustible liquid; however the vapor will burn
** : Noncombustible liquid at ordinary temperatures, but the gaseous form will ignite and burn weakly at 1256° F
t : total dust/particulate
r : respirable fraction of dust

REFERENCES:
ACGIH, Threshold Limit Values, 1993-1994.
NIOSH, Pocket Guide to Chemical Hazards, 1990.
OSHA, Permissible Exposure Limits, 29 CFR 1910.1000, 1989.
Sittig, Hazardous and Toxic Effects of Industrial Chemicals, 1979.
ATSDR, Toxicological Profiles for Constituents, 1987-1991.

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Hunter Army Airfield FTA
Savannah, Georgia

Constituent	OSHA PEL (ppm)	ACGIH TLV (ppm)	IDLH (ppm)	UEL (%)/ LEL (%)	Odor Threshold (ppm)	Respirator Cartridge Breakthrough Time (min)[B]	Ionization Potential (eV)	Health Hazards (Acute/Chronic)
Toluene	100 150 [ST]	50	2000	7.1/1.2	2.9	94	8.82	Acute: Fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervousness, muscle fatigue, insomnia, paresthesia, dermatitis Chronic: CNS effects, brain dysfunction, liver and kidney damage
Xylene (o-,m-,p-isomers)	100 150 [ST]	100 150 [ST]	1000	7.0/ 1.1 (o) 1.0 (m) 1.1 (p)	1.1	NA (o) 99 (m) NA (p)	8.56 (o) 8.54 (m) 8.44 (p)	Acute: Dizziness, excitement, drowsiness, incoordination, staggering gait, irritation of eyes, nose, or throat, eye disorders, anorexia, nausea, vomiting, abdominal pain, dermatitis Chronic: Lung and liver effects
Total Petroleum Hydrocarbons (as gasoline)	300 500 [ST]	300 500 [ST]	NA	NA/NA	0.25	NR	NR	Acute: Irritation of upper respiratory tract, depression of central nervous system, irregular heartbeat, irritation of mucous membrane Chronic: Ukn

NOTES:
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CLASS: METALS/INORGANICS								
Arsenic	0.01 mg/m^3 [Ca]	0.2 mg/m^3 [Ca]	100 mg/m^3	CP/CP	ND	NR	NR	Acute: Nasal septum ulceration, dermatitis, respiratory irritation, GI disturbances Chronic: Peripheral neuritis, hyperpigmentation of skin, carcinogen
Barium	0.5 mg/m^3	0.5 mg/m^3	1100 mg/m^3	NC/NC	NR	NR	NR	Acute: Upper respiratory tract irritation, gastroenteritis, muscle spasms, slow pulse, extrasystoles, hypokalemia, eye and skin irritant, skin burns Chronic: Hypertension
Cadmium (elemental & compounds)	0.005 mg/m^3 [Ca]	0.01 mg/m^3 [t] [A2] 0.002 mg/m^3 [r] [A2]	50 mg/m^3	NC/NC	NR	NR	NR	Acute: Pulmonary edema, dyspnea, cough, tight chest, substernal pain, headache, chills, muscle aches, nausea, vomiting, diarrhea Chronic: Lung fibrosis, emphysema, proteinuria, mild anemis, carcinogens

NOTES:
B : Time to reach 1% breakthrough (tested at 1000 ppm, 50% relative humidity, 22°C, and 53 L/min
C : Ceiling limit
ST : Short term exposure limit
skin : Recognized as having potential for dermal absorption
A1 : Confirmed human carcinogen (ACGIH)
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Chromium	1 mg/m^3	0.5 mg/m^3	NE	NC/NC	ND	NR	NR	Acute: Sneezing, throat irritation, bronchial spasm, skin ulcers, GI irritation, nausea, vomiting, severe diarrhea, hemorrhage (oral form) Chronic: Nasal perforation, chronic inflammation of respiratory tract, lung cancer
Lead	0.05 mg/m^3	0.15 mg/m^3	700 mg/m^3	NC/NC	ND	NR	NR	Acute: Weakness, lassitude, insomnolence, facial pallor, anorexia, low weight, constipation, abdominal pain, colic, anemia, irritation of eyes, hypotension Chronic: Malnutrition, gingival lead line, tremor, paralysis of wrist or ankles, brain disorder, nerve disorder
Mercury (metallic)	0.1 mg/m^3 [Ca] [skin]	0.025 mg/m^3 [A4] [skin]	10 mg/m^3	NR/NR	NR	NR	NR	Acute: Incoordination, vision, hearing disturbance, spastic, jerky, dizziness, salvation, lacrimation, nausea, vomiting, diarrhea, constipation, skin burns, emotional distress Chronic: In animals: decreased weight gain, kidney damage
Selenium, and compounds	0.2 mg/m^3	0.2 mg/m^3	Ukn	NA/NA	ND	NR	NA	Acute: Lung and eye irritation, pallor, irritability, giddiness, GI effects Chronic: Pulmonary edema, possible liver and kidney damage

NOTES:
B : Time to reach 1% breakthrough (tested at 1000 ppm, 50% relative humidity, 22°C, and 53 L/min
C : Ceiling limit
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A1 : Confirmed human carcinogen (ACGIH)
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CLASS: VOLATILE ORGANICS								
1,2-trans-Dichloroethene	200	200	4000	12.8/5.6	0.085	33	9.65	Acute: Eye and skin irritant, central nervous system depression, dizziness, nausea and vomiting Chronic: Liver and kidney dysfunction
Methylene chloride	500 1000 [C] 2000 [FMP]	50 [A2]	5000	22/14	214	NA	11.32	Acute: Fatigue, weakness, sleepiness, lightheadedness, numbness or tingling of limbs, nausea, eye and skin irritation Chronic: In animals: slight liver damage, lung and liver tumors
Trichlorofluoromethane	NA	1000 [C]	10000	NC/NC	5	NA	11.77	Acute: Incoordination, tremors, dermatitis, frostbit, cardiac arrhythmias, cardiac arrest Chronic: ND
Vinyl chloride	1 5 [C] [Ca]	5 [A1]	NE	33/3.6	4000	3.8	9.99	Acute: Eye and skin irritation, nausea, lightheadedness, dulling of vision and hearing Chronic: Cancer (liver, lung, CNS, lymphatic system), Raymond's phenomenon, liver damage

NOTES:
B : Time to reach 1% breakthrough (tested at 1000 ppm, 50% relative humidity, 22°C, and 53 L/min
C : Ceiling limit
ST : Short term exposure limit
skin : Recognized as having potential for dermal absorption
A1 : Confirmed human carcinogen (ACGIH)
A2 : Suspected human carcinogen (ACGIH)
A4 : Not classifiable as a human carcinogen (ACGIH)
Ca : Carcinogen (NIOSH)
NC : Noncombustible solid or liquid
FMP : 5 minute maximum peak in any two hours
CP : Combustible in dust or powdered form
NE : No evidence found for the existence of an IDLH (NIOSH)
NA : Not Available
NR : Not relevant
Ukn : Unknown
VA : Varies according to compound
* : Noncombustible liquid; however the vapor will burn
** : Noncombustible liquid at ordinary temperatures, but the gaseous form will ignite and burn weakly at 1256° F
t : total dust/particulate
r : respirable fraction of dust

REFERENCES:
ACGIH, Threshold Limit Values, 1993-1994.
NIOSH, Pocket Guide to Chemical Hazards, 1990.
OSHA, Permissible Exposure Limits, 29 CFR 1910.1000, 1989.
Sittig, Hazardous and Toxic Effects of Industrial Chemicals, 1979.
ATSDR, Toxicological Profiles for Constituents, 1987-1991.

5.3 EXPOSURE STANDARDS AND GUIDELINES

This section outlines the regulatory protective exposure standards and guidelines for chemicals of concern at the FTA. The most stringent standard or guideline for a chemical will be applied to provide adequate protection for the workers.

5.3.1 Regulatory Protective Exposure Standards

Permissible Exposure Limits (PELs) are the OSHA regulatory standards (enforceable by law) for personnel protection from exposure to hazardous chemicals. The OSHA PEL is usually weighted over an 8-hour work day period to represent the exposure over the average work day which occurs during a 40-hour work week. The Short Term Exposure Limit (STEL) is defined as a 15-minute TWA exposure which should not be exceeded at any time during a work day, even if the 8-hour TWA is within the TLV-TWA. The Ceiling Limit is the concentration that should not be exceeded during any part of the working exposure. PELs are the airborne concentration (over specified time periods) of a chemical to which nearly all workers may be exposed, day after day, without adverse effects.

5.3.2 Non-Regulatory Protective Exposure Guidelines

Non-regulatory guidelines for occupational exposure to chemicals are threshold limit values (TLVs). TLVs are analogous to OSHA's PELs, but, as guidance, are not enforceable legal standards. TLVs are established by the American Conference of Governmental Industrial Hygienists (ACGIH) and are usually time-weighted over an average 8-hour work day per 40-hour work week.

5.4 ACTION LEVELS

This section describes the criteria upon which:

- PPE will be selected, upgraded or downgraded.
- Work practice controls will be used.
- Emergency evacuation of on-site personnel will be implemented.
- Prevention and/or minimization of public exposures to hazards created by site activities will be accomplished.

Air monitoring/sampling will be performed in accordance with Section 11.0, and the resulting data compared with the action levels described in this SSHP and in the following paragraphs. Appropriate actions will be taken as necessary to ensure worker safety and the safety of the public.

5.4.1 Action Levels: Organic Vapor Photoionization Detector and Detector Tubes

Ambient air in the breathing zone and borehole locations will be monitored for organic vapors at least once every 15 minutes during site operations and with every change in task or work location. The organic vapor monitoring instrumentation to be used are described in Section 11.1. Continuous monitoring will be conducted at locations where vapor buildup is a potential hazard. Since organic vapor monitors provide only qualitative readings, chemical-specific detector tubes (Draeger tubes) will be used in conjunction with organic vapor monitoring during field investigations to monitor for the presence of specific organic vapors.

5.4.2 Action Levels: Oxygen

Oxygen levels in the breathing zone will be monitored continuously using a portable multi-gas monitor during intrusive activities and during work at locations where vapor accumulation is a potential hazard. Action levels for oxygen are not site-specific and are pertinent for all sites at HAAF. Action levels based on oxygen levels are as follows.

Oxygen Level	Action
19.5 - 23.5%	None; normal oxygen level
<19.5%	Oxygen deficient atmosphere; stop work, notify Site Safety and Health Officer (SSO), ventilate area until normal oxygen levels are present; or upgrade to Level B PPE
>23.5%	Fire/explosion hazard; stop work, ventilate area until normal oxygen levels are present

5.4.3 Action Levels: Combustible Gases

Combustible gas monitoring will be performed continuously during intrusive site activities, using an explosimeter, and at locations where vapor accumulation is possible (i.e., tops of boreholes or excavations), using a portable multi-gas monitor. Action levels based on Lower Explosive Limit (LEL) readings monitored at the source are as follows:

LEL Level	Action
<10% LEL	None; proceed with work and continue monitoring
>10% LEL	Explosion hazard exists; stop work; evacuate site and ventilate area until levels of combustible gases fall below 10 percent LEL

5.4.4 Action Levels: Dust

Dust levels will be visually monitored in the ambient air within the working zone during all tasks involving disturbance of soils. If fugitive dust emissions are a potential problem at a site, suppression techniques will be employed when dust is visible and constant in the work environment.

6.0 ACCIDENT PREVENTION

Daily safety and health inspections will be conducted by the Site Safety Officer to determine if operations are being performed in accordance with this SSHP, and OSHA regulations. Personnel will be alert for potentially hazardous situations and symptoms in themselves and others that warn of hazardous conditions and exposures. Safety briefings will be conducted by the SSO to review site-specific hazards and/or changing site conditions so that dangerous situations can be rapidly recognized and appropriate response taken. A site safety meeting with all site personnel will be held prior to the onset of field activities and once a week thereafter. The purpose of the meetings will be to discuss the potential safety and health hazards associated with field activities, and to ensure that standard operating procedures are followed at all times.

Some topics that will be covered in the briefings are as follows:

- Emergency response procedures
- Chain of command
- Standard operating procedures
- Slip, trip, and fall prevention
- Symptoms associated with heat or cold stress
- Vehicle, drill rig accidents
- Electrical injuries (shocks)
- Physical injuries (blows, cuts, and impacts)
- Insect/animal hazards
- Good housekeeping practices (accident prevention)
- Use of emergency hand signals

Additional topics will be addressed as warranted by site-specific field activities and conditions.

In the event of an accident/incident, the Contracting Officer shall be notified according to EM 385-1-1. Within two working days of a reportable accident, the Site Manager/Project Manager will complete and submit the required Accident Reports.

7.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

The responsibilities of personnel for the formulation, implementation and enforcement of the LAW Health and Safety Program and this SSHP are presented in this section.

7.1 CERTIFIED INDUSTRIAL HYGIENIST (CIH)

The Law Environmental Corporate Consultant in Industrial Hygiene, Dr. Jack Peng, has responsibility for reviewing the SSHP. Dr. Peng has over seven years experience in hazardous waste site investigations. The Corporate Consultant does not directly supervise the work activities of the LAW field personnel or subcontract personnel, but is a major resource in the development and implementation of safe work practices on the project.

7.2 SITE SAFETY OFFICER

The Site Manager will serve as Site Safety and Health Officer, and will be available during field activities at HAAF and will be responsible for the field implementation of this plan. These responsibilities include ensuring the following:

- All site personnel, including subcontractor personnel and authorized visitors, have received the OSHA required 40-hour health, safety, and emergency response training and receive annual 8-hour refresher courses.

- All supervisors on site have received the OSHA required 8-hour supervisory course and are certified in first aid and CPR by the American Red Cross or an equivalent agency.

- All site personnel have completed the required medical examination and meet the qualification criteria for site work as specified in 29 CFR 1910.120 and ANSI Z-88.2.

- All site personnel, including subcontractor personnel and authorized visitors, have received appropriate site-specific safety and health training prior to site entry.

- All equipment, including safety equipment, is suitable and adequate for its intended use.

- Supervisors and project managers meet at least once monthly to review past activities, to plan ahead for new or changed operations, and to establish safe working procedures and that a written outline of these meetings is kept on file.

- A site safety meeting with all site personnel is conducted prior to commencement of field activities, and at least once weekly thereafter and a written record is maintained which notes the date, time, attendees, subjects discussed and person conducting the meeting.

- Standard Operating Procedures (SOPs) are followed at all times.

7.3 MEDICAL CONSULTANT

Dr. David Barnes serves as the medical consultant for Law Environmental's Kennesaw location. He is a board-certified occupational health physician. If immediate health care is needed during site operations or a medical emergency arises, the medical personnel employed at Candler Hospital will be consulted.

8.0 TRAINING REQUIREMENTS

The following minimum hazard training requirements should be met by all on-site personnel, including visitors. The SSO is responsible for briefing field personnel regarding potential contamination that may be encountered at the site, site safety procedures, and the emergency response plan.

8.1 TRAINING REQUIREMENTS FOR SITE PERSONNEL

A thorough understanding of the types of hazards most likely to be encountered at hazardous sites and the personal protection measures needed to protect on-site personnel are the first requirements of a complete HSP. This section describes the minimum training that each project team member is required to complete before working on site.

8.1.1 Comprehensive Training Requirements

All on-site personnel are required to have participated in a 40-hour comprehensive training course that complies with OSHA 29 CFR 1910.120. This training should consist of off-site classroom instruction and field exercises to demonstrate the worker's familiarity with personal protective equipment and potential hazards to which they may be exposed. This initial training includes, but is not necessarily limited to, the following:

- Review of OSHA 29 CFR 1910.120 regulations
- Chemical hazards
- Physical hazards
- Health hazards
- Compatibility of chemicals
- Toxicology (acute exposure, chronic exposure, carcinogens)

- Medical surveillance
- First aid
- Physical hazards (radiation, heat/cold stress, noise)
- Site control
- Safe work practices
  - OSHA standards
  - Common work injuries
  - Common work-site hazards
  - Drum handling
- Air monitoring
- Protective clothing
- Respiratory protection
- Confined spaces
- Decontamination
- Contingency and emergency planning
- Hands-on training on SCBAs, PPE, respirators, air monitoring, and decontamination

In addition to the initial off-site training described above, all general site workers must have a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. Documentation of this experience must be provided by each worker, including subcontractor personnel, prior to the start of work.

8.1.2 Annual Refresher Training

Refresher training is an integral part of training and is also required for all on-site personnel. Site personnel are required to have participated in a minimum of 8 hours of refresher training meeting OSHA 29 CFR 1920.120 requirements on an annual basis following completion of the comprehensive training requirements described in Section 8.1. Documentation of this experience must be provided by each worker, including subcontractor personnel, prior to the start of work.

8.1.3 Supervisor Training Requirements

Minimum training requirements for health and safety team supervisory personnel are described below.

8.1.3.1 Site Manager/Site Safety Officer - A Site Manager will be designated to implement the on-site training and safety requirements during all site activities at the HAAF sites. The Site Manager is required to satisfy the comprehensive training requirements and annual refresher training requirements described above, and must have at least eight (8) additional hours of specialized training pertaining to hazardous waste site management meeting the requirements of OSHA 29 CFR 1920.120.

8.1.4 CPR/First Aid Training Requirements

At a minimum, two individuals having current certification in CPR and first aid procedures by the American Red Cross (or equivalent agency) will be continuously present at each work site during site operations.

8.1.5 Site-Specific Training And Safety Briefing

Site-specific training covering site hazards, procedures and the contents of the SSHP will be conducted by the Site Manager for all on-site LAW employees, subcontractors and approved visitors prior to site entry or commencement of work. Hazards specific to the site and the tasks to be performed, and specification of the proper initial level of PPE for each task will be discussed. Emergency response procedures and contacts will be reviewed. Standard Operating Procedures (SOPs) for activities at the site will be outlined. It will be the responsibility of the Site Manager to ensure that all field personnel are thoroughly familiar with SOPs and the overall chain of command at the site.

8.1.6 Visitor Training

Authorized OSHA-trained visitors entering the work site shall receive a safety briefing from the SSO to inform them of the hazards associated with the site, to explain emergency procedures and inform them of the recommended level of PPE during the visit. With the exception of prescription safety glasses, respirators and safety footwear, LAW will provide PPE as needed for site visitors.

8.2 TRAINING RECORDS

Records will be maintained and available for LAW personnel working at the site to verify compliance with health and safety training requirements. Records available for review should include the type of training completed (initial, refresher, supervisory, and site-specific), the duration, and the dates of training.

9.0 PERSONNEL MONITORING AND PROTECTIVE EQUIPMENT

The use of appropriate personal protective equipment (PPE), in conjunction with site entry, safety, and decontamination procedures will reduce the potential for worker exposure to hazardous substances present at the site. A personal protective equipment (PPE) program established in accordance with 29 CFR 1910.120(g)(5) and 29 CFR 1910.134 will be implemented. The level of protection to be used during field work at the HAAF sites will be determined based upon conditions indicated by previous investigations at the site, and actual site conditions encountered and anticipated. Field personnel must be prepared to upgrade their PPE if an unexpectedly hazardous situation is encountered.

Level D protection will be used initially during non-intrusive field activities at the FTA, and Modified Level D will be used initially during intrusive field activities covered by this plan. PPE will be upgraded to Level C and/or Level B, as warranted by the monitoring of site conditions during work, according to the action levels for monitoring equipment described in Section 5.0.

It should be noted that the use of PPE can itself create hazards such as heat stress, impaired vision and mobility, and communications difficulties. Equipment and clothing will be selected that provides an adequate level of protection, but avoids, to the maximum extent practicable, potentially adverse effects that can result from overprotection. PPE levels and equipment are described below.

9.1 LEVELS OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

Three levels of personal protection (level B through D) are described in this SSHP. If Level A or B PPE is determined to be required to adequately protect workers, work will be stopped and the CESAS-EN-GH Project Manager will be notified so that the contract can be modified to allow upgrade necessary to operate at these levels of protection. The following levels of protection may be used on site according to the conditions encountered during field operations.

9.1.1 Level D PPE

Level D PPE is considered to be the basic work uniform and is the minimum protection level for property boundary and survey tasks performed at on-site and off-site areas. Level D PPE consists of:

- Distinct work clothing (long-sleeved shirts, long pants)
- Safety glasses
- Hard hat (when working around heavy equipment or machinery)
- Steel-toed safety boots meeting ANSI Z41.1 standards
- Ear plugs (as required)

If these tasks require traversing wet or submerged areas, PPE should be upgraded to Modified Level D (described below).

9.1.2 Modified Level D PPE

Modified Level D PPE will be the minimum protection level for intrusive work and sampling activities in wet or submerged areas. Level D and Modified Level D PPE provide no respiratory protection and minimal skin protection. The atmosphere must contain at least 19.5 percent oxygen and no greater than 23 percent oxygen and vapor levels must be below the action levels specified in this SSHP. Modified Level D PPE includes the following clothing and equipment outlined below:

- Safety goggles or glasses
- Hard hat (when working around heavy equipment or machinery)
- Tyvek coveralls or disposable chemical resistant coveralls
- Hip-waders, if field sampling or site activities require working in water or muddy areas
- Chemical resistant gloves, with optional cotton liners (type of gloves to be worn are specified in SSHP)
- Face shield for personnel conducting sampling when splash hazard exists (i.e., monitoring well sampling)
- Ear plugs (as required based on noise level)
- Steel
- Steel-toed safety boots meeting ANSI Z41.1 standards
- Ear plugs (as required)

9.1.3 Level C PPE

Level C PPE includes the use of a full-face air-purifying respirator, and will be used when atmospheric conditions of the indicator chemicals exceed action levels specified in this SSHP, but are below levels Immediately Dangerous to Life and Health (IDLH). Because these respirators do not use supplied air, air purifying respirators will be used only if the atmosphere contains at least 19.5 percent oxygen, but does not contain greater than 23.5 percent oxygen.

Atmospheric concentrations of chemicals must not exceed the maximum use concentration levels specified on the respirator cartridges.

All field personnel will be trained in the proper use of their respirators, and will be qualitatively fit-tested for their individual respirators. Each individual will conduct a negative and positive pressure check prior to each use. When used properly, full-face respirators provide a protection factor of 50.

Level C PPE equipment includes the following:

- Full-face air-purifying respirator, with combination organic vapor/dust and mist/HEPA filter respirator cartridges
- Tyvek coveralls or disposable chemical resistant coveralls
- Chemical resistant gloves, with optional cotton liners
- Disposable outer boots (optional)
- Hard hats (as required)
- Earplugs (as required)

9.1.4 Level B PPE

If Level B conditions are encountered, as described in this SSHP, site work will be terminated, the CESAS-EN-GH Project Manager will be notified by the Site Manager/Site Safety Officer. The contract may then be modified to allow upgrades necessary to operate at this level of protection. Level B equipment includes the following:

- Pressure-demand (positive pressure) self-contained breathing apparatus (SCBA), NIOSH approved, or NIOSH approved pressure-demand supplied air respirator with 5-minute emergency escape bottle

- Chemically resistant hooded coveralls (to be specified in the SSHPs)
- Inner gloves, chemically-resistant
- Outer gloves, chemically-resistant
- Hard hat (as required)
- Disposable outer boots (optional)
- Two-way communication system
- Ear plugs (as required)

Level B can be used only when chemical vapors or gases present cannot be easily absorbed through intact skin or are not harmful to the skin.

9.2 RESPIRATORY PROTECTION

In accordance with the requirements of 29 CFR 1910.134, respirators are selected on the basis of hazards to which the worker is exposed. Air-purifying respirators should not be used under the following conditions:

- Oxygen-deficient atmospheres
- IDLH-level concentrations of site constituents
- Entry into unventilated or confined area where the exposure conditions have not been characterized

- Contaminant concentrations are unknown or exceed designated maximum use concentrations for respirators

- Identified gases or vapors have inadequate warning properties

- High relative humidity may reduce the protection offered by the chemical sorbent material in the respirator

9.2.1 Fit Testing

Fit testing procedures are performed to ensure the proper fit of the respirator, and personal comfort of the user. Qualitative fit testing involving a chemical challenge is performed as part of the initial respirator selection process. These methods are contained in 29 CFR 1910.1028 and include isoamyl acetate (banana oil) and irritant fume testing protocols. Fit testing is performed at least every six months, or if physical changes in face structure have occurred or significant weight gain or loss (greater than 20 pounds) has occurred.

Prior to entry into the Exclusion Zone, the respirator user will perform a positive and negative pressure check upon donning the respirator to ensure a tight face-to-facemask seal. Adjustments will be made until a proper fit is achieved. The respirator is not to be used if a proper seal is not achievable. Facial hair such as beards or long sideburns are prohibited, as they interfere with the seal. Contact lenses are also prohibited.

9.2.2 Respirator Maintenance/Inspection Storage

Air-purifying respirators will be stored and maintained properly and checked before and after each use. Respirators will be dismantled, washed and disinfected after each use. Clean respirators will be stored individually in sealable plastic bags or in their original cartons in a clean, convenient location. Respirators will be inspected before each use for material damage (pliability, deterioration or distortion, cracks, crazing or fogginess). Worn or deteriorated parts will be replaced. Respirator cartridges will be checked to ensure that they are proper for the intended use, the expiration date has not passed, and that they have not been opened or used previously. Based on breakthrough (but only if odor is an adequate warning property, i.e., odor threshold is below the TWA-PEL), cartridges should be changed out when chemical odor is noticeable to worker.

10.0 MEDICAL SURVEILLANCE

All personnel involved in on-site operations must participate in an ongoing medical surveillance program meeting the requirements of OSHA 29 CFR 1920.120/29 CFR 1926.65 (f), ANSI Z-88.2, and 10 CFR 20 before working at the site. The medical surveillance protocols and examination results are overseen by a licensed physician who is certified in Occupational Medicine by the American Board of Preventative Medicine, or who, by necessary training and experience, is Board-eligible.

10.1 MEDICAL EXAMINATIONS

In consultation with the occupational physician, and based upon probable site conditions, potential occupational exposures and required protective equipment, the minimum content and frequencies of required medical examinations are as follows:

- **Initial Examination** (preliminary to employment) - Determines complete medical history and minimum physical requirements. Tests include vision, hearing, smell, speech, drug screening, and urinalysis.

- **Baseline Physical** - Performed prior to potential exposure to hazardous/toxic substances. The baseline examination will establish data to subsequently verify the efficacy of protective measures and to later determine if exposures have adversely affected the worker. The standard biomedical monitoring performed includes a full physical, EKG, chest X-ray, hematology evaluation [including complete blood count, differential and platelet count, hemoglobin and hematocrit, urinalysis, vision screen, executive profile (SMA-22, CBC, thyroid profile), pulmonary function test, audiometry, and proctoscopic examination (at the physician's discretion)].

- **Annual Examination** - Same as Baseline Physical, with the exception that the EKG, chest X-ray, audiometry, and proctoscopic examinations (male personnel only) are performed at the discretion of the examining physician.

- **Special Medical Surveillance Parameters** - Additional examinations and tests may be performed following exposure to hazardous substances, or if deemed necessary by the examining physician, as indicated by the medical history and/or initial examination results. The evaluation will be repeated as indicated by substandard performance or evidence of particular stress evidenced by injury or time loss due to injury by the worker.

- **Final Examination** - A final examination will be performed for any employee terminating employment.

10.2 MEDICAL SURVEILLANCE RECORDS

Records certifying the participation of the worker in the medical surveillance program, the date of the last examination, and name of reviewing occupational physician will be maintained in the employees file for each employee. The written medical opinion from the attending physician as to fitness for site work and wearing respiratory protection is maintained in the employee's files and will be made available upon request for any LAW employee. Subcontractor personnel will be required to supply fitness for work certification prior to work on the sites.

10.3 FITNESS FOR WORK CERTIFICATION

At a minimum, each person who wears respiratory protection must meet the requirements of 29 CFR 1910.134. A certification in the employee's files from the examining physician is required stating the person is "fit for duty" to wear the required PPE, including air-purifying respirators or SCBA, and perform the required work.

11.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Monitoring for the presence of hazardous conditions will be performed during work to prevent personnel exposure to chemical and physical hazards. Information gathered from air monitoring will be used to determine appropriate on-site protective measures and to design appropriate contingency plans and/or control measures which limit the potential for migration of constituents away from the site. Monitoring activities and equipment are described in the following sections.

11.1 MONITORING EQUIPMENT USE AND LIMITATIONS

Monitoring instruments to be used at the site include the following: a photoionization detector; a combination combustible gas/oxygen/hydrogen sulfide indicator; and chemical detector tubes able to quantify specific organic vapor levels. Limitations on the use and application of monitoring instruments will be described in this section of the SSHP. All atmospheric monitoring equipment will be calibrated daily in accordance with the manufacturer's instructions. Table 11-1 lists the tasks, and monitoring equipment, to be used when measuring combustible gases, oxygen, and organic vapors, during site activities.

11.1.1 Vapor Monitoring

Monitoring for organic/inorganic vapors will be performed in the breathing zone of the worker nearest to the borehole during intrusive activities and/or at the source (as appropriate) to determine appropriate levels of PPE to be used during work. A photoionization detector (PID) will be used in conjunction with chemical-specific detector tubes to detect organic vapor levels.

Atmospheric monitoring measurements obtained are compared with 50 percent of the OSHA Permissible Exposure Limits (PELs) and/or 50 percent of the ACGIH Threshold Limit Values, whichever standard is lower. Site-specific action criteria based on the results of vapor monitoring are specified in the site-specific SSHPs.

TABLE 11-1

AIR MONITORING EQUIPMENT CRITERIA FOR FIELD INVESTIGATION ACTIVITIES
Hunter Army Airfield FTA
Savannah, Georgia

TASKS TO BE PERFORMED	TYPE OF ACTIVITY	MONITORING EQUIPMENT
Soil Borings	Intrusive	Combustible Gas Indicator Oxygen Meter PID/Draeger Tubes*
Monitoring Well Installation	Intrusive	Combustible Gas Indicator Oxygen Meter PID/Draeger Tubes*
Soil Sampling	Intrusive	Combustible Gas Indicator Oxygen Meter
Ground-water Sampling	Intrusive	Combustible Gas Indicator Oxygen Meter PID/Draeger Tubes
Monitoring Well Development and Sampling	Intrusive	Combustible Gas Indicator Oxygen Meter PID/Draeger Tubes*

11.1.1.1 Photoionization Detector (PID) - The PID is designed for use with interchangeable probes with lamps of different energies (10.2 eV, 9.5 eV, and 11.7 eV). Lamps are selected based on the ionization potential (IP) of suspected contaminants on site; the lamp energy must be equal to or greater than the IP of a compound for the compound to be detected.

The PID is sensitive to many organic and inorganic vapors/gases and therefore, cannot be used as a qualitative instrument in unknown situations. It is strictly quantitative except when the nature of the contamination is known, and the instrument has been calibrated. High humidity decreases the sensitivity of the PID and therefore should not be used during rainfall. Atmospheres with concentrations of gases above the upper range of the instrument may cause inconsistent behavior.

A 11.7 eV lamp will be used in the PID and the span control will be set at 9.8 (benzene equivalent). Action levels for the PID are designed to be used in conjunction with the benzene detector tubes (Draeger tubes) and are based on half of the lowest TWA PEL or TLV of the suspected contaminants. Readings for the Draeger tubes and for the PID are referenced to above background and reflect those sustained for greater than 5 seconds in the breathing zone. If action levels requiring the use of Draeger tubes are reached, Draeger tube monitoring shall be performed every 15 minutes until PID concentrations fall below action levels.

11.1.2 Oxygen, Hydrogen Sulfide and Combustible Gas Monitoring

A portable triple-gas monitor will be used to monitor the atmosphere for oxygen, hydrogen sulfide, and combustible gases. Oxygen levels are monitored to determine the presence of oxygen-deficient or oxygen-enriched (flammable/explosive) atmospheres. Monitoring for hydrogen sulfide (H_2S) gas will be performed to determine its presence in ambient air at applicable sites (i.e., landfills). Combustible gas levels will also be monitored to determine the fire or explosion hazard and actions to be taken in response to these hazards.

The triple-gas meter will be used continuously on sites where there is the potential for vapor buildup or the potential for oxygen deficient/oxygen enriched atmospheres. Readings will be taken at the source (i.e., at the tops of boreholes and monitoring wells) and in the breathing zone. Air-purifying respirators do not protect against oxygen-deficient atmospheres and should not be used when these conditions are present.

Air-purifying respirators do not provide protection for hydrogen sulfide (H_2S) gas, due to its low PEL and poor warning properties. Level B PPE must be used in oxygen-deficient atmospheres and when H_2S gas levels exceed the action level. Action criteria based on oxygen, H_2S, and explosive gases are presented in Section 5.4.3.

11.1.3 Chemical-Specific Detector Tubes

Chemical-specific detector tubes will be used to detect and quantify specific organic vapor levels at the sites. Detector tubes indicate the presence of a particular chemical by a color change in the tube's packing material. A pre-specified sample volume is drawn through the detector tube at a constant flow rate. If the sample contains the vapor or gas in question, it will react with the chemical on the packing material, resulting in a color change. Action criteria for organic vapors are provided in Table 11-2.

11.2 MONITORING ACTIVITIES

Monitoring for chemical and physical hazards during site activities is a primary component of this SSHP. The monitoring program is described in the following section.

TABLE 11-2

MONITORING EQUIPMENT AND ACTION GUIDELINES
Hunter Army Airfield FTA
Savannah, Georgia

EQUIPMENT:	* OXYGEN MONITOR$^{(a)(b)}$		COMBUSTIBLE GAS INDICATOR$^{(a)}$ (EXPLOSIMETER)		PHOTOIONIZATION METER (PID) AND CHEMICAL-SPECIFIC DETECTOR TUBES$^{(c)}$			
ACTION GUIDELINES:	Oxygen Level	Action	LEL Levels	Action	PID Levels (ppm)		Draeger Tube Benzene Levels/ Vinyl Chloride Levels (ppm)	Action
	19.5-23.5%	Normal Oxygen Level	0-10%	No explosion hazard	0-1			Modified Level D
	>23.5%	Fire/Explosion hazard; Stop tasks, evacuate site; notify Site Manager			1-5	and	0-0.5	Modified Level D; begin monitoring for benzene (with 0.5/a Draeger tube) and vinyl chloride (with 1/a Draeger tube) every 15 min.
	<19.5%	Oxygen deficient; Stop tasks, evacuate site; notify Site Manager; upgrade to Level B	>10%	Explosive hazard exists; stop tasks; evacuate site; notify Site Manager	5-250	and/or	1-25	Level C
					>250	and	>25	Stop work; notify COE regarding need to upgrade to Level B

(a) Monitoring to be conducted at top of borehole
(b) Used in conjunction with combustible gas indicator to confirm combustible gas indicator function
(c) Monitoring to be conducted in breathing zone of worker nearest to borehole; concentrations sustained for 5 min. above background.

11.2.1 Meteorological Monitoring

Meteorological monitoring will be conducted at each site to assess the possibility of varying sample results and to assess the potential for physical hazards (i.e., heat and cold stress). Meteorological information that will be collected includes, but is not limited to, the following:

- Temperature
- Wind direction
- Wind speed

Temperature may affect the performance of the monitoring equipment. Wind speed and direction are used to assess possible contaminant migration, and are used to set up the location of exclusion zones, support zones, etc. Wind speed is also used for estimating cold stress to workers at the sites.

11.2.2 Noise Monitoring

Unacceptable levels of noise can be expected when working in close proximity to aircraft and drilling equipment. It should be assumed that hearing protection will be required when working around drilling operations or within 250 feet of an aircraft which is revving its engines or when working in a flyover zone at HAAF.

Hearing Protection:

- Expandable foam earplugs will be worn whenever personnel are working in proximity of drilling operations or operational aircraft.

- Minimum Noise Reduction Rating (NRR) for earplugs or muffs is greater than or equal to 25.

- Hand signals will be used when noisy conditions exist and/or when hearing protection equipment is used. The hand signals to be used will be discussed and agreed upon by site personnel before continuing work with hearing protection.

11.2.3 Dust Monitoring and Control

When soil contamination exists, the potential exists for inhalation and/or skin exposure to contaminated fugitive dusts re-suspended by mechanical disturbance or wind. There is a potential for skin and/or inhalation exposure to dusts that may be contaminated with metals at this site. Prior to performing field activities in dry, dusty areas where particulate matter is likely to be encountered, workers will wet down the area of activity with water in order to decrease dust generation and the potential for dust inhalation. If the wetting process is expected to result in potentially contaminated run-off, measures to contain run-off should be undertaken. In the event that dust suppression measures are not possible, personnel must wear Level C protection, including full-face air purifying respirators with HEPA cartridges when intrusive activity produces dusty conditions. The presence of visible dust emissions will be the criterion upon which PPE upgrade or dust suppression measures will be implemented.

11.2.4 Logs and Recordkeeping

Instrument calibration information and the results of monitoring should be documented daily in the SSO's field log for each site. An example of the appropriate format is given in Figure 11-1.

11.2.5 Heat and Cold Stress Monitoring

The Site Manager will provide all project personnel with the necessary training and monitoring designed to prevent personnel injury due to heat or cold stress, as dictated by weather conditions. This monitoring shall commence when the ambient environmental temperature

FIGURE 11-1

DAILY INSTRUMENT CALIBRATION FORM
Hunter Army Airfield FTA
Savannah, Georgia

SITE LOCATION: ______________________ DATE: __________

CALIBRATION PERFORMED BY: ______________________

CALIBRATION STANDARD: __________ CONCENTRATION: __________

INSTRUMENT CALIBRATED (specify model)/serial no.	DATE/ TIME	INSTRUMENT READING	INITIALS	COMMENTS

exceeds 70 degrees Fahrenheit (for heat stress) or falls below 40 degrees Fahrenheit (for cold stress). In addition, all field personnel will be provided rest breaks. The break areas shall be situated so that personnel may remove the chemical-protective clothing, rest in a protected area, and drink cool or warm fluids (as the weather dictates). Working within protective clothing, such as may be required for this project, places a significant physiological stress upon the worker. For this reason, the personnel and environmental measurements described below will be conducted for those personnel required to wear chemical-protective clothing as a part of this project. In very hot conditions, careful thought should be given as to type of PPE worn. In some cases, PPE should be downgraded as much as possible, since the onset of heat stress may be a greater hazard than the actual constituent of concern.

11.2.5.1 Heat Stress Monitoring - Heat stress can be a major hazard for personnel wearing PPE. Depending upon the ambient conditions and the work being performed, onset of heat stress can be rapid.

Early signs of heat stress include heat rash, heat cramps (muscle spasms), discomfort and drowsiness. Continued heat stress can result in heat exhaustion, with symptoms including pale, cool, moist skin, heavy perspiration, dizziness, nausea and fainting. Extreme heat stress can result in heat stroke, as body temperature regulation fails and the body temperature rises to critical levels. Symptoms of heat stroke include red, hot, usually dry skin, absence of or reduced perspiration, nausea, dizziness and confusion, strong, rapid pulse and coma. Measures to prevent the occurrence of heat stress consist of avoiding overprotection, training and monitoring of personnel wearing PPE, scheduling of work and rest periods, and frequent replacement of fluids.

During hot working conditions, rest breaks shall be established based upon the results of physiological monitoring combined with environmental factors measured using a Wet Bulb Globe Temperature index (WBGT). WBGT values are calculated using the following equations (ACGIH, 1993 - 1994):

1. Outdoors with solar load:

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

2. Outdoors with no solar load:

$$WBGT = 0.7NWB + 0.3GT$$

where:
WBGT = Wet Bulb Globe Temperature
NWB = Natural Wet Bulb Temperature
GT = Globe Temperature

The determination of WBGT will be performed, by the Site Manager, using a heat stress monitor containing a black globe thermometer, a natural wet-bulb thermometer, and a dry-bulb thermometer. The WBGT and the Permissible Heat Exposure Threshold Limit Values provided in Table 11-3 (ACGIH, 1993-1994) will be used to determine the Work-Rest schedule.

If symptoms of heat stress are exhibited by workers, the pulse rate and body temperature will be monitored during all tasks (as deemed appropriate by the Site Manager). Action guidelines are as follows:

- Pulse rate: Determine normal resting pulse rate prior to start of work. Monitor pulse rate as soon as possible at beginning of rest period. If the rate exceeds the determined normal resting pulse rate by 40 beats per minute (BPM), shorten the next work period by one-third without changing the rest period. If the pulse rate is greater than 40 BPM above the resting pulse rate at the start of the next rest period, shorten the following work cycle again by one-third. Repeat until pulse rate at beginning of rest period is less than 40 BPM above resting pulse rate.

- Body Temperature: Determine the body temperature at the end of the work cycle and before drinking. If the temperature is greater than 99.6 degrees Fahrenheit (37.6 degrees Celsius), shorten the next work cycle by one-third without changing

TABLE 11-3

ACGIH PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES
Hunter Army Airfield FTA
Savannah, Georgia

WORK/REST REGIMEN	WORK LOAD		
	LIGHT	MODERATE	HEAVY
Continuous Work	86°F (30.0°C)	80°F (26.7°C)	77°F (25.0°C)
75% Work 25% Rest (each hour)	87°F (30.6°C)	82°F (28.0°C)	78°F (25.9°C)
50% Work 50% Rest (each hour)	89°F (31.4°C)	85°F (29.4°C)	82°F (27.9°C)
25% Work 75% Rest (each hour)	90°F (32.2°C)	88°F (31.1°C)	86°F (30.0°C)

NOTE: Values are given in °F (and °C) Wet Bulb Globe Temperature. For unacclimatized workers, the permissible heat exposure TLV should be reduced by 2.5°C.

Reference: 1993-1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists.

TLV WBGT CORRECTION FACTORS IN °C FOR CLOTHING

Clothing Type	Clo Value*	WBGT Correction
Summer work uniform	0.6	0
Cotton coveralls	1.0	-2
Winter work uniform	1.4	-4
Water barrier, permeable	1.2	-6

*Clo: Insulation value of clothing. One clo unit = 5.55 kcal/m^2/hr of heat exchange by radiation and convection for each °C of temperature difference between the skin and adjusted dry bulb temperature.

the rest schedule. Repeat. **DO NOT** permit a worker to wear semipermeable or impermeable clothing when his/her body temperature exceeds 100.6 degrees Fahrenheit (38.1 degrees Celsius).

11.2.5.2 Cold Stress - Cold injury (frostbite and hypothermia) and impaired ability to work are dangers at low temperatures and when the wind-chill factor is low. Prolonged exposure to cold air with a high wind chill factor or immersion in cold water can produce hypothermia at temperatures well above freezing. Symptoms of cold stress include pain in the extremities and severe shivering. A marked reduction in body temperature reduces mental alertness and the ability to make rational decisions and may result in loss of consciousness with potentially fatal consequences. Cold exhaustion is another potential adverse effect which can occur with strenuous field operations during cold weather. Measures to prevent cold stress and injury include ensuring that workers are appropriately dressed to prevent exposure to cold so that their deep core temperature does not fall below 98.6 degrees Fahrenheit (36 degrees Celsius); providing warm shelter for workers; monitoring the physical condition of workers; and implementing a work/rest schedule to allow workers to replenish liquids and calories.

Permissible cold exposure TLVs for work where dry clothing is worn are shown in Table 11-4.

TABLE 11-4

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

Hunter Army Airfield FTA
Savannah, Georgia

Wind Speed in mph	ACTUAL THERMOMETER READING (F)									
	50	40	30	20	10	0	-10	-20	-30	-40
	EQUIVALENT TEMPERATURE (F)									
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-49	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
(Wind speeds greater than 40 mph have little additional effect)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.			GREAT DANGER Flesh may freeze within 30 seconds.		
	Trenchfoot and immersion foot may occur at any point on this chart.									

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

12.0 STANDARD OPERATING PROCEDURES/ENGINEERING CONTROLS AND WORK PRACTICES

The following procedures will be used during the investigations at HAAF to protect the health and safety of on-site personnel.

12.1 GENERAL SITE RULES/OPERATING PROCEDURES

- Personnel will not be permitted to work when sick or injured.

- Hand signals will be established to maintain communications when noisy conditions are present (see Section 13.3 for standard hand signals). These signals will be reviewed by the SSO prior to the start of work each day.

- Any facial hair which interferes with the face to face-piece seal of the respirator will not be permitted on personnel required to wear such equipment. Contact lenses will not be allowed to be worn in conjunction with the use of respiratory protection. Arrangements should be made by the SSO prior to site mobilization to obtain spectacle kits for those who may need them.

- Procedures for entering and leaving the Exclusion Zone will be planned and reviewed by the SSO prior to entering the site.

- No personnel will be admitted to the site without proper safety equipment and training. Authorized visitors will be briefed by the SSO regarding the SSHP and emergency procedures before entering work areas.

- All personnel will be required to comply with the safety procedures established in this document. Any person who does not comply with safety policy, as established by the SSO, will be immediately dismissed from the site.

- Any medical emergency supersedes routine safety and decontamination requirements. If an employee experiences a life-threatening accident or illness, decontamination is <u>not</u> necessary prior to medical treatment or transport to a medical facility if the decontamination process will aggravate the injury or delay life-saving treatment. Figure 12-1 is an example of a decision aid for determining if emergency decontamination is necessary (NIOSH/OSHA/USCG/EPA, 1985).

- Portable generators/welders shall have an effective ground rod installed and bonded.

- Illumination levels, in the general work area, must average no less than 5-foot candles.

12.1.1 <u>Buddy System</u> -

- A buddy system will be used at all times when working at HAAF. Work teams will be established prior to site entry by the Site Manager. The buddy will provide his/her partner with assistance; observe his/her partner for signs of chemical, physical, or biological exposure; periodically check the integrity of his/her partners PPE; and notify the SSO if emergency help is needed.

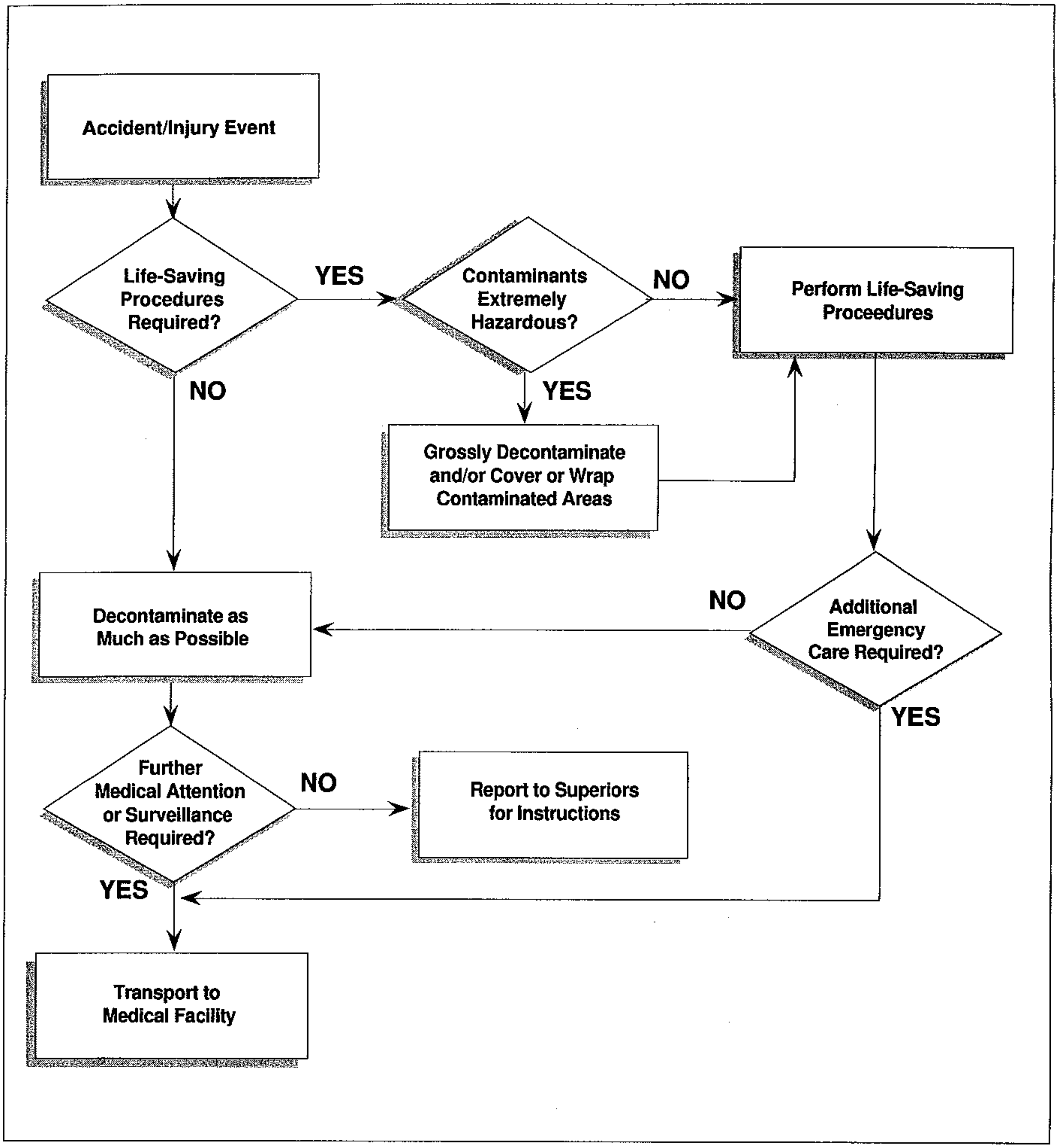
- During site operations, each worker will consider himself/herself as a safety backup to his/her partner. Arrangements will be made with off-site personnel to provide emergency assistance prior to site entry and commencement of work. All personnel will be made aware of dangerous situations that may develop in the course of work and response actions to be taken to prevent accidents and respond to emergencies.

- Visual contact will be maintained between buddies in the Exclusion Zone at all times.

FIGURE 12-1

DECISION AID FOR EMERGENCY DECONTAMINATION

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



Source: NIOSH / OSHA / USCG / EPA, 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. USDHHS.

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12.1.2 Eating, Drinking, Smoking

Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of hazardous material is prohibited in the Exclusion Zone and CRZ. A rest area in which eating/drinking/smoking will be permitted will be established in a clean area in the Support Zone.

12.1.3 Use of Alcohol and Drugs

The use of illegal drugs is prohibited at the site. Alcoholic beverage intake is prohibited at all HAAF locations and during the work day at any location.

12.2 SITE ENTRY PROCEDURES

Before entering the work site, all field personnel will review site-specific information and work procedures for:

- Expected hazards
- Special conditions such as natural disasters or multiple person injuries
- Procedures related to proper performance of task
- Hand/horn signals
- Decontamination facility location and procedures
- Locations of telephones and emergency equipment
- Emergency medical information, including hospital location
- Level(s) of initial PPE required and action levels for upgrade
- Location of supplies and equipment
- Condition and functioning of safety gear and equipment

The following equipment will be used at the site depending on site-specific conditions:

- Standard Tyvek or chemical resistant coveralls and coverall hoods
- Hard hats
- Goggles or safety glasses
- Chemical-resistant gloves, latex gloves, cotton underliner gloves
- Steel-toed neoprene safety boots meeting ANSI Z41.1 standards
- Disposable outer boot covers
- Face shields
- Full-face, air-purifying respirator with combination cartridges suitable for organic vapors, dusts, mists
- Emergency eyewash
- First aid kit(s)
- Field standard operating procedures and safety references
- Plastic bags to keep spare equipment clean

Backup equipment and spares will be maintained, including, but not necessarily limited to:

- Duct tape
- Respirator wipes or isopropyl alcohol swabs
- Disinfectant spray for boots and gloves
- Trash containers, plastic bags, and drop cloths
- Decontamination supplies (tubs, brushes, decontamination solutions)
- Paper towels
- Extra PPE supplies
- Extra air monitoring supplies

Set up buddy system and work teams prior to entering site. If any person develops any physical discomfort, such as lightheadedness, the worker must stop work, notify his buddy, return to the designated contamination reduction zone and report to the SSO.

12.3 SITE ACTIVITIES

This section describes activities to be performed on site at HAAF.

12.3.1 Material Handling Procedures

Material handling will be performed in accordance with the requirements of 29 CFR 1910.120. Drums and containers will meet the Department of Transportation (DOT), OSHA, and Environmental Protection Agency (EPA) regulations for the materials that they are to contain.

12.3.2 Drilling and Well Installation

In addition to those previously described, the following safety and operating procedures should be followed at all times during drilling and well installation operations:

- Underground utilities and overhead lines (i.e., sewer, water, gas, electric, fuel) will be located and locations marked prior to starting any excavation work.

- Equipment furnished for use on the site is to be maintained in safe operating condition and be operated by qualified operators. Any cranes, pressure vessels, and large earth-moving equipment will have valid certificates and logs of inspection and maintenance. All equipment used on site will be inspected daily at the start of each work shift.

- Portable electric tools shall be protected with ground fault circuit interrupters.

- Hand tools are to be kept clean and serviceable and shall be neatly arranged. Non-sparking tools should be used in areas where explosive or flammable liquids were manufactured or stored.

- Worn or otherwise defective tools will be immediately repaired and/or replaced.

- Adequate provisions will be made to prevent pipe, drill collars, drill stems, or similar round material from accidentally rolling off a storage rack.

- Personnel will not be permitted on, or on the ground adjacent to, a vehicle on which pipe, or similar round material, is loaded, where they would be in danger of such material rolling off the vehicle, unless one or more of the following precautions have been taken:

  a. The pipe or similar round material on the vehicle is secured with binder chains or similar devices.

  b. An adequate number of stakes of sufficient height and strength are in the vehicle bed or bolsters.

  c. The skids for rolling or skidding the pipe or similar round material to or from the vehicle are securely in place.

- In using chains, avoid sudden or abrupt application of loads. Take up slack slowly and see that every link in the chin seats properly.

- Where toxic materials are used, only authorized personnel will handle the materials, and safety equipment should be specified and used.

- All drilling operations will be monitored, either by area testing or personnel testing, for organics and inorganics (hydrogen sulfide). In addition, the combustible gases will be monitored. If elevated readings are encountered above action levels, appropriate action must be taken to provide personnel with appropriate protection.

12.3.3 Safe Working Distances From Power Lines

Safe working distances of drill rigs/heavy equipment from power lines are indicated below (USACE, 1977).

- When operating near high voltage power lines:

Normal Voltage (phase-to-phase)	Minimum Required Clearance
< 50 kV	10 ft. (3.05 m)
50 to 100 kV	12 ft. (3.66 m)
101 to 200 kV	15 ft. (4.60 m)
201 to 300 kV	20 ft. (6.10 m)
301 to 500 kV	25 ft. (7.62 m)
501 to 750 kV	35 ft. (10.67 m)
751 to 1000 kV	45 ft. (13.72 m)

- While in transit with no load and boom or mast lowered:

Normal Voltage (phase-to-phase)	Minimum Required Clearance
< 50 kV	4 ft. (1.22 m)
50 to 345 kV	10 ft. (3.05 m)
> 345 kV	16 ft. (4.87 m)

No work shall be performed, i.e., raising of the mast, without first contacting appropriate site personnel as to electric hazards involved.

12.3.4 Machine Guarding

The following requirements for machine guarding will be followed:

- All self-propelled construction equipment, whether moving alone or in combination, will be equipped with a reverse signal alarm. The alarm should operate automatically upon commencement of backward motion and continue throughout the duration of backward motion.

- All reciprocating, rotating or moving parts should be guarded when exposed to contact by persons or otherwise create a hazard.

- All equipment hot surfaces, including exhaust pipes, should be guarded or insulated to prevent personnel injury or fire.

- Protection against the elements, falling or flying objects, swinging loads and similar physical hazards will be provided for operators of all machinery equipment.

- Getting on or off any equipment while in motion is prohibited.

12.3.5 Fall Protection

The activities to take place at HAAF will not take place over water, machinery, dangerous operations, or more than 25 feet above ground surface. Safety nets will not be required during work at the site.

12.3.6 Illumination

Supplemental illumination will not be needed for most of the work at HAAF, as the work will be taking place out-of-doors during daylight hours. If entry into confined spaces is to take place, artificial lighting will be necessary [per 29 CFR 1910.120(m)]. Where artificial light is used, it will be intrinsically safe and maintained until all personnel have exited the area.

12.3.7 Sanitation

Potable water will be available in the Support Zone [per 29 CFR 1910.120 (n)]. Personnel should wash hands with potable water prior to exiting the area. There shall be absolutely no smoking, eating or drinking in any zone other than that of the support zone.

13.0 SITE CONTROL MEASURES

Delineation of work zones, communications procedures, and site access procedures implemented at HAAF are discussed in this section.

13.1 SITE ACCESS AND SECURITY

A check-in and check-out system will be used so that there is a written record of all personnel, including visitors, in each work zone at all times. This information may be recorded in the field log book.

13.2 WORK ZONES

Each site will be divided into three zones, based on the potential for exposure to hazardous conditions and activities to be performed:

- Exclusion Zone
- Contamination Reduction Zone (CRZ)
- Support Zone

13.2.1 Exclusion Zone

The Exclusion Zone is the area of greatest contamination and presents the highest potential for worker exposure to hazardous conditions. The Exclusion Zone includes all active work areas. The outer boundary of the Exclusion Zone will be clearly marked, and access will be restricted to personnel performing tasks at the site. Personnel entering the Exclusion Zone must wear the mandated level of PPE designated for the task to be performed and upgrade PPE as conditions warrant. The determination of the boundaries of the Exclusion Zone will be specific for each site and will be indicated in the SSHPs for each site.

13.2.2 Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) serves as a transition area between the Exclusion Zone and Support Area. Personnel and equipment decontamination facilities will be located in the CRZ.

13.2.3 Support Zone

The Support Zone serves as a clean control area. This area serves as the safety center where the following safety equipment can be obtained:

- Fire extinguishers
- First aid kit
- Emergency eye wash
- Emergency oxygen unit (as appropriate)
- Emergency SCBA equipment (as appropriate)
- Ice

The Support Zone includes a changing area for personnel to change into street clothes after decontamination, a break area where food and beverages can be consumed, and equipment storage and maintenance areas.

13.3 SITE COMMUNICATIONS

Emergency telephone numbers and reporting instructions for emergency response, ambulance, physician, hospital, fire and police will be conspicuously posted at the work site. All field personnel are briefed concerning emergency response procedures and chain of command during emergencies.

An internal communication system consisting of hand signals as well as voice communications will be adopted by field personnel when noisy conditions exist at the site or PPE precludes verbal communication. The choice and use of hand signals will be coordinated during on-site safety briefings. Sample hand signals are presented below.

HAND SIGNAL	MEANING
Hands on top of head	Need assistance
Grip partner's wrist or place both hands around partner's arm	Leave area immediately
Thumbs up	OK; I'm alright
Thumbs down	No; Negative
Hand gripping throat	Cannot breathe; out of air
Pointed finger on extended arm	Look in that direction
Wave hands over head from side to side	Attention; Standby for next signal
Swing hand from direction of person receiving signal to directly overhead and through in a circle	Come here

A system of horn signals can be developed for communicating with personnel in work areas from the CRZ or Support Zone. Examples of horn signals are presented below. Additional signals can be developed as necessary.

SIGNAL	MEANING
Three short blasts	Caution, or look here
Long blast	Leave work zone area

14.0 PERSONAL HYGIENE AND DECONTAMINATION

The purpose of decontamination is to remove or neutralize contaminants that have accumulated on personnel and equipment. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate protective clothing and other equipment used on site. It also minimizes the transfer of contaminants to clean areas and protects the community by preventing uncontrolled transportation of contaminants off site. All personnel will complete appropriate decontamination prior to leaving the site in a manner that is responsive to actual site conditions. A personnel decontamination area will be set up at an appropriate location specified by the SSO. The decontamination process will consist of a series of procedures performed in a specific sequence. Each procedure is performed at a separate station in order to prevent cross-contamination.

14.1 DECONTAMINATION FACILITIES

A drop cloth constructed of polyethylene sheeting will be laid out in the area initially.

A detergent solution will be adequate to remove the chemical constituents identified at the sites. Wash tubs containing dilute detergent decontamination solution and soft-bristle brushes will be used to clean reusable personal protective clothing and boots. Following the detergent wash, equipment will be rinsed at least once using clean, potable water. Decontamination solutions and rinse waters will be drummed and disposed of in a manner consistent with the handling of hazardous wastes.

Trash receptacles will be provided for all disposable items. The receptacles can be conventional trash cans lined with heavy duty polyethylene trash bags.

Personal hygiene primarily entails washing and is not strictly considered decontamination. Each individual should conduct proper personal hygiene, which includes washing of hands, face, and any exposed skin prior to eating, drinking, smoking and leaving the site. It is recommended that each person shower at the end of each work day. Routine showering facilities will not be provided in the Support Zone. OSHA 29 CFR 1910.120 requires that shower facilities be provided only when remediation exceeding six months in duration is performed on site.

14.2 DECONTAMINATION EQUIPMENT AND SUPPLIES

Supplies that will be available for personnel decontamination procedures include:

- Tubs for washing and rinsing equipment
- Detergent (i.e., Alconox)
- Scrub brushes (soft bristle)
- Potable water source (to be provided by HAAF)
- Drying rack for equipment drying
- Aluminum foil for wrapping clean equipment
- Respirator wipes and bags for clean respirator storage
- Paper towels
- Trash receptacles and polyethylene bags
- Hand soap
- Receptacle(s) for storage of decontamination liquid wastes pending disposal
- Drop cloths (polyethylene sheeting)

14.3 DECONTAMINATION PROCEDURES

This section describes the personnel decontamination procedures to be implemented at HAAF for specific levels of PPE.

14.3.1 Level D Decontamination

A minimum decontamination for Level D site work consists of cleaning and removal of boots and gloves, changing into street shoes before leaving the site, and washing hands and face.

14.3.2 Level C Decontamination

The decontamination layout depicted in Figure 14-1 will be adjusted to accommodate actual site conditions. Decontamination procedures for Level C include the following:

First Drop Site

- Field equipment is placed at the first drop site for later decontamination.
- Boot covers and gloves are washed with detergent solution and rinsed in clean, potable water.
- Boot covers and outer gloves are removed. Boots and/or safety suit (nondisposable) are washed with a detergent solution and rinse with clean, potable water.
- Disposable clothing is removed and discarded into the trash receptacle.

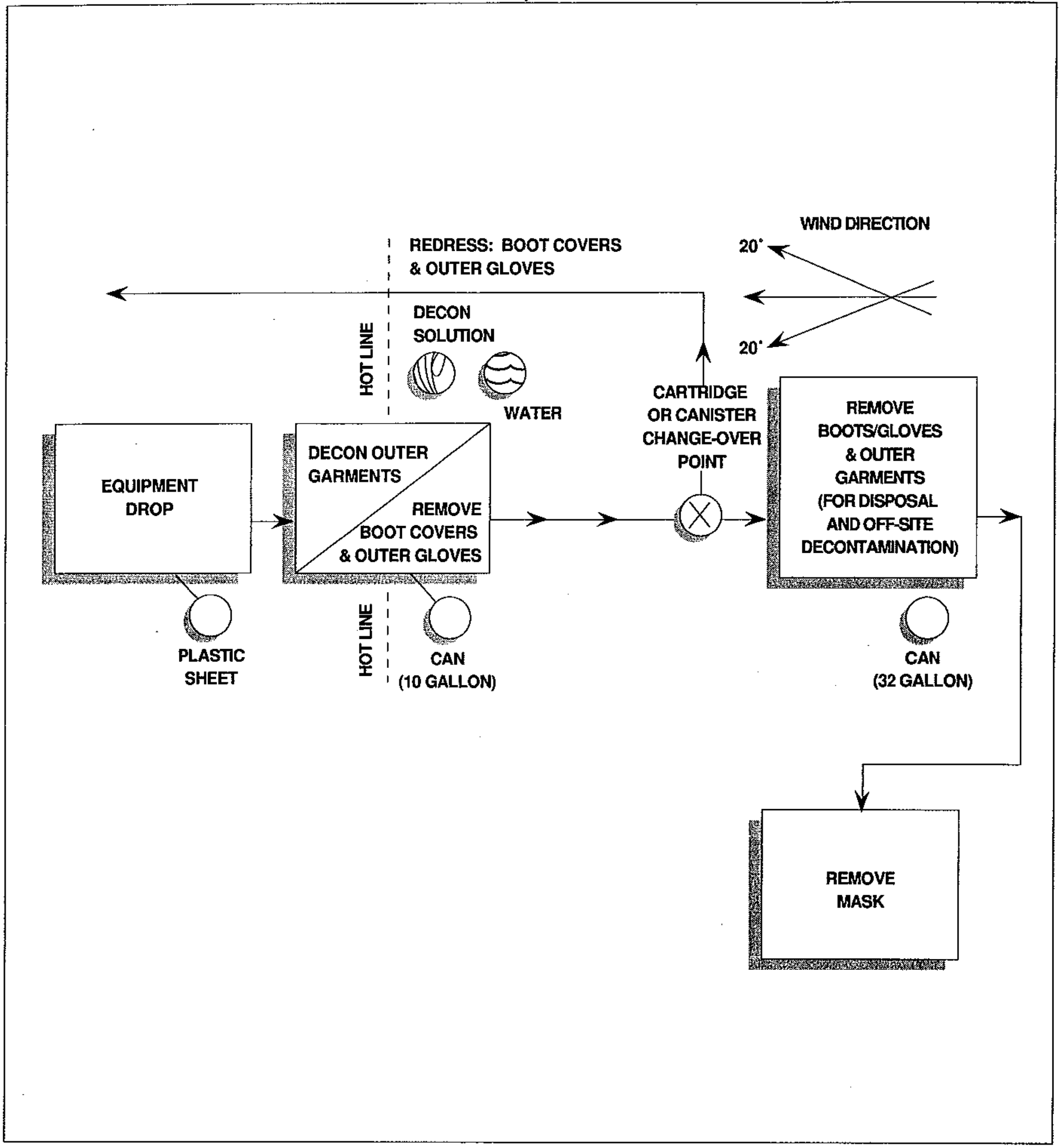
Second Drop Site

- Nondisposable inner gloves, hard hats, and boots are removed and deposited at a second drop site.

FIGURE 14-1

DECONTAMINATION LAYOUT LEVEL C PROTECTION

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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Third Drop Site

- Respirators are removed, washed, swabbed down with respirator wipes and bagged for storage. Used respirator cartridges are removed and disposed. Respirators are left at the third drop site for cleaning. A disinfectant solution (i.e., CIDEX) will be used on a regular basis to disinfect the respirators. (Note: Personnel with respiratory tract infections, however minor they may seem, should disinfect their respirators at least weekly).

- Street shoes can be put on. All personnel will thoroughly wash face and hands before exiting the site.

14.3.3 Level B Decontamination

The decontamination layout depicted in Figure 14-2 will be adjusted to accommodate actual site conditions. Decontamination procedures for Level B include the following:

First Drop Site

- Field equipment is placed at the first drop site for later decontamination.

- Nondisposable boots/boot covers, gloves and outer garments are washed with detergent solution and rinsed in clean water.

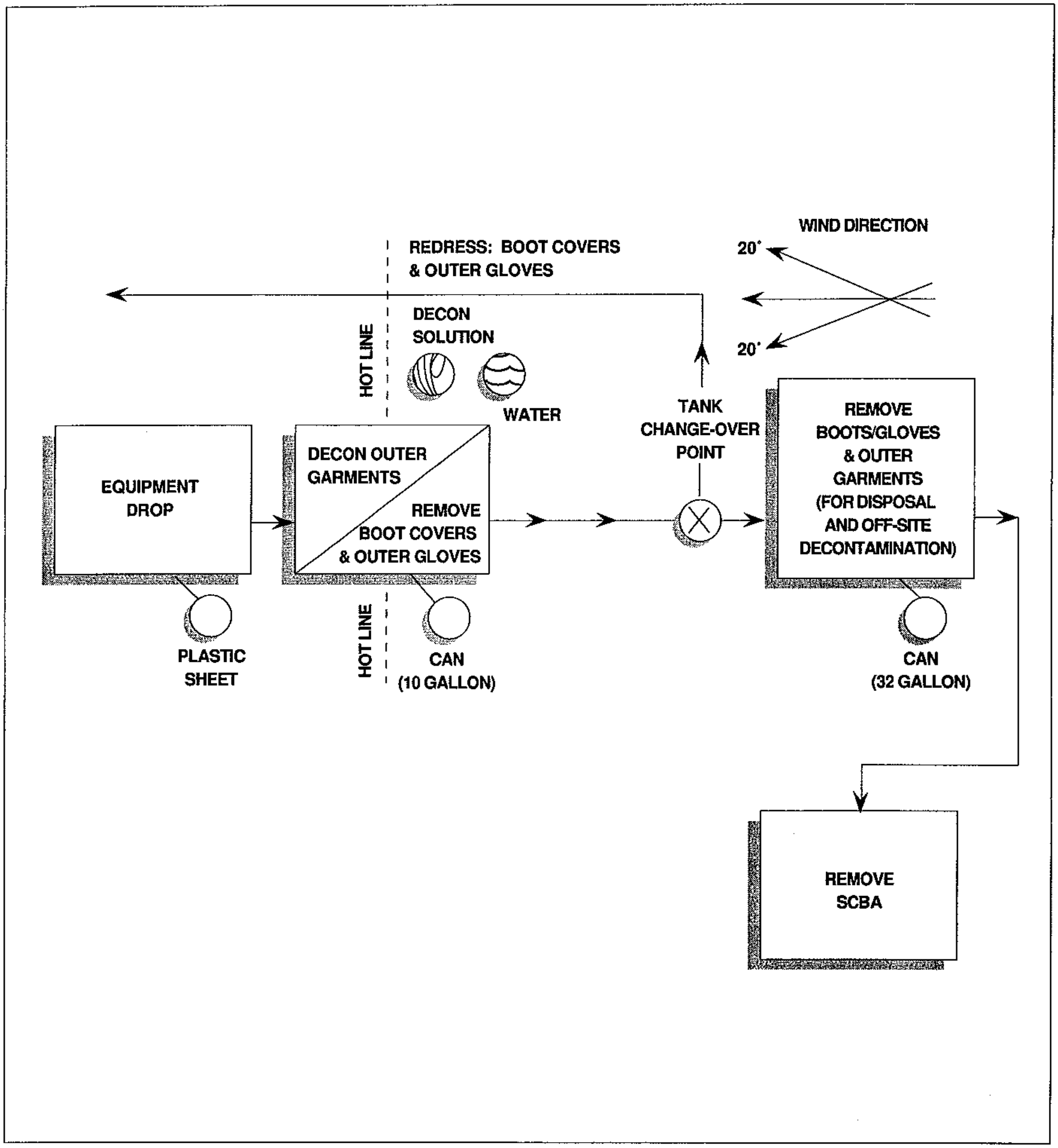
Second Drop Site

- Boot covers and outer gloves are removed and disposed at second drop location. Boots and/or safety suit (nondisposable) is washed.

FIGURE 14-2

DECONTAMINATION LAYOUT
LEVEL B PROTECTION

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



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Third Drop Site

- For site exit, clothing, boots, inner gloves and hard hats are removed and deposited at a third drop site. SCBA equipment is removed and segregated for decontamination. Street shoes can be put on. All personnel are to thoroughly wash face and hands before exiting the site.

- For SCBA tank change-out, SCBA tank can be replaced following decontamination of outer garments and removal of contaminated boot covers and outer gloves. Redress, including clean boot covers and outer gloves is performed following tank change. Return to work site.

  Note: An occasional CIDEX or Clorox wash of inside of boots is recommended to alleviate odor problems. A thorough rinse is required after such use.

14.4 EQUIPMENT DECONTAMINATION PROCEDURES

Heavy equipment will be decontaminated after use to prevent cross-contamination of sites and transport of contaminants off site. Equipment requiring decontamination during remedial investigation activities at HAAF includes drilling and excavation equipment. This equipment will be cleaned using a high-pressure water washer and steam cleaner when it shows signs of gross contamination and prior to leaving the site. One or more areas for heavy equipment decontamination and maintenance will be designated by HAAF. All equipment will be decontaminated prior to maintenance or leaving the site.

15.0 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Emergency telephone numbers are noted in Table 15-1. The following emergency equipment will be available on site at all times during field operations.

15.1 FIRE EXTINGUISHERS

Because of the possibility of fire and explosion at the sites, portable fire extinguishers (ABC-type) meeting the standards of the National Fire Protection Association (NFPA 10) will be readily available (within 100 feet) to field personnel during all on-site work. A fire extinguisher will also be present on each drill rig. Foam, dry chemical or CO_2 type extinguishers are to be inspected for proper charge, pressure and physical integrity before field operations begin and after each use. All personnel will review the use of fire extinguishers before commencing work at the site.

15.2 FIRST AID KITS

Industrial first aid kits with sufficient supplies will be readily available within the Support Zone. The first aid kit containers will be weatherproof. At a minimum, first aid kits will be provided in the ratio of one per 25 persons or less. Smaller kits can be kept in the clean areas and with field crews. The contents of the first aid kit(s) will be checked by the SSO before being sent out to the job site, and rechecked at least once weekly and immediately after each emergency to ensure that expended items are replaced.

15.3 EMERGENCY AIR HORN

An air horn for use in signaling in the case of emergencies will be located in the Exclusion Zone and Support Zone. The air horn will be of sufficient loudness to be audible above operating

TABLE 15-1

EMERGENCY TELEPHONE NUMBERS
Hunter Army Airfield, Georgia

Hospitals:	Tuttle Army Health Clinic Bldg. 1450 Hunter Army Airfield Savannah, GA 31419 (912) 352-5551
	Candler Hospital 5353 Reynolds St. Savannah, GA 31405 (912) 692-6247
Ambulance:	911(a) or 352-5700(b)
Police:	911(a) or 352-6133(b)
Fire Department:	911(a) or 352-5600(b)
Environmental Response Team/Spill Control:	(912) 352-5535
Law Environmental, Inc. Government Services Branch:	Kennesaw, Georgia (404) 499-6800
Project Manager	Deepak R. Ghosh
Office:	(404) 499-6733
Home:	(404) 952-8894
Site Manager/Health and Safety Officer	William M. Craig
Office:	(404) 499-6817
Home:	(404) 437-1863
Health and Safety Contact	Dr. Jack C.Peng
Office:	(404) 499-6752
Home:	(404) 578-4955

(a) Emergency situations
(b) Non-emergency situations

machinery and/or aircraft. Horn signals and their meanings will be established and reviewed prior to site entry (refer to Section 13.3 for sample horn signals).

15.4 SPILL CONTROL MATERIALS AND EQUIPMENT

Absorbent material, shovels, polyethylene sheeting, and overpack containers will be available for containing materials that may be spilled during site operations.

16.0 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

In order to effectively handle emergency situations, planning is essential. An emergency response and contingency plan will be implemented in accordance with 29 CFR 1910.120 which includes measures to prevent accidents and emergencies and to limit the adverse impact of these incidents when they occur. Specific aspects of emergency planning are discussed below.

16.1 PRE-EMERGENCY PLANNING

This section contains information pertaining to the planning for site emergencies before their occurrence.

16.1.1 Notification of Emergency Response Authorities

Local fire/police/rescue authorities and nearby hospital personnel will be contacted and briefed prior to site entry or work regarding the scope of the study and hazardous chemicals and conditions that may be encountered at the site by personnel that pose potential emergency situations, to ascertain their response capabilities and to obtain a response commitment. In addition, off-site emergency personnel will be informed about site emergency procedures and decontamination procedures.

16.1.2 Training

All field personnel will be briefed by the SSO prior to site entry concerning personnel and equipment which will be available and summoned during an emergency and concerning their responsibilities during an emergency situation. Personnel will be briefed on evacuation routes, assembly points, and the person to report to when an alarm sounds. Visitors will be briefed on basic emergency procedures such as decontamination, emergency signals, and evacuation routes.

Personnel who are assigned specific emergency responsibilities will be thoroughly trained in their duties. This training will include the emergency response chain of command, available off-site support, how/where to call for help, what information to provide to emergency response agencies, location and use of emergency equipment, and emergency evacuation while wearing PPE.

16.1.3 Emergency Communications

A system of communicating emergency situations to on-site personnel should be included in the contingency plan. The communication program will describe audible signals (i.e., air horn signals) to be used during an emergency, as well as hand signals to be used when noisy conditions exist. Signals used will be brief and exact and limited in number so that they are easily remembered. Communications devices (i.e., flags, lights, walkie-talkie, radio, mobile phone) appropriate to site-specific conditions will be used.

16.1.4 Emergency Recognition

The Site Manager will brief personnel about potential hazards before site entry so that each individual will be alert for indicators of potentially hazardous situations and for signs and symptoms in themselves and others that warn of hazardous conditions and exposures.

16.1.5 Regulatory Notification Requirements

In the event of a significant chemical release at a site, the Site Manager will notify the HAAF Emergency Response Coordinator, who will notify the National Response Center (NRC). The NRC will activate federal response actions under the National Contingency Plan to promote the coordination and direction of federal and state response systems.

16.2 PERSONNEL ROLES AND LINES OF AUTHORITY

All individuals and teams who will participate in emergency response, and their particular roles will be identified in the plan. All personnel will be briefed concerning their own responsibilities in an emergency, as well the names of those in authority and the extent of that authority. Changes in the contingency plan in response to new or changing site conditions, new information or personnel changes will be reviewed periodically. Emergency contacts and telephone numbers are provided in Table 15-1.

16.3 POSTED INSTRUCTIONS AND EMERGENCY CONTACTS

This section lists emergency contacts, the location of emergency instructions, and shows the nearest medical facilities for emergency treatment.

16.3.1 Instructions

Instructions on actions for personnel to take in an emergency will be posted at each work site. All field personnel will be briefed concerning the personnel and equipment which will be summoned during an emergency situation which requires hospitalization.

16.3.2 Emergency Contacts

The names and phone numbers of all emergency response personnel (ambulance, physician, fire hospital, police) will be conspicuously posted at each work site. This information is also presented in Table 11-3.

16.3.3 Hospital

To access Candler Hospital, from Fire Training Area, travel east on Strachan Avenue to Mitchell Avenue. Travel north on Mitchell to Duncan Drive. Turn right (east) on Duncan Drive to DeRenne Avenue. Travel east on DeRenne to Nelson Road and go north. Hospital will be on left (Figure 16-1).

16.4 EMERGENCY RECOGNITION AND PREVENTION

Personnel should be alert for potentially hazardous situations and symptoms in themselves and others that warn of hazardous conditions and exposures. (Refer to Sections 5.0 and 12.0 for symptoms of chemical exposure and heat/cold stress.) Safety briefings will be conducted to review site-specific hazards and/or changing conditions so that dangerous situations can be rapidly recognized and appropriate response taken.

16.5 SITE EVACUATION

There are three stages of site evacuation, based upon the hazard posed by the incident:

1. Withdrawal from the immediate work area
2. Evacuation of site
3. Evacuation of potentially affected facilities in vicinity

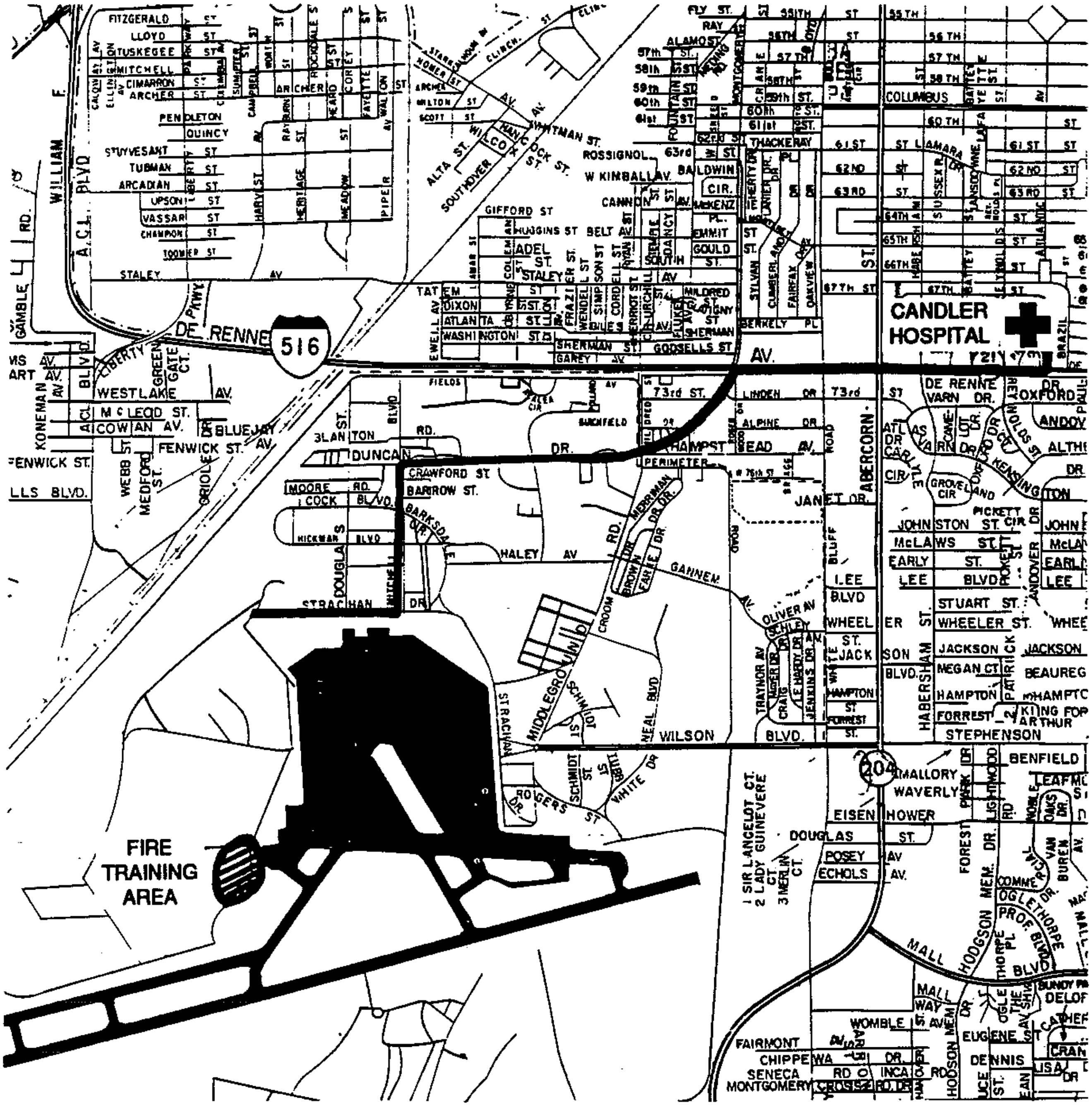
16.5.1 Withdrawal from Work Area

Withdrawal to a safe upwind location outside the Exclusion Zone will be required should any of the following occur:

FIGURE 16-1

ROUTE TO CANDLER HOSPITAL

HUNTER ARMY AIRFIELD FTA
SAVANNAH, GEORGIA



TO CANDLER HOSPITAL:

- GO EAST ON STRACHAN DR. TO MITCHELL ST., TURN LEFT
- TAKE MITCHELL ST. TO DUNCAN DR., TURN RIGHT
- CONTINUE ON DUNCAN DR. TO DeRENNE AVE., TURN RIGHT
- GO EAST ON DeRENNE AVE. TO NELSON RD., TURN LEFT
- HOSPITAL ON LEFT

- Concentrations of volatile organics, combustible gases or toxic gases exceed action guidelines. Work will be temporarily stopped until concentrations fall below the action levels, or PPE upgrade will be implemented in accordance with the guidelines presented in Section 5.0.

- If an incident such as a containable fire or minor accident occurs, field operations will resume after appropriate response is completed and the site manager has cleared the site.

- Equipment malfunctions.

16.5.2 Site Evacuation

The work site should be evacuated under the following conditions:

- Levels of contaminants are detected in excess of action guidelines.

- The oxygen content measured by an oxygen level monitor drops below 19.5 percent in the ambient breathing zone or the oxygen content in the air rises above 22 percent (explosive atmosphere) for 2 consecutive minutes.

- A major accident or injury occurs.

- Fire and/or explosion occurs.

16.5.3 Evacuation of Facilities in Vicinity of Site

The Site Manager is responsible for determining if circumstances exist for adversely affecting areas or facilities surrounding the site, and should always assume worst-case conditions until conditions are demonstrated to be otherwise.

If air concentrations of vapors exceed the work area site action levels contained in earlier sections, monitoring will be performed at the edge of the Exclusion Zone and CRZ to be protective of personnel in nearby areas and/or buildings. If action levels are encountered at these locations, measurements should be performed at the edges of nearby buildings. If action levels are encountered at the edges of nearby buildings, the buildings should be evacuated. Under such circumstances, the Site Manager will convey this information immediately to the HAAF Emergency Response Coordinator for further action.

16.5.4 Site Security and Control During Emergencies

The buddy system must be adhered to during response to emergencies. Control checkpoints through which all personnel entering or exiting the site must pass will be designated to maintain a record of personnel present in the emergency area. Written records of the names and affiliation of off-site personnel, status, time of entry/exit, areas to be entered, team or "buddy," task being performed, PPE (air time left if SCBA), and rescue and response equipment will be maintained during emergency response.

16.6 MEDICAL EMERGENCY RESPONSE AND DECONTAMINATION

Depending upon the severity of the injury, first aid treatment may be given at the site by trained and certified personnel. Additional assistance from emergency medical technicians may be required at the site, and/or the victim may require transport to the hospital for treatment.

The Site Manager/Safety Officer should be notified immediately by the SSO of the medical emergency situation and provide him/her with the following information:

- Location of victim
- Nature of emergency
- Whether victim is conscious

After being notified of the medical emergency, the Site Manager should determine whether the victim requires assistance from the Emergency Medical Team (EMT). Actions required depend upon the seriousness of the emergency. If a life-threatening condition exists, the EMT should be called immediately. The Site Manager will meet or appoint a person to meet the EMT when it arrives and lead it to the victim.

When possible, normal decontamination procedures should be followed. In life-threatening situations, care must begin WITHOUT considering decontamination. Outside protective clothing can be removed if it will not delay or aggravate the victim's condition.

16.7 FIRE

The potential for fire is possible when dealing with flammable materials during activities at the site. The local and facility fire departments will be alerted to the nature and location of any field investigation activities to take place at the site. The following preventative procedures will be followed during site activities:

- Before work is started in an area, the Site Manager/Site Safety Officer will review fire prevention and response procedures and identify personnel assembly points and site evacuation procedures.
- Potential sources of ignition will be identified and kept way from areas in which potentially flammable materials will be encountered.
- Air monitoring will be performed during subsurface operations or operations in confined spaces using combustible gas, oxygen level indicators and organic vapor monitoring equipment.

- Field personnel will be briefed on action levels for combustible gases and oxygen prior to starting work at a site.

- Fire extinguishers will be kept readily available (within 100 feet) of the work site.

The following procedures for responding to a fire will be followed during work at the site:

- The buddy system must be adhered to during response to a fire. Work teams must exit the work area together if evacuation is necessary.

- All personnel in the immediate work area should be alerted to the presence of a fire. Personnel will disconnect all electrical equipment in use at the site and move other equipment, if possible, away from the fire.

- Field personnel are not trained firefighters and should not attempt to combat fires that can not be quickly contained with the available fire extinguishers.

- If there is any doubt that a fire cannot be quickly contained and extinguished with available fire extinguishers, personnel must sound the fire alarm and proceed to the designated assembly point.

- When a small fire has been extinguished, the HSO must be informed of the incident.

In the event of a fire that cannot be rapidly extinguished using available equipment, the following personnel will be contacted immediately:

- Personnel in the immediate work area
- Fire Department
- Contracting Officer

16.8 EMERGENCY FOLLOW-UP RESPONSE

The following actions will be taken prior to the resumption of normal site activities:

- The Site Manager will notify appropriate government agencies, as required.
- All equipment and supplies will be restocked and damaged equipment replaced or repaired.
- The HSO and/or Site Manager will review all aspects of the contingency plan according to new site conditions and lessons learned from the emergency response.
- Personnel will be briefed on revisions to the contingency plan and emergency procedures and other information pertinent to future emergency response activities.

17.0 LOGS, REPORTS AND RECORDKEEPING

This section describes the logs, reports and recordkeeping required to document the safety procedures of the SSHP.

17.1 TRAINING AND DOCUMENTATION

The following training logs, and records will be developed and maintained by the site manager and will become part of the permanent record.

Prior to Work

- List of site personnel and training/experience
- 40-hour OSHA training certificates
- 8-hour supervisor training certificates
- CPR/first aid training certificates
- Certification of fitness to work
- Medical Background Summary Sheet

During Work

- Site-specific training and safety briefings logs
- Visitors' training records

In addition to maintaining logs the following records will be maintained and kept as part of the permanent record.

- Meteorological data logs
- Equipment calibration logs
- Daily safety inspections
- Daily exposure monitoring logs
- Employee and visitor register