INSTALLATION RESTORATION PROGRAM

SITE INVESTIGATION REPORT

VOLUME I

FINAL

ALABAMA AIR NATIONAL GUARD
187th FIGHTER GROUP

DANNELLY FIELD MUNICIPAL AIRPORT
MONTGOMERY, ALABAMA

NOVEMBER 1995

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Environmental Restoration and Waste Management Programs
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For the U.S. DEPARTMENT OF ENERGY under contract
DE-AC05-84OR21400

AIR NATIONAL GUARD
INSTALLATION RESTORATION PROGRAM

SITE INVESTIGATION REPORT

187TH FIGHTER GROUP
ALABAMA AIR NATIONAL GUARD
DANNELLY FIELD MUNICIPAL AIRPORT
MONTGOMERY, ALABAMA

Prepared for

AIR NATIONAL GUARD READINESS CENTER/CEVR
ANDREWS AIR FORCE BASE, MARYLAND

Submitted by

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
MARTIN MARIETTA ENERGY SYSTEMS, INC.
U.S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. DE-AC05-840R21400

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NOVEMBER 1995

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LIST OF ACRONYMS

ADEM	Alabama Department of Environmental Management
AGE	Aerospace ground equipment
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center/CEVR
ARAR	Applicable or relevant and appropriate requirements
BGMW	Background groundwater monitoring well
BTEX	Benzene, toluene, ethyl benzene, and xylenes
CAG	Carcinogen assessment group
CAL	Corrective action level
CDI	Chronic daily intake
CLP	Contract Laboratory Program
CPF	Carcinogenic potency factor
CRDL	Contract required detection limit
DD	Decision Document
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FG	Fighter Group
FFS	Focused feasibility study
FS	Feasibility study
HAZWRAP	Hazardous Waste Remedial Actions Program
HEAST	Health Effects Assessment Summary Table
HHEM	Human Health Evaluation Manual
HI	Hazard index
HMTC	Hazardous Materials Technical Center
IRIS	Integrated risk information system
IRP	Installation Restoration Program
MCL	Maximum contaminant level
MDL	Method detection limit
NOAEL	No observable adverse effects level
OWS	Oil/water separator
PA	Preliminary assessment
PAH	Polynuclear aromatic hydrocarbons
PCE	Tetrachloroethene
POL	Petroleum, oil, and lubricants
ppm	Parts per million
PQL	Practical quantification limit
PRE	Preliminary risk evaluation
PVC	Polyvinyl chloride
RD	Remedial design
RfD	Reference dose
RI	Remedial investigation

LIST OF ACRONYMS
Cont'd

RM	Remedial measures
SI	Site investigation
SOV	Soil organic vapor
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCE	Trichloroethene
TPH	Total petroleum hydrocarbons
TRG	Tactical Reconnaissance Group
TRS	Tactical Reconnaissance Squadron
USGS	United States Geological Survey
UST	Underground storage tank
VOC	Volatile organic compound

Executive Summary

The Air National Guard Readiness Center/CEVR (ANGRC) has initiated an Installation Restoration Program (IRP) in response to the policies of the Department of Defense (DOD). The IRP has been developed as a phased program for identifying and addressing environmental contamination caused by past practices at Air National Guard (ANG) installations. The overall objective of the ANG IRP is to identify and address the potential environmental problem sites at ANG installations. Additionally, the ANG IRP will provide timely remediation as required to protect the public health and environment from contamination associated with hazardous waste spill sites.

A Site Investigation (SI) was conducted as part of the IRP for the 187th Fighter Group of the Alabama National Guard, Dannelly Field Municipal Airport, Montgomery, Alabama (the base). The SI was conducted in accordance with the SI Work Plan dated December 1990 and followed the 1987 Preliminary Assessment (PA) at the base that identified five sites that were potential sources of environmental contamination.

Two of the sites (Sites 3 and 5) were storm water discharge points that received drainage from the northeastern and western portions of the base. After the PA was performed, the Alabama Highway Department destroyed Sites 3 and 5 during roadway construction activities. However, the Highway Department conducted sampling and analysis of surficial soil and water at the sites to prevent safety problems before highway construction in the area. A report of the findings prepared by a Highway Department environmental engineer concluded that low levels of compounds were detected in various samples, but no major environmental problems existed in the area. Consequently, these sites were dropped from the SI. Appendix G contains the sampling report from the Alabama Highway Department.

The primary objectives of the SI at the base were to accomplish the following:

- Evaluate the presence of environmental contamination at the three remaining sites
- Conduct limited assessment of the extent of contamination, if detected
- Evaluate the potential risks that the contamination posed to human health and the environment

SI activities were divided into two separate categories: screening activities and confirmatory activities. Screening activities included magnetic surveys, soil organic vapor (SOV) surveys, and piezometer installation. Confirmatory activities included soil borings, monitoring well installation, surface soil sampling, and soil and groundwater laboratory analysis. The objectives of the screening activities were to assess the presence or absence of environmental contamination and to obtain water level data for evaluation of the

groundwater gradient and flow direction. The results of the screening activities were used to implement the confirmatory activities. The primary objectives of the confirmatory activities were to obtain analytical data to assess the nature and degree of environmental contamination.

The SI field work began in February 1991 with the magnetic and SOV surveys. Surface soil sampling and drilling activities were conducted from February through March 1991. Sampling of the background groundwater monitoring well (BGMW) was completed in March 1991, concluding the field investigation.

FINDINGS AND CONCLUSIONS

Site 1, POL Facility

Site 1 is used primarily as a jet fuel (JP-4) storage facility. The facility consists of six 25,000-gallon underground storage tanks (USTs) containing JP-4. There is evidence of past UST leakage and reports of minor JP-4 spillage. Investigation activities at Site 1 included an SOV survey and eight soil borings. Temporary well points also were installed in two of the soil borings located within the fuel island backfill.

The analytical results of soil collected from Site 1 (POL facility) indicated the presence of petroleum fuel contaminants. Total petroleum hydrocarbons (TPH) were detected above the Alabama Department of Environmental Management (ADEM) Corrective Action Level (CAL) of 100 parts per million (ppm) TPH at four boring locations at the site. Most of the TPH contamination appears to be in the upper 6 feet of soil.

Water is present at Site 1 within the POL backfill and appears to be a result of residual rainwater. This water is contained by the native soils, which exhibit low hydraulic conductivity ranging from 10^{-6} to 10^{-9} centimeters per second (cm/sec), which probably restricts vertical and horizontal groundwater migration. Water samples collected from saturated backfill well points indicated the presence of volatile organic compounds (VOCs) and semivolatile organic compound (SVOCs). Benzene was detected in one of the samples above the public water supply Maximum Contaminant Level (MCL) (5 μg/L) at a concentration of 400 μg/L. Toluene, ethyl benzene, and xylene (total) also were present in this sample. Three fuel-related SVOCs, naphthalene, 1-methylnapthalene, and 2-methylnapthalene, were also detected. No groundwater was encountered in the native soil outside the POL backfill.

Site 2, Oil/Water Separator (OWS) and Tank

Site 2 consists of the area around an OWS and a related underground holding tank. The OWS receives aircraft wash rack and floor drain wastewater that contains solvents, paint strippers, and lacquer thinners. The holding tank receives floating-phase overflow from the OWS and holds it before it is disposed of offsite through underground piping and eventually into the west storm drain outfall. Five soil borings were drilled during the Site 2 field investigation.

Concentrations of organic contaminants were detected in both the surface and subsurface soil samples collected at Site 2. Metal concentrations found in soils at Site 2 were not significantly higher than the background metals concentrations except for selenium, which is more than twice the background concentration. Thirty-four organic compounds were detected within the lateral and vertical (18 ft depth) range of soil investigation at Site 2. Contaminant levels ranged from 1 μg/kg 1,1-dichloroethane to 160,000 μg/kg trichloroethene. Also detected during the investigation were 1,2-dichloroethene (total), ethyl benzene, toluene, xylene (total), and vinyl chloride at 28,000, 11,000, 21,000, 89,000, and 1,300J μg/kg, respectively. Contaminant levels for SVOCs ranged from Di-n-butylphthalate at 42J μg/kg to 8,800 μg/kg naphthalene. Bis (2-ethylhexyl) phthalate, 2-methylnaphthalene, fluoroanthrene, and pyrene were detected at concentrations above 1,000 μg/kg. No groundwater was encountered in the borings drilled at Site 2.

Site 4, Edge of Aircraft Parking Apron

Site 4 consists of the area abutting the southern edge of the aircraft parking apron. The site was reported as a receptor of PD-680 and hydraulic fluids that have been washed to the edge of the parking apron. Also, 400 to 500 gallons of JP-4 were spilled at this site in 1980. Investigation activities at the site consisted of collecting eight surface soil samples and drilling three soil borings.

At Site 4, both surface soil and subsurface samples were collected for chemical analysis. Composite surface soil samples collected along the perimeter and low area at this site indicated the presence of 13 organic compounds in the surface soils (0-2 feet). These organic compounds are similar to what would be expected in asphalt and could be explained by the presence of a nearby asphalt runway. No organic compounds were detected above method detection limits in the subsurface samples collected from the boreholes drilled at the site. Organic compound contamination appears to be present only in the upper 2 feet of soils, with the highest concentrations typically found in the top 6 inches of soil. No groundwater was encountered within the subsurface borings at Site 4.

Preliminary Risk Evaluation (PRE)

A preliminary risk evaluation (PRE) was conducted based on the data collected from the three investigation sites in accordance with guidance provided in the United States Environmental Protection Agency's (US EPA's) *Risk Assessment Guidance for Superfund, Volume 1--Human Health Evaluation Manual* (HHEM) Part A, December 1989, and with reference to the revised National Contingency Plan 55 FR 8666. The objectives of this evaluation were as follows:

- Evaluate public health risks posed by the sites, assuming no remedial action is taken

- Evaluate potential human health risks, assuming changes in future site usage by considering risks associated with alternative future land uses

- Identify additional data needed to define the risks and to evaluate the completeness of possible exposure pathways

The results of the PRE indicate that there are no significant health risks from the contaminants found at the SI investigation sites.

Recommended Actions

Based on the analysis of data collected during the SI, the following actions are recommended for each of the investigation sites.

Sites 1 and 2

The base plans to decommission Sites 1 and 2 under an ongoing construction project. While these sites may pose no risk to human health or the environment in their current state, decommissioning of these sites may trigger state and federal applicable or relevant and appropriate requirements (ARARs) for soil and water (contained in UST backfill) contamination that may need to be addressed.

Although soil contamination is present at Sites 1 and 2, the PRE indicates that the potential health risk from contaminants at these sites is low. Decision documents (DDs) for no further action are recommended for these sites.

Site 3

Based on the results of the Alabama Highway Department investigation and subsequent construction activities, a DD for no further action is recommended at this site.

Site 4

A DD for no further action is recommended for the site. Contamination was found only in the surface soils (0-2 feet) next to the aircraft parking apron. The contamination detected is indicative of compounds associated with runoff from asphalt paved areas.

Site 5

Based on the results of the Alabama Highway Department investigation and subsequent construction activities, a DD for no further action is recommended at this site.

1. INTRODUCTION

1.1 PURPOSE

This report describes the tasks, procedures, results and conclusions, and recommendations resulting from the Site Investigation (SI) at the 187th Fighter Group (FG) Alabama Air National Guard–Dannelly Field (ANG). The purpose of the SI was to evaluate the presence of contamination and, if found, to perform limited quantification of contamination at potential sites. The sites were identified during the Phase I Records Search, referred to in this report as the Preliminary Assessment (PA), conducted by the Hazardous Materials Technical Center (HMTC).

1.2 REPORT ORGANIZATION

This report is organized into five sections. Section 1 includes introductory information such as the purpose, facility and project background, and general project objectives. Section 2 describes the field program implemented during the SI. Results of the field work are discussed in Section 3. Results of a PRE, using data developed during the field program, are presented in Section 4. Section 5 documents immediate response activities, and Section 6 outlines conclusions and recommendations from the SI. The appendixes present detailed information on project activities such as magnetic and soil organic vapor (SOV) surveys, field effort memorandums, investigation-derived waste management, soil boring logs, data validation, and geotechnical data.

1.3 FACILITY BACKGROUND

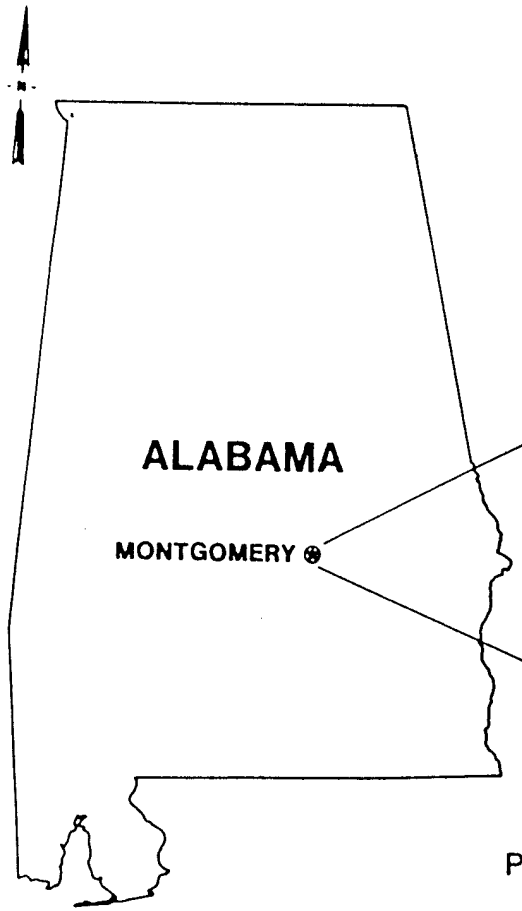
1.3.1 Installation Description and History

The 187th FG is located at the Alabama ANG, Dannelly Field Municipal Airport, Montgomery, Alabama (see Figure 1.1). This ANG installation has been active at the Montgomery Airport since 1953. Through the years, the base has had several missions. Both past and present operations have involved the use of hazardous materials and disposal of hazardous wastes.

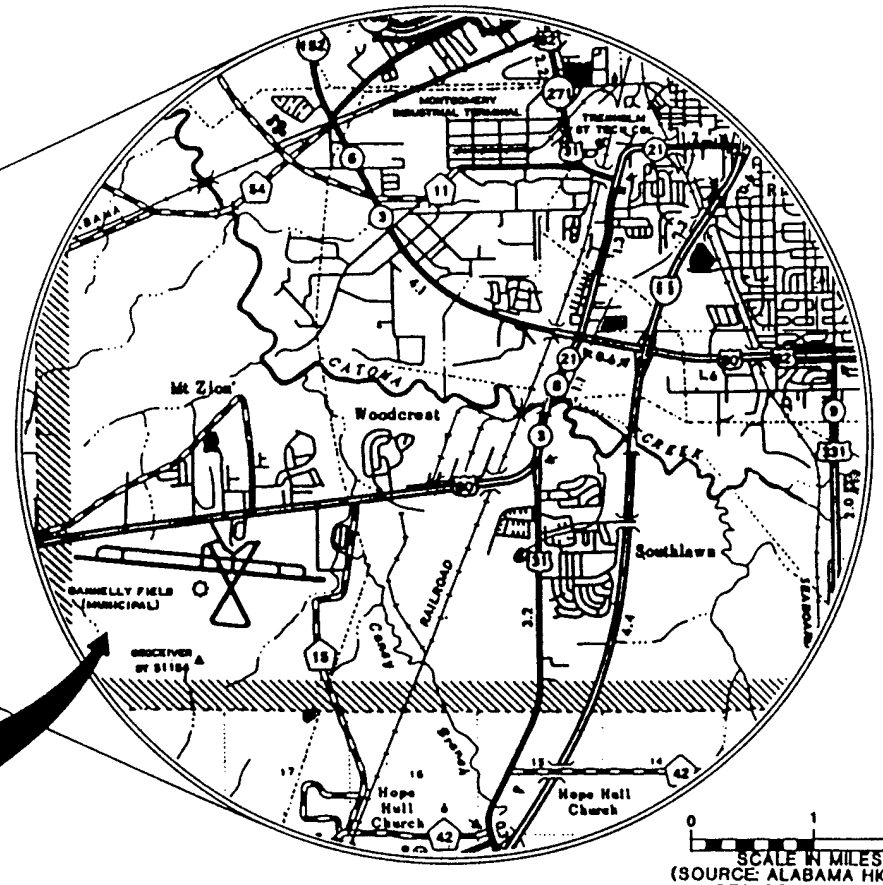
The missions and types of aircraft at the base have varied over the years.

From 1953 to 1962 this Alabama ANG unit operated as the 160th Tactical Reconnaissance Squadron (TRS), which flew propeller-driven RF-51D "Mustangs," and subsequently RF-80 "Shooting Stars" and RF-84F "Thunderflash" jets.

In 1962, the 187th Tactical Reconnaissance Group (TRG) reorganized to incorporate the 160th TRS. The 187th TRG began flying RF-4Cs in 1971. In July 1983, the 187th TRG adopted a fighter group mission and was renamed the 187th Tactical Fighter Group and was later renamed the 187th Fighter Group. The 187th FG currently flies F16 fighter



PROJECT LOCATION
DANNELLY FIELD



VICINITY MAP

LOCATION MAP

FIGURE 1.1
SITE LOCATION MAP
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Alabama

CH2M HILL

planes. The 187th FG is dedicated to both its Federal mission as a Fighter Group and to its State role as an arm of the Alabama militia.

1.3.2 Site Descriptions and History

The following five sites were recommended for SI work in the PA. A summary of the site backgrounds and descriptions (as presented in the PA) is below. The investigation sites are shown in Figure 1.2.

1.3.2.1 Site 1: POL Facility

The Petroleum, Oil, and Lubricant (POL) facility is located at the north end of Phantom Street, adjacent to Perimeter Road. The facility consists of an asphalt paved area with a raised, curbed fueling island in the center. Below the fueling island are six 25,000-gallon Underground Storage Tanks (USTs) containing JP-4.

At the POL facility, there is evidence of past UST leakage, and reports of minor JP-4 spillage have been made. Groundwater entering a shallow hole dug at this site by Base personnel had a JP-4 odor; however, an underground refueling line, suspected of leakage, was repaired in June 1991. JP-4 fumes also were evident in storm sewer manholes next to the POL facility.

Four of the six USTs in this area were replaced in 1976. Tank inventory data collected by the base have not indicated continuing leakage. This POL area was scheduled for closure and replacement with an aboveground tank storage area in 1993.

1.3.2.2 Site 2--Oil/Water Separator (OWS)

Site 2 consists of the area around an OWS and a related UST. The site is located between Building 1304 (south side, east end) and Buildings 1330 and 1331. The OWS has received contaminated wastewater from the aircraft washrack and floor drainage from Building 1304. Contaminants in washrack wastewater draining to the OWS include Stoddard solvents, paint strippers, and lacquer thinners. The holding tank receives floating-phase overflow from the OWS and holds it before offsite disposal. Water from the OWS flows through underground piping and eventually discharges into the west storm drain outfall (Site 5).

The ground immediately surrounding the opening to the OWS holding tank is oil-stained and devoid of vegetation. Contamination reportedly has seeped from beneath a concrete conduit located 3 to 5 feet from the UST/OWS. The total quantity of waste released at this site is not known, but was estimated in the PA to be small.

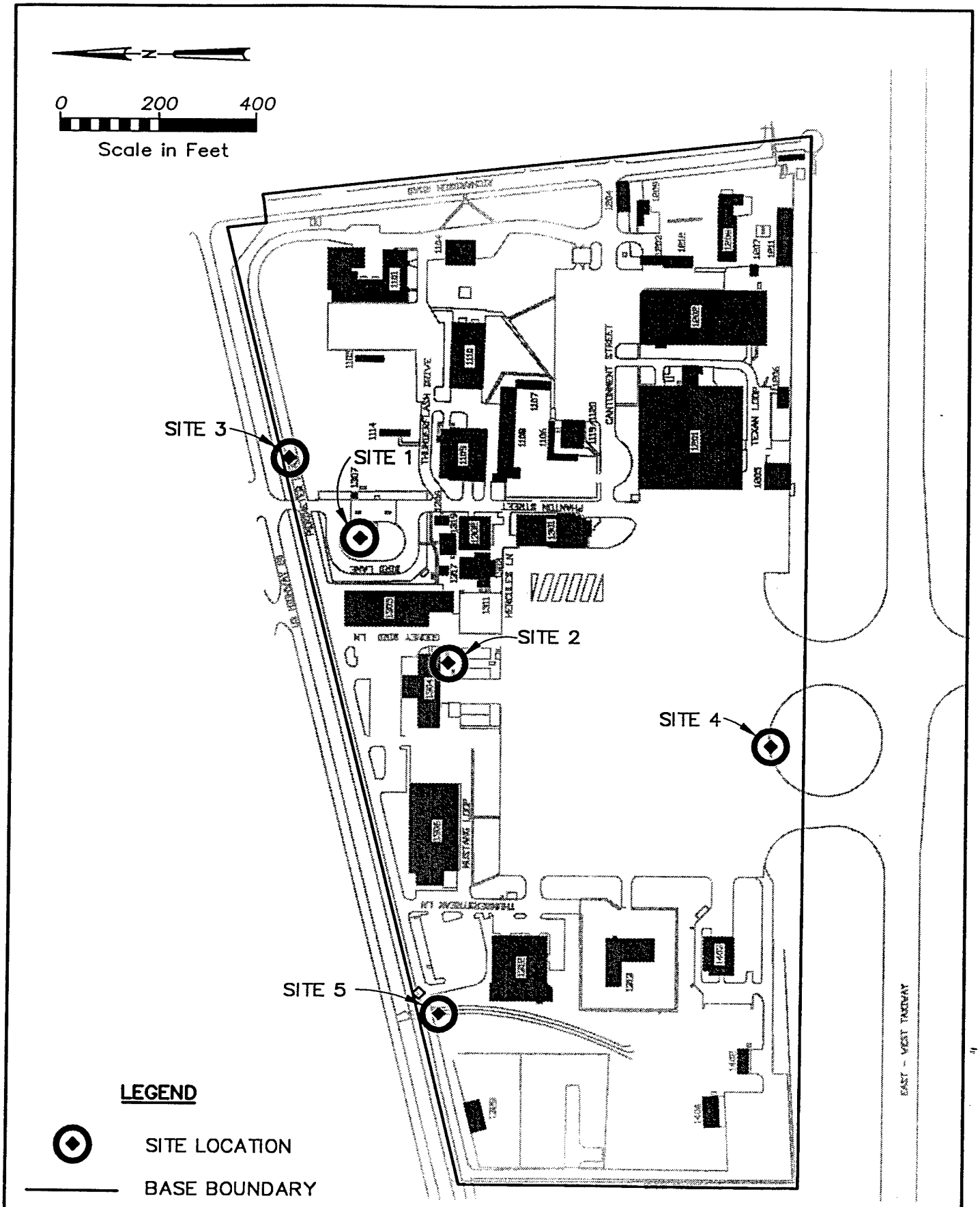


FIGURE 1.2
INVESTIGATION SITES
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

DNG-0007.DWG

1.3.2.3 Site 3--Storm Drainage Discharge Point, East

This site is located between Perimeter Road and U.S. Highway 80, across from the POL facility. Storm drainage from the majority of the northeastern portion of the base, including the POL area and the Aerospace Ground Equipment (AGE) shop, is discharged here. Storm drainage routed to this point through underground piping discharges into an earthen stream channel; it then flows off the installation and into a small tributary of Catoma Creek. Overflow from the OWS at the AGE shop also discharges into this area. Potentially contaminated groundwater underlying the POL facility also may discharge at this point. Oily sheens have been observed periodically on water at this site, especially after rainfall. The first report of this sheen was in 1982.

After the PA, the Alabama Highway Department destroyed Sites 3 and 5 during roadway construction, so they were not investigated during the SI. Decision Documents (DDs) for no further action will be prepared for both of these sites using data collected by the Highway Department.

1.3.2.4 Site 4--Edge of Aircraft Parking Apron

This site consists of the area abutting the southern edge of the aircraft parking apron. Four to five hundred gallons of JP-4 were spilled at this site in 1980. No visible vegetative stress is evident along the edge of the aircraft parking apron.

1.3.2.5 Site 5--Storm Drainage Discharge Point, West

Site 5 is located in the north open storm drainage ditch that crosses Perimeter Road approximately 150 feet northwest of Building 1312. Storm discharge from portions of the installation along the runway and most of the western portion of the base are channeled to this point. Drainage from this point flows into tributaries of Catoma Creek. A 500-gallon JP-4 spill, which occurred in 1976, entered the drainage pipe leading to the Site 5 discharge point. Base personnel have observed a sheen on the water flowing in the drainage channel that was traced to contaminant leakage from the north storm open drainage conduit at Site 2.

After the PA, the Alabama Highway Department destroyed Sites 3 and 5 during roadway construction, so they were not investigated during the SI. DDs for no further action will be prepared for both of these sites.

1.4 PREVIOUS INVESTIGATIVE ACTIVITIES

1.4.1 Installation Restoration Program

The ANGRC has initiated an IRP in response to the policies of the Department of Defense (DOD). The IRP has been developed as a phased program for identifying and addressing environmental contamination caused by past practices at ANG installations. As part of the IRP, the ANGRC has entered into an interagency agreement with the Department of

Energy (DOE), under which the DOE will provide technical assistance for implementing this program. The Hazardous Waste Remedial Actions Program (HAZWRAP) as a DOE contractor is responsible for managing this effort under the interagency agreement.

The July 1987 PA records search at the base consisted of an evaluation of historical base records, interviews with base employees, and analysis of existing hydrogeologic and environmental data. Five sites at the base were identified during the PA as potential past hazardous waste disposal sites that warrant further investigation. These sites were described in the previous section. CH2M HILL, through an existing agreement with HAZWRAP, performed an SI of these sites.

1.5 REGIONAL INVESTIGATION AREA

1.5.1 Environmental Setting

The base is located at Dannelly Field Municipal Airport, approximately 6 miles southwest of downtown Montgomery. The airport is next to U.S. Highway 80, the main road between Montgomery and Selma. The land immediately surrounding the airport is used for commercial and light industrial purposes. Within 1 mile to the east there are residential developments; to the south and west land use is predominantly agricultural with scattered commercial development along U.S. 80. Immediately to the west of the base itself is an Army National Guard installation that includes helicopter operations.

According to the 1986 Local Climatological Data Annual Summary with Comparative Data published by the National Oceanic and Atmospheric Administration, Montgomery County has a humid, mild, almost subtropical climate. The average annual precipitation is 51.12 inches. Most of the rain that falls occurs from late April to early June in the form of showers and thunder showers. The average annual temperature is 65.5°F. The average monthly temperature ranges from 49.2°F in January to 81.6°F in July. Winds are usually light. Strong winds generally last only a short time, and dangerous or catastrophic winds are rare.

Drinking water in the Montgomery area is provided by the Water Works and Sanitary Sewer Board of the City of Montgomery. The municipal water supply is provided from a combination of surface water and groundwater sources. The C.T. Perry Filtration Plant, located in northeast Montgomery, withdraws and treats water from the Tallapoosa River and currently provides about 59 percent of the Water Board's potable water.

The Water Board also operates two well fields that withdraw water from wells at an average depth of 700 feet below land surface. Typically, the wells are multiple-aquifer completions, withdrawing groundwater from the Coker, Gordo, and Eutaw Formations. The Board's West Well Field is located about 3 miles north of the base and provides about 36 percent of the total potable water supply. The remaining 5 percent is supplied by the Water Board's North Well Field, located in the north Montgomery area.

1.5.1.1 Surface Water Hydrology

The base is located within the Alabama River drainage basin. All surface drainage from the base flows north, through small unnamed streams, towards Catoma Creek (Figure 1.3). Catoma Creek, located approximately 1.5 miles northeast of the base, flows northwest towards the Alabama River, which is approximately 5 miles from Dannelly Field. Officials of the Alabama Department of Conservation and Natural Resources stated that Catoma Creek is used for fishing and that tributaries to the creek in the area of the airport are probably fished. Manmade drainage ditches and storm drainage culverts channel storm runoff from the base into tributaries of Catoma Creek. According to sources at the Alabama Highway Department, Urban Planning Division, the base is not located within a floodplain associated with 100-year occurrence floods.

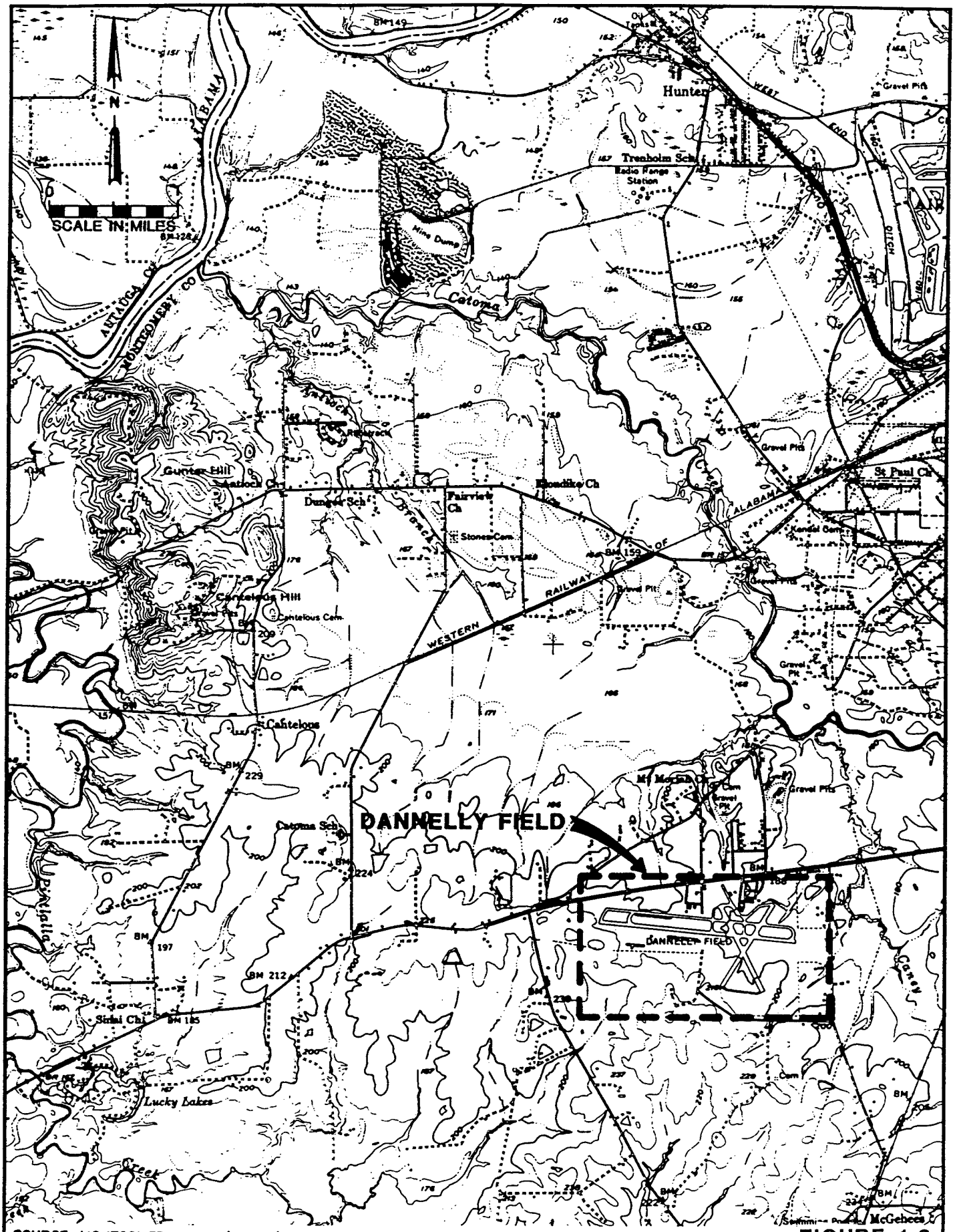
1.5.1.2 Critical or Sensitive Habitats

The Alabama Natural Heritage Program (ANHP) searched their database for occurrences of rare and endangered elements on the Cantelous USGS topographic quadrangle and immediately surrounding quads. They found no occurrences on the base or immediately surrounding properties.

Hawthorn (Crategus triflora) was located east of Dannelly Field. This woody shrub is ranked SR (state reported) in the state of Alabama, which indicates a lack of data on the status of the species in the state. The habitat for this species is thin rocky woods. The hawthorn is ranked C2 (candidate species, category 2) by the U.S. Fish and Wildlife Service (USFWS). C2 species are taxa which USFWS information indicates that proposing to list the species as endangered or threatened is appropriate by inconclusive. Data on biological vulnerability and threat are not available to support proposed rules at this time. The shrub has a global ranking that indicates the species is globally imperiled because of rarity or vulnerability to extinction.

Seven other rare or endangered elements are located on adjoining USGS quads sheets. One of these species, the Alabama sturgeon (Scaphirhynchusis sultkusi) is ranked as endangered by the USFWS. Alabama sturgeon have been located in the deep water areas of the Alabama River. The other 3 fish listed, Backwater darter (Etheostoma zonifer), Mississippi silvery minnow (Hybognanthus nuchalis) and Silverside shiner (Notropis candidus), are shallow water species which occur in tributary streams. They are ranked S3 (rare or uncommon) by the state.

The ANHP did not report any wetland areas on the base or within the immediate vicinity. However, two small tributaries to Catoma Creek exit the base under Highway 80 to the north. Both are primarily storm water drainage ditches from the base and surrounding properties.



SOURCE: MONTGOMERY QUAD (15 MIN), 1958

FIGURE 1.3

TOPOGRAPHY AND SURFACE DRAINAGE FEATURES

187th Fighter Group

Alabama Air National Guard, Dannelly Field, Montgomery, Al

1.5.2 Regional Hydrogeology

Montgomery County is in the northern part of the Coastal Plain physiographic province and encompasses parts of four physiographic divisions of the Coastal Plain: the Terraces, the Black Prairie, the Chunnennuggee Hills, and the Floodplain. The base is within the Black Prairie physiographic division, which is typically characterized by moderate to rolling prairie with extensive grasslands and very few trees.

Igneous and metamorphic rocks ranging in age from Precambrian to Pennsylvanian underlie the coastal plain sedimentary sequence in the Montgomery area. This highly weathered crystalline bedrock surface, consisting mainly of gneiss, schist, quartzite, marble, and granite, slopes generally toward the south at about 60 to 100 feet per mile (Knowles et al., 1963).

Coastal plain sedimentary deposits overlie the metamorphic and igneous bedrock surface in the Montgomery area. These deposits range in age from Late Cretaceous to Quaternary. These deposits, from oldest to youngest are comprised of the Tuscaloosa Group, the Eutaw Formation, and the Mooreville Chalk of the Upper Cretaceous Series. Terrace and alluvial deposits are present in and adjacent to floodplains in the Montgomery area. A geologic map of the Montgomery area is shown in Figure 1.4. Figure 1.5 illustrates the subsurface geologic section constructed from geologists' logs of wells drilled by the City of Montgomery (C3, K24, K127), the Alabama Air National Guard (N7), and the U.S. Geological Survey (N21).

1.5.2.1 Tuscaloosa Group

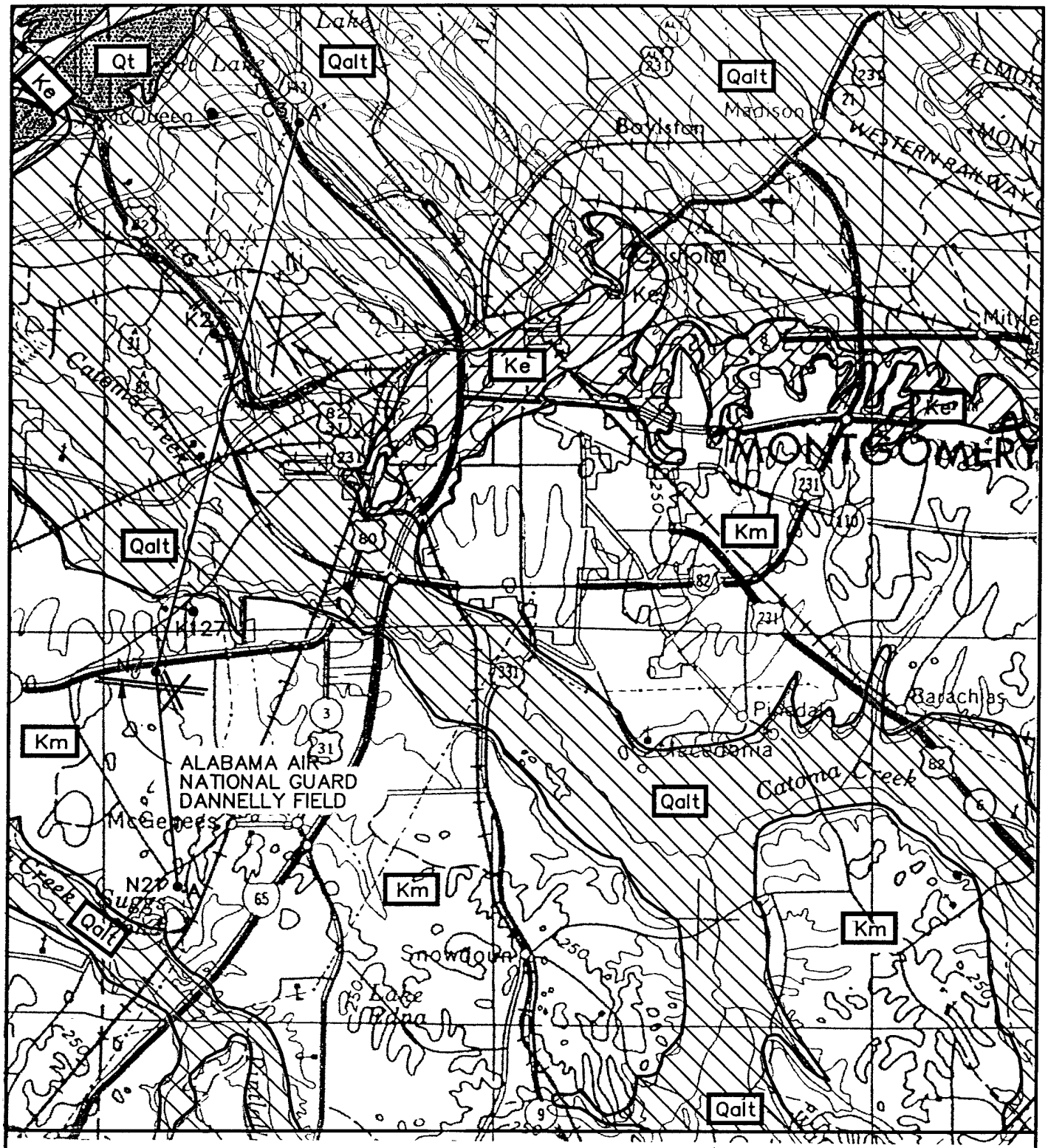
The Tuscaloosa Group is made up of the Coker and Gordo Formations. These formations consist chiefly of clay, sand, gravel, and a few thin beds of lignite.

1.5.2.2 Coker Formation

The Coker Formation overlies the pre-cretaceous crystalline bedrock. In northwest Montgomery County, a United States Geological Survey (USGS) well drilled near Maxwell Air Force Base logged over 500 feet of Coker Formation before encountering crystalline bedrock at a depth of 1,008 feet below land surface. The Coker Formation contains two principal sand and gravel beds that yield major quantities of groundwater for public water supplies in the Montgomery area. The Coker Formation is a potable groundwater source in the Montgomery Water Board's North and West Well Fields.

1.5.2.3 Gordo Formation

The Gordo Formation overlies the Coker Formation and averages 250 to 300 feet in thickness in the Montgomery area. The Gordo contains two sand and gravel units that produce significant quantities of potable groundwater in the Montgomery Water Board's North and West Well Fields.



SOURCE: GEOLOGICAL SURVEY OF ALABAMA, SPECIAL MAP 220, GEOLOGICAL MAP OF ALABAMA, 1988.

LEGEND

QUATERNARY	Qalt	ALLUVIUM
	Qt	TERRACE DEPOSITS
UPPER CRETACEOUS	Km	MOOREVILLE CHALK
	Ke	EUTAW FORMATION

A——A' LINE OF CROSS SECTION

• N21 WELL LOCATION

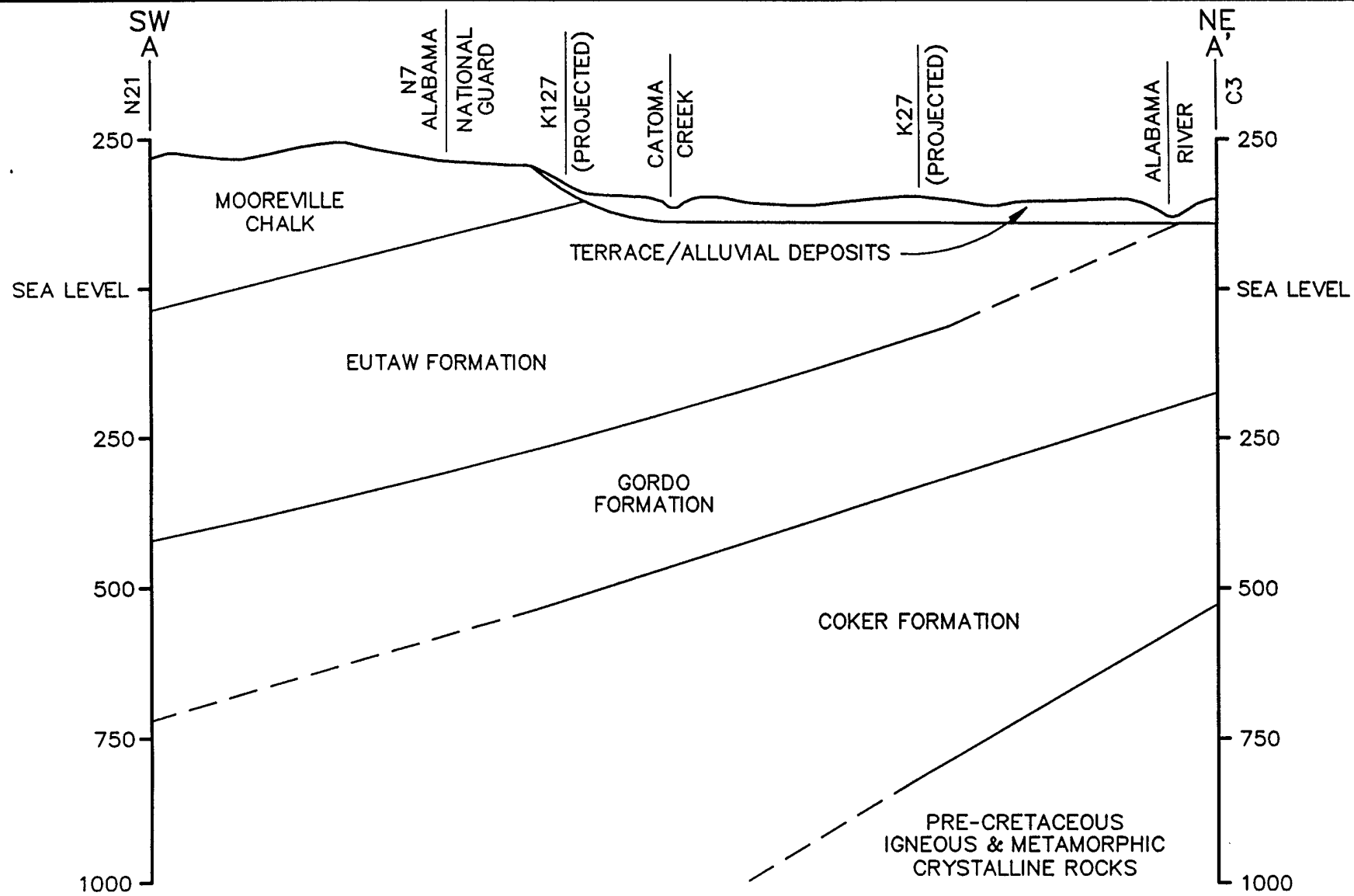
0 1 2
SCALE IN MILES

FIGURE 1.4
REGIONAL GEOLOGIC MAP
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

CH2M HILL

DNG-0027.DWG

06-19-91 MGM27526.SI



NOTES:

1. WELL LOCATIONS ARE SHOWN AT THE TOP OF SECTION.
2. SOURCE OF SUBSURFACE DATA IS GSA BULLETIN 68, PART B, 1960.
3. REFER TO FIGURE 1.2 FOR LINE OF CROSS SECTION.

0 1 2

HORIZONTAL SCALE IN MILES
VERTICAL SCALE IN FEET
(GREATLY EXAGGERATED)
35:1

FIGURE 1.5
GEOLOGIC SUBSURFACE SECTION
ACROSS NORTHWEST MONTGOMERY COUNTY
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

CH2M HILL

DNG-0026.DWG

1.5.2.4 Eutaw Formation

The Eutaw Formation overlies the Gordo Formation and crops out in a narrow, east-west band in the central Montgomery area. The Eutaw can be in excess of 400 feet thick in the southwestern Montgomery area, as indicated by a USGS well located less than 2 miles southwest of the base. Typically, the Eutaw consists of light grey or greenish-grey cross-bedded fine to medium-grained well-sorted glauconitic sand.

The Eutaw Formation contains an upper and basal sand bed that yields major quantities of potable groundwater in the Montgomery Water Board's North and West Well Fields. The Eutaw is also the principal source of groundwater for private wells in the Montgomery area.

1.5.2.5 Mooreville Chalk

The Mooreville Chalk belongs to the Selma group and overlies the Eutaw Formation. The Mooreville crops out in central Montgomery County and is present beneath a thin veneer of residual clay at the base.

The Mooreville Chalk can be up to 600 feet thick in Montgomery County and is chiefly a grey to pale-olive silty or finely sandy, argillaceous, fossiliferous chalk. The Arcola limestone member at the top of the Mooreville is about 10 feet thick in western Montgomery County and contains thin-bedded light-grey limestone.

The Mooreville Chalk is relatively impermeable in Montgomery County, and is the confining bed for water in the underlying Eutaw Formation. Vertical hydraulic conductivity values for the Mooreville Chalk are estimated to range from 7.7E-07 cm/sec to 2.0E-08 cm/sec. These values are based on SI results in the weathered Mooreville residuum and data published on the Demopolis Chalk, which overlies the Mooreville Chalk south of the base.

A geologist's log from a well owned by the Alabama ANG and located on the base describes the Mooreville Chalk as a grey, silty chalk containing glauconite, mica, and fossils. The chalk thickness at this location is about 126 feet and was logged between 11 and 137 feet below land surface. The well was completed at a total depth of 470 feet below land surface in the Eutaw Formation.

1.5.2.6 Terrace and Alluvial Deposits

Terrace and alluvial deposits consisting chiefly of lenses of gravel, poorly sorted quartz sand, and sandy clay may reach a combined thickness of up to 150 feet along the floodplains of the major surface water drainage systems in the Montgomery area. Although they are not developed as a major source of public water supply in the Montgomery area, these deposits are capable of producing major quantities of groundwater where the deposits are relatively thick.

1.5.3 Regional Background Data

The chemical character of groundwater is controlled primarily by the nature of materials the groundwater comes in contact with and how long they are in contact with those materials. Groundwater generally contains a higher dissolved mineral content than surface water because of slow groundwater movement within the geologic formations and longer contact times.

In general, the chemical character of groundwater in the Montgomery area is good. A chemical analysis of composite samples from Montgomery's North and West Well Fields is shown in Table 1.1. The primary aquifers contributing to the composite well field samples are from the sand and gravel deposits that occur within the Eutaw Formation and Tuscaloosa Group.

Table 1.1
CHEMICAL CHARACTER OF GROUNDWATER FROM THE NORTH AND WEST WELL FIELDS
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Constituents or Property	West Well Field	North Well Field
Total Solids (ppm)	272	254
Free Carbon Dioxide (ppm)	0.0	0.0
Total Hardness (ppm $CaCO_3$)	48.5	5.1
pH	8.3	9.2
Silica (ppm)	8.0	6.7
Iron Oxide (ppm)	0.2	0.3
Chloride (ppm)	11.2	7.1
Manganese (ppm)	0.0	0.0

2. FIELD PROGRAM

2.1 SUMMARY

During February and March 1991, the field program described in the SI Work Plan (12/90) was implemented at Sites 1, 2, and 4. The primary objective of the field activities conducted at the Alabama ANG base was to acquire the information needed to evaluate the presence or absence of environmental contamination at each identified site; assess the potential risk to human health, welfare and the environment; and to remediate those sites that pose public health impacts.

Field activities would include collecting information to identify contaminants present, their concentrations in the soil and groundwater, and the potential for contaminant migration. Data collected from each site may be sufficient to support a preliminary risk assessment and address applicable or relevant and appropriate requirements (ARARs) for remediating confirmed contamination at each site. In those cases with evidence of extensive contamination, further characterization through a formal Remedial Investigation (RI) may be required to support a definitive Feasibility Study/Focused Feasibility Study/Remedial Measures (FS/FFS/RM) and baseline risk assessment.

SI activities were divided into two categories: screening activities and confirmation activities. Screening activities consisted of magnetic surveys, Soil Organic Vapor (SOV) surveys and surface and subsurface soil sampling. The objectives of the screening activities were to assess the presence or absence of environmental contamination. The analytical results from these activities were used to assist in effective location of the confirmation sampling. The confirmation activities were used to obtain data that assessed the nature and degree of environmental contamination. Confirmation activities also were used to assess the need for optional activities such as additional soil borings. The field activities conducted at each site are summarized in Table 2.1.

The field program consisted of collecting and analyzing soil samples from surface soils and soil borings, and groundwater samples from well points, monitoring wells and piezometers. Samples were analyzed for the parameters outlined in the SI Work Plan. Sixteen soil borings were drilled and sampled at varying intervals at the three sites under investigation. In addition, four background piezometers were installed as well as a background monitoring well. Surface soil sampling also was conducted at eight locations at Site 4.

2.1.1 Field Variations

Field changes to the program specified in the SI Work Plan were carried out during the course of the SI because of site conditions or at the request of HAZWRAP and ANGRC representatives. The field changes incorporated and the reasons for the changes are summarized below:

Table 2.1
SITE INVESTIGATION ACTIVITY SUMMARY
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Site	Screening Activities	Confirmation Activities	Soil and Monitoring Well Sampling
Backgrd	4 piezometers	1 monitoring well	Soil samples collected from all boreholes drilled for installation of piezometers and monitoring well in February 1991. Monitoring well sampled in April 1991.
1	Magnetic Survey SOV Survey	8 borings 2 well points	Three soil borings drilled and sampled in February 1991. Five soil borings drilled and sampled in March 1991.
2	Magnetic Survey	5 borings	One soil boring sampled in February 1991. Four soil borings sampled in March 1991.
4		3 borings 8 surface soil samples	Surface soil samples collected in February 1991. Three soil borings drilled and sampled in March 1991.

- **Description of Change:**

  A shallow background piezometer (B4PS) at the southeast corner of the base and piezometers/monitoring wells at the investigation sites was not installed.

  Reason for Change:

  After three of the background piezometers and one background monitoring well were installed, the subsurface soils above the chalk did not yield enough water to collect groundwater samples for background measurements. Based on this evidence and general knowledge of regional hydrogeology, it was concluded that the piezometers and wells were unnecessary.

- **Description of Change:**

  An additional interval for each boring location within the POL facility was sampled.

  Reason for Change:

  An additional sampling interval was incorporated at each boring location at the POL to collect more information on the chemical characteristics of the Mooreville chalk.

- **Description of Change:**

  Boring locations at Site 1 were revised.

  Reason for Change:

  The original locations did not penetrate the backfill material of the POL tank pit. Two of the confirmatory boring locations (P5BS and P7BS) specified in the Work Plan were relocated to within the backfill on the north and south sides of the POL in order to sample the backfill area.

- **Description of Change:**

  An extra boring at Site 2 was drilled and sampled.

  Reason for Change:

  One boring previously drilled was not close enough to the OWS to provide sufficient information.

- **Description of Change:**

  Site 2 boring location O4BS was redrilled and sampled.

  Reason for Change:

  OWS boring location O4BS was redrilled and sampled because samples collected from the original location the previous week were damaged during shipment to the analytical laboratory.

2.2 GEOLOGIC AND HYDROGEOLOGIC INVESTIGATIONS

The geologic/hydrogeologic investigative approach was developed to address the following technical objectives:

- Develop a sufficient understanding of the site hydrogeology to evaluate groundwater movement and identify potentially affected aquifers.
- Establish background soil and groundwater quality criteria within the base.
- Evaluate potential groundwater contamination adjacent to Sites 1, 2, and 4.
- Evaluate the presence of surface and subsurface soil contamination at Sites 1, 2, and 4.
- Collect samples representative of actual site conditions.
- Collect, analyze, and provide valid, defensible data that eventually may be used to support a DD for no further action, a preliminary risk assessment, or an FFS, RI, or remedial design (RD) at each site.

The geologic/hydrogeologic investigation consisted of the following tasks:

- Magnetic survey at Sites 1 and 2
- SOV survey at Site 1
- Well inventory within a 1 mile radius of the base
- Surface soil collection at Site 4
- Five background soil borings within the base
- Installation of four background piezometers and one background monitoring well

- Eight soil borings and two well points at Site 1 (well points were installed in borings P5BS and P7BS)
- Five soil borings at Site 2
- Three soil borings at Site 4
- Collect and analyze 3 split spoon soil samples from each of the borings
- Collect and analyze groundwater from background locations B6MW and B2PS and 2 well points at Site 1
- Collect and perform geotechnical analysis on the residual soil (Sites 1 and 2), Mooreville Chalk (Site 2), and the POL backfill

2.3 FIELD SCREENING ACTIVITIES

Each investigation site was initially evaluated on the basis of site history. Field screening activities were then conducted at the sites to evaluate whether contamination existed or to refine confirmation activities. The following sections describe in detail field screening activities conducted at the base and the purpose of each.

The field program was designed to include screening activities that would evaluate the soil and groundwater conditions at each of the investigation sites and the three background locations. The field screening analytical parameters were selected based on knowledge of past materials handled at each site, as documented in the PA. Data gathered during field screening activities were used to establish a preliminary evaluation of site conditions and modify the original confirmation activity strategy.

Screening activities included magnetic surveys, a soil gas/groundwater probe survey, and piezometer installations.

2.3.1 Piezometer Installation

A truck-mounted CME 75 drill rig used 3¼-inch I.D. hollow-stem auger to advance soil borings for piezometer placement. Background soil borings were completed by installing piezometers in four of the five boring locations. Figure 2.1 shows the location of the background sampling points. The initial approach included a nested piezometer pair or one monitoring well paired with a piezometer at each of the three background locations. This approach (nested locations) would allow for evaluation of the vertical flow component within the saturated zone.

The approach was modified slightly after three piezometers and one monitoring well were installed and observed at background locations B1PS, B2PS, B5PS, and B6MW.

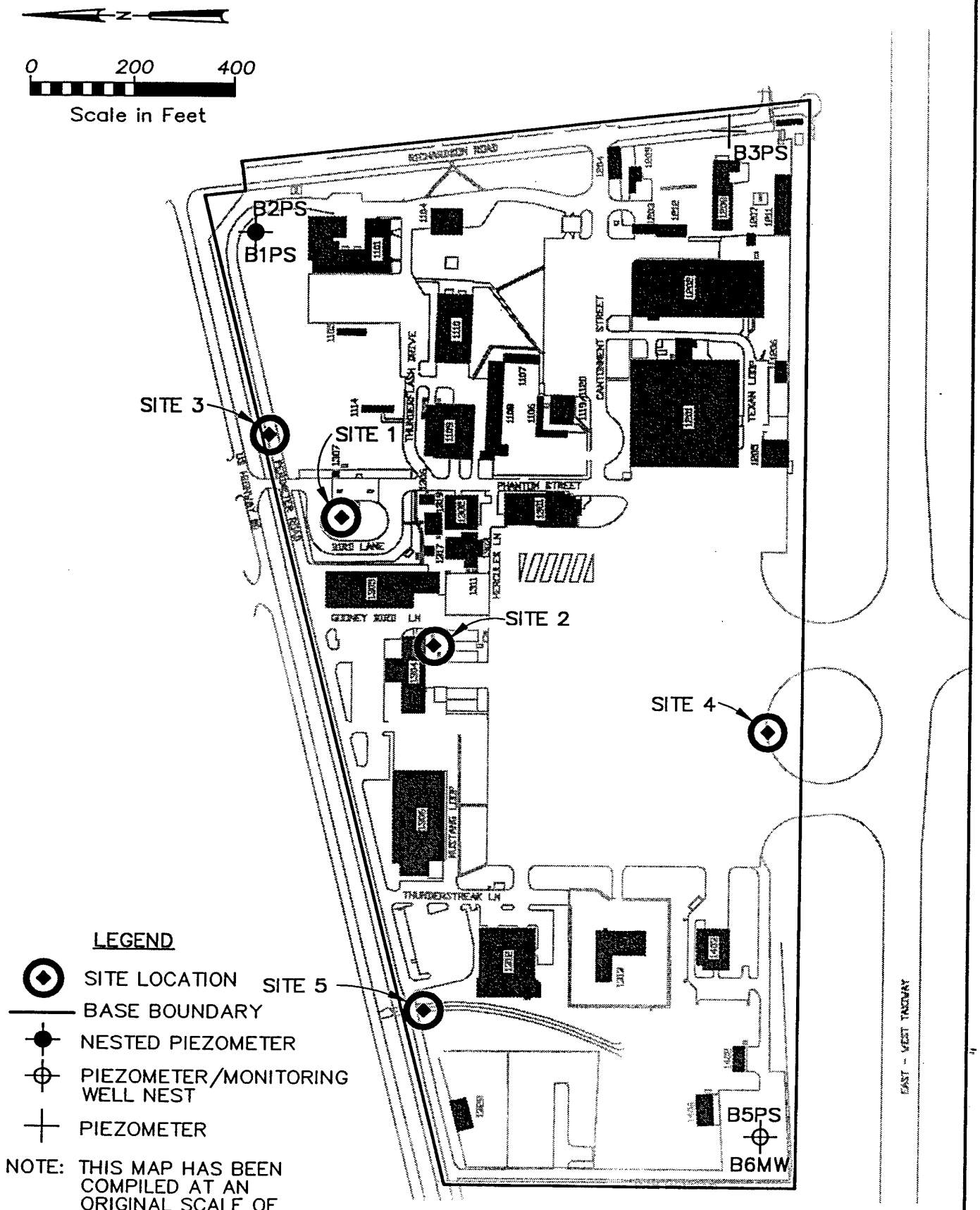


FIGURE 2.1
NESTED PIEZOMETERS/BACKGROUND MONITORING WELL LOCATIONS
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

Background piezometer B3PS, Site 4 piezometers, and Sites 1, 2, and 4 monitoring wells were eliminated from the field program during a meeting at the base that included representatives from HAZWRAP, the ANG, ANGRC, and CH2M HILL. The field modifications were implemented following discussions about the base hydrogeology and the inadequate groundwater conditions observed during the initial stages of the field program.

Piezometers were installed at background locations B1PS, B2PS, B3PS, and B5PS. Piezometers B1PS, B3PS, and B5PS were completed in the Mooreville Chalk at depths ranging from 20 to 30 feet below land surface. Piezometer B2PS was nested with B1PS and completed in the residual clay at a depth of 10 feet below land surface.

The piezometers were constructed according to HAZWRAP specifications with 1.25 inch I.D. PVC screen and well casing. The piezometer screens were 5 feet in length with a 0.010-inch slot size. Piezometer B3PS was not nested with another piezometer or monitoring well as were B1PS, B2PS, and B5PS. Therefore, in order to evaluate a similar subsurface interval, the screen length was extended to 10 feet. An artificial 20/40 grade sand pack was installed to a depth of at least 2 feet above the top of each of the screens. A minimum 2-foot bentonite seal was placed above the sand pack, and the annulus was grouted to surface.

The piezometers were completed with a watertight locking cap and flush mount manhole collar/cover inside a concrete apron.

2.3.2 Magnetic Surveys

A magnetic survey was conducted at Sites 1 and 2 before further site investigation activities at these sites. Both a Fisher MSCOPE and a Schonstedt Magnet Locator were used to conduct the surveys. The purpose of the magnetic survey was to locate any underground objects that might interfere with performing the SOV survey or drilling. When objects were detected below or near staked boring locations, the stake was repositioned to an area that was designated clear by the instruments. If no objects were detected, the preliminary staked locations were cleared for subsurface investigation (i.e., SOV survey and soil borings locations).

The survey was of limited use because of interference from above-ground metal objects.

2.3.3 Soil Gas/Groundwater Survey

On February 19-21, 1991, Target Environmental Services, Inc., conducted a soil gas and groundwater survey at the ANG POL facility (Site 1). The purpose of this investigation was to evaluate the extent of subsurface volatile organic compounds (VOCs) at this site.

The results of the analyses are included in the Soil Gas and Groundwater Survey provided as Appendix A. The following target compounds were analyzed during this investigation:

- Benzene
- Toluene
- Ethylbenzene
- Xylene
- Trichloroethene (TCE)
- Tetrachloroethene (PCE)

These target compounds were chosen based on their suspected presence in the subsurface. Twelve soil gas samples from the native soil surrounding the backfill material and 10 water samples from the saturated backfill were collected and analyzed in the field.

Elevated levels of VOCs were present in all soil gas and water samples. Benzene, toluene, ethylbenzene, and xylene isomers were present in all water samples and most soil gas samples. Chlorinated hydrocarbons (PCE and TCE) were not present above their detection limit in any of the soil gas or water samples collected from Site 1.

2.4 CONFIRMATION AND DELINEATION ACTIVITIES

Confirmation soil sampling activities were performed to investigate soil and groundwater conditions at Sites 1, 2, 4, and background locations. Optional delineation borings and monitoring well installations were planned to investigate each of the sites further but were not performed because of the relatively impermeable soil and inadequate groundwater conditions observed during the screening and confirmation stages of the field program.

2.4.1 Soil Sampling

2.4.1.1 Surface Soil Sampling

A surface soil investigation was conducted at the edge of the aircraft parking apron (Site 4) as part of the site investigation field activities. Information obtained from the PA indicated that PD-680 and hydraulic fluids had been washed to this area over the years during base operations. In addition, four to five hundred gallons of JP-4 were spilled at this site in 1980. Contamination adsorbed onto surface soils can be a long-term source of surface and groundwater contamination in the immediate vicinity. The purpose of this investigation was to evaluate whether contamination from prior activities was present, and if so, to estimate the extent of contamination at the site.

The surface soil sampling at Site 4 was conducted as a screening activity. The results of the analyses were used to evaluate whether original soil boring locations at this site needed to be repositioned.

Eight locations at Site 4 were designated for surface soil sample collection. Seven of the locations were equally spaced along an arc approximately 2 feet from the edge of the

pavement on the northern perimeter of the site. The remaining sample location was placed at the lowest point of depression in the southeastern part of the site and approximately 100 feet north of that location.

Samples were collected from each sample location using a hand auger. Soil collected from the sample interval was composited by mixing in a stainless steel bowl. Sampling equipment was decontaminated between sampling intervals using the procedures outlined in the SI Work Plan and HAZWRAP HWP-69 (Quality Control Requirements for Field Methods).

The sampling intervals were 0 to 6 inches and 6 inches to 24 inches. Samples collected were analyzed for polynuclear aromatic hydrocarbons (PAH) and benzene, toluene, ethylbenzene, and xylenes (BTEX). In addition, three of the composite samples collected from the 6-inch to 24-inch interval were analyzed for TPH. The analytical results of the samples collected are discussed in Section 3 (Interpretation of Results).

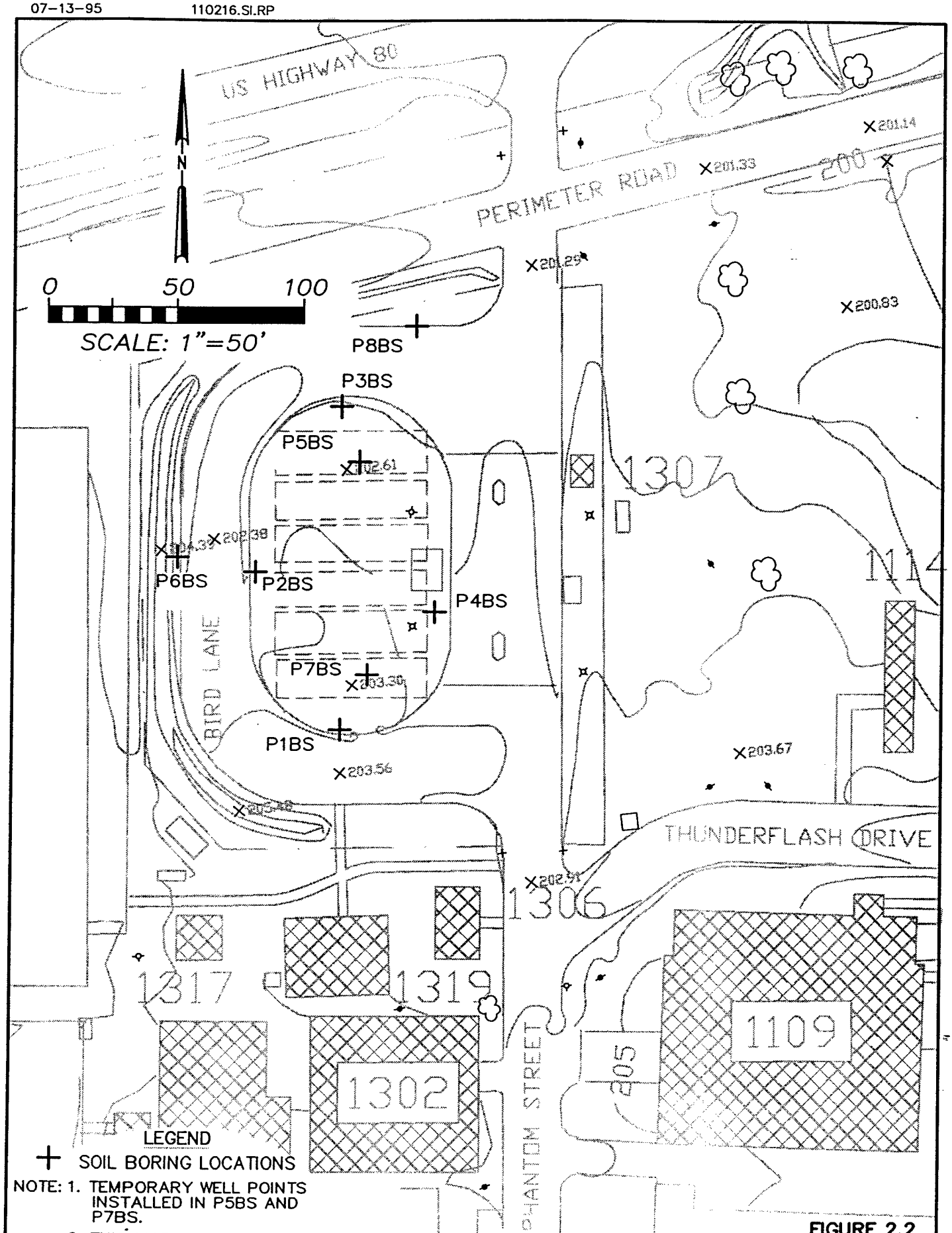
2.4.1.2 Soil Borings

Soil samples were collected from borings at three background locations. The conceptual approach involved augering a pair of boring nests at each of the background locations. The borings were converted to nested groundwater monitoring locations that could be used to evaluate the vertical hydraulic gradient. However, because of insufficient groundwater recharge, a field change resulted in only one boring (B3PS) at one of the background locations.

At the two nested background locations (B1PS and B2PS, B5PS and B6MW) one boring was advanced into the Mooreville Chalk and the other was terminated within the residual clay above the chalk. Soil samples were collected for laboratory analysis from the deeper (chalk) boring (B1PS and B5PS) at each location. Background location B3PS also was advanced to the Mooreville Chalk to characterize and collect soil for laboratory analysis. At the completion of each boring, a piezometer or monitoring well was installed and completed flush with the existing grade.

Eight confirmation soil borings were performed within the Site 1 (POL) investigation area. Two of the borings (P5BS and P7BS) were advanced into the Mooreville Chalk within the backfill of the POL facility. Two additional borings (P6BS and P8BS), located outside the POL fueling island, were advanced through the residual clay and into the Mooreville chalk. Figure 2.2 shows the locations of Site 1 soil borings.

Confirmation borings were the initial soil investigative activity performed at Site 2. Four borings were completed adjacent to each of the four sides of the oil/water separator tank located at the site. A fifth boring (O5BS) was completed at the site to evaluate soil conditions at a location nearer to the west side of the tank than was previously performed at O2BS. Soil boring locations at Site 2 are shown on Figure 2.3.

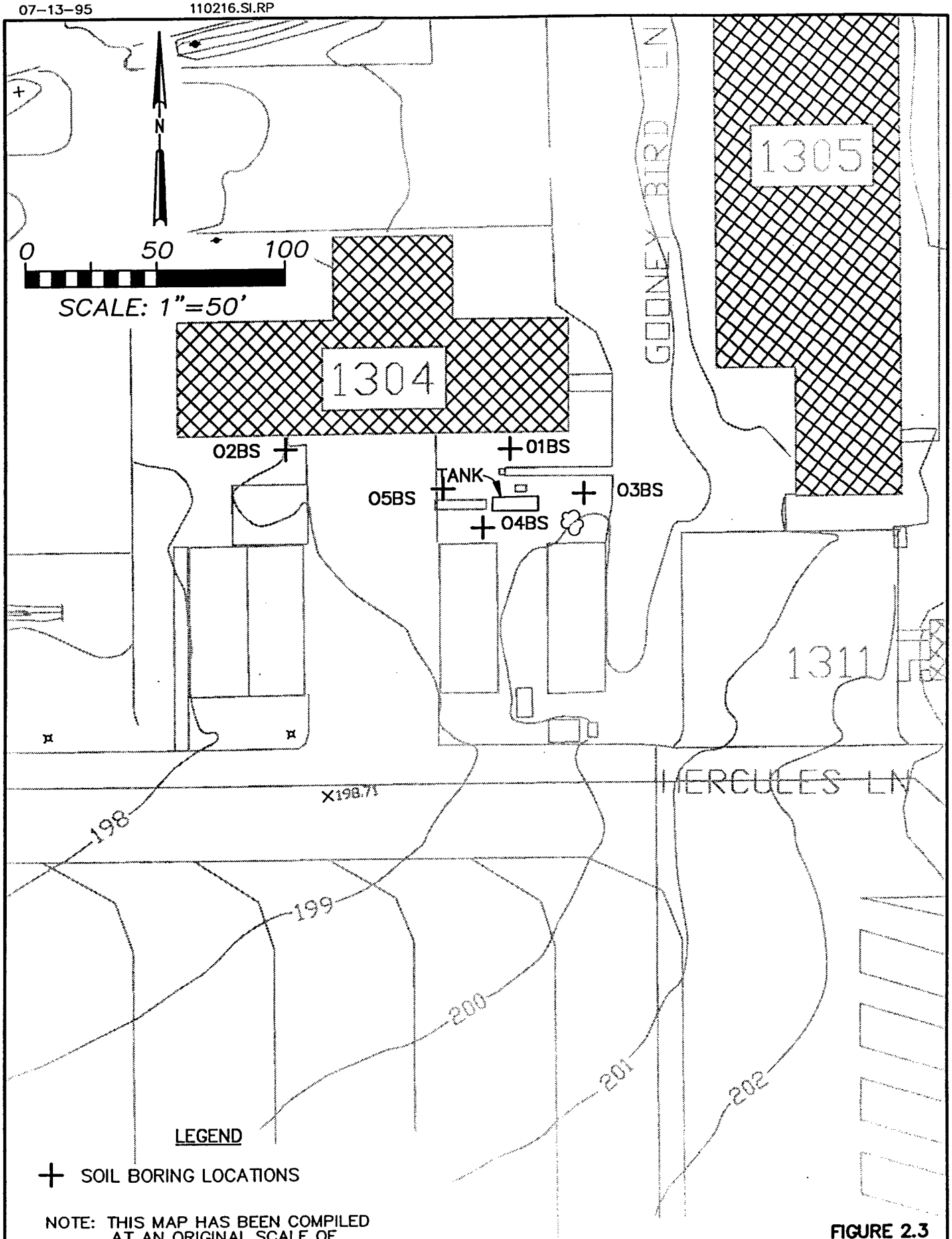


NOTE: 1. TEMPORARY WELL POINTS INSTALLED IN P5BS AND P7BS.

2. THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 2.2
SOIL BORING LOCATIONS AT SITE 1:
POL (PETROLEUM, OIL, AND LUBRICANT) SITE
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Al

DNG-0030.DWG



NOTE: THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 2.3
SOIL BORING LOCATIONS
AT SITE 2: OIL/WATER SEPARATOR SITE
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Al

Three confirmation borings were completed at Site 4 to evaluate soil conditions below the surficial sediments, which were collected and analyzed during the previous screening phase. Site 4 soil borings are shown on Figure 2.4.

Confirmation borings at Sites 1, 2, and 4 were advanced using hollow stem auger methods. The soil was sampled continuously using a brass lined split spoon sampler. An HNu photoionization detector was used to evaluate soil vapor headspace at each of the boring locations.

Three soil samples per boring were selected from each of the borings for Level C laboratory analysis. Table 2.2 summarizes the laboratory analytical parameters and methods for soil and groundwater.

The sampling interval selection criteria for laboratory analysis of soils depended primarily on depth and soil type. At Site 1, one soil sample was collected from the Mooreville Chalk. The two remaining samples were collected from the native residual clay interval below the surficial soil and above the chalk. At Sites 2 and 4, one sample was collected in the surficial (upper 2 feet) soil, one in the residual clay, and one from the Mooreville Chalk.

Soil samples also were collected from selected borings for geotechnical analysis. The results of geotechnical testing are included in Appendix B.

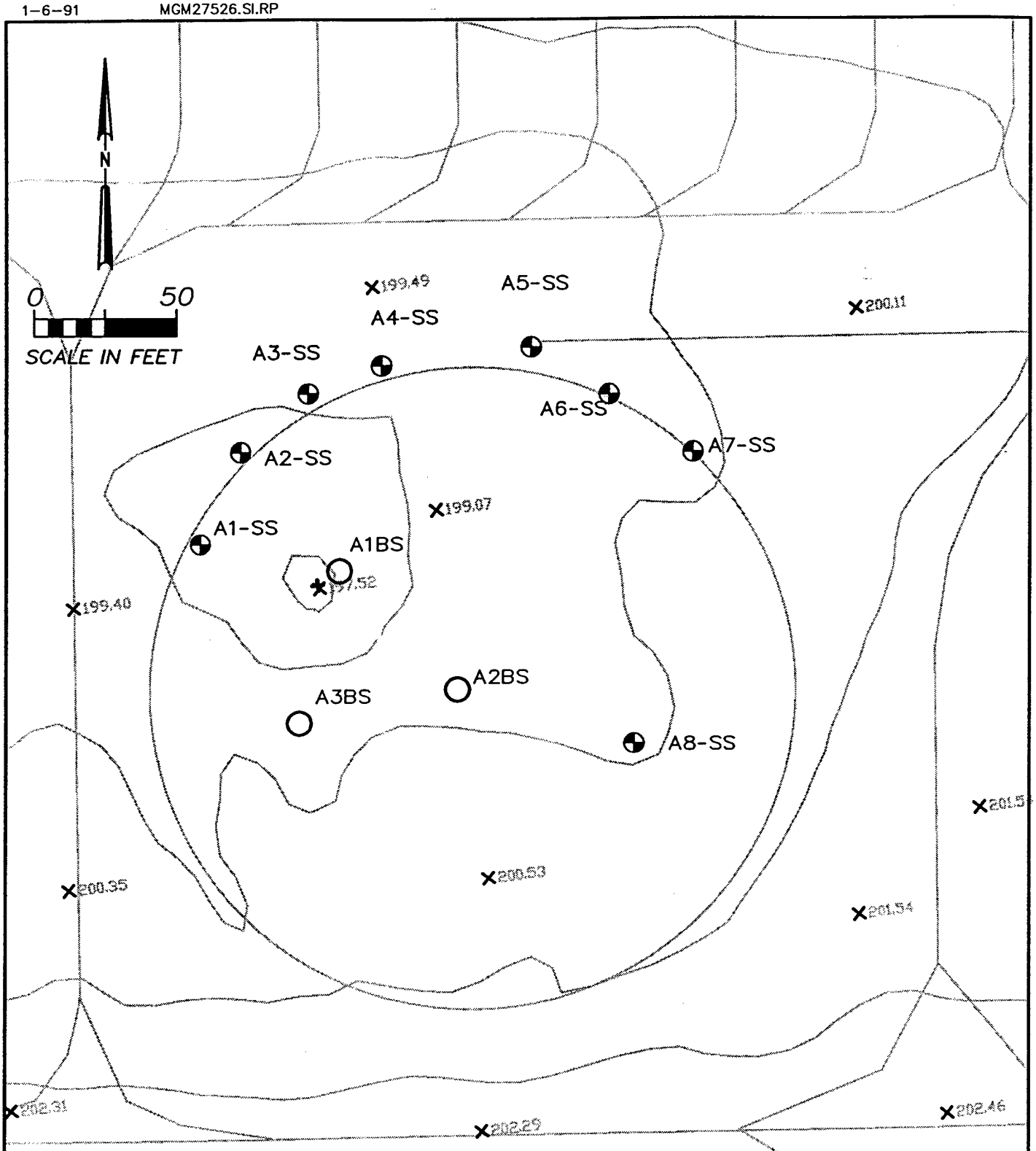
2.4.2 Monitoring Well Installation

One background monitoring well (B6MW) was installed in the residual clay at a total depth of 20 feet below ground surface. The well was completed in a nested pair with piezometer B5PS. The monitoring well was constructed according to the SI work plan specifications (Appendix A), which include a 2-inch ID PVC well casing and screen. The well screen is 10 feet in length with a 0.010-inch slot size. A 20/40 grade sand pack was installed to 3.5 feet above the top of the screened interval. A 2-foot bentonite seal was placed above the sand pack and the remaining annulus was grouted to surface.

The well was completed with a watertight locking cap and flush-mount manhole collar/cover inside a concrete apron.

Confirmation and optional monitoring wells were planned at Sites 1, 2, and 4; however, during the initial stages of the field program, the plan was modified. The monitoring wells were eliminated from the program because of relatively impermeable soils beneath each of the sites and inadequate groundwater conditions observed in the background piezometers.

Two temporary well points were, however, installed in POL borings P5BS and P7BS. The well points were installed within the backfill sand and gravel surrounding the USTs and consisted of 10 feet of 2-inch I.D. PVC screen. The well points were purged of three well



LEGEND

○ SOIL BORING LOCATIONS

◐ SURFACE SOIL SAMPLING LOCATIONS

NOTE 1. MONITORING WELL LOCATION NOT SHOWN

2. THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1" = 100' FROM FIELD SURVEY AND EXISTING MAPS.

FIGURE 2.4
SAMPLING LOCATIONS AT SITE 4:
EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

Table 2.2
SUMMARY OF ANALYTICAL PARAMETERS AND METHODS
SITE INVESTIGATION
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Site	Sample Matrix	Method	
Background	Water	VOCs	7/88 CLP SOW
		Metals	7/88 CLP SOW
	Soil	TPH	418.1
		VOCs	7/88 CLP SOW
		SVOCs	7/88 CLP SOW
		Metals	7/88 CLP SOW
Site 1 POL Facility	Soil	TPH	418.1
		BTEX	8020
	Water	BTEX	8020
		PAH	8100
Site 2 Oil/Water Separator	Soil	TPH	418.1
		Metals	7/88 CLP SOW
		VOCs	7/88 CLP SOW
		SVOCs	7/88 CLP SOW
Site 4 Edge of Aircraft Parking Apron	Soil (0-6")	BTEX	8020
		PAH	8100
	Soil (0-24")	TPH	418.1
		BTEX	8020
		PAH	8100
	Soil	BTEX	8020
		PAH	8100
		TPH	418.1

Notes: Priority Pollutant Metals: Sb, As, Ba, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn
SW-846 preparation method numbers: 8010/8020—5030 8100—3510, 3520 (water), 3550 (soils)

volumes using a peristaltic pump. A groundwater sample was collected from each of the well points using a Teflon bailer. The samples were analyzed for BTEX and PAH using QC Level B standards. Analytical results are discussed in Section 3.

2.4.3 Specific Media Sampling

Confirmation activities were limited to the installation and sampling of soil from borings and water from the POL backfill as described in Sections 2.4.1 and 2.4.2, respectively.

No additional media were sampled during the site investigation confirmation activities.

2.5 BACKGROUND SAMPLING FOR BASELINE DATA

Baseline data were generated from soil and groundwater analysis at three background locations. Background location B1PS/B2PS consists of a pair of nested piezometers, location B5PS/B6MW a nested piezometer and monitoring well, and location B3PS a single piezometer. The third location consisted of a single piezometer because a field change was made as a result of insufficient groundwater recharge observed in the residual clay.

Initially, the background piezometers and monitoring well could not be developed and sampled as planned because of insufficient groundwater recharge. Following an equilibration period of about 4 weeks, the water levels were checked in the piezometers and monitoring well. Background piezometers B1PS, B3PS, and B5PS were dry.

Piezometers B1PS and B5PS were constructed with 5 feet of screen installed in the Mooreville Chalk. Piezometer B3PS was constructed with 10 feet of screen and was installed across the residual clay/chalk interval.

Background piezometer B2PS and background monitoring well BG-6 were screened in the residual clay interval above the chalk with 5 and 10 feet of screen, respectively. The water levels in B2PS and B6PS were 3.47 feet and 10.9 feet, respectively.

Three well volumes of groundwater were evacuated from sample locations B2PS and B6MW using a peristaltic pump. The samples were collected with a Teflon bailer and analyzed for VOCs and metals (total and filtered) by the Contract Laboratory program (CLP) method. Semivolatile organic compounds (SVOCs) could not be analyzed because of insufficient volume in the well due to slow groundwater recharge. B6MW and B2PS were analyzed under QC level C and QC Level B standards, respectively.

Soil samples also were collected and analyzed from each of the background boring locations. In each of the boring nests, three soil samples were collected and analyzed for volatiles, semivolatiles, metals, and TPH under Level C QC standards.

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3. INTERPRETATION OF RESULTS

3.1 BACKGROUND

In this section, SI activities are discussed by site, and laboratory analytical results for soil and groundwater are summarized. The significance of the chemical analyses as they relate to existing or potential health risks is discussed in Section 4.

Summary tables of laboratory data appear in Appendix C. These tables present all samples collected during the SI and those analytes for which there was at least one reported value greater than the instrument detection limit.

Each site has been evaluated on the basis of site history, results from SI data collection (laboratory and field survey results), and assessment of site hydrogeology.

3.2 BASE GEOLOGY AND HYDROGEOLOGY

3.2.1 Geologic Framework

The base is underlain by approximately 1,100 feet of coastal plain sedimentary deposits of the Upper Cretaceous series. The deposits are comprised of the Tuscaloosa Group (Coker and Gordo Formations), the Eutaw Formation, and the Mooreville Chalk. Beneath the sedimentary deposits are igneous and metamorphic rocks that form the underlying crystalline bedrock surface.

Soil borings (see Appendix D) performed during the SI indicate that the residuum overlying the chalk averages 15 to 20 feet in thickness and typically consists of very stiff, silty, or fat calcareous clay that becomes chalky with depth. The residuum and chalk generally are homogeneous throughout the base except for moderate variations in color, plasticity, stiffness, and occasional sand and/or gravel seams.

Below the veneer of residual clay is the Mooreville Chalk. Nineteen of the 21 borings performed during the SI were advanced into the upper portion of the chalk. The Mooreville Chalk was encountered at an average depth of 15 to 20 feet and is typically olive green to grey, moist, stiff to hard, and slightly silty. The chalk was cored in boring OWS-3 to obtain a sample suitable for analyzing percent calcium carbonate. The results indicate a low to moderate $CaCO_3$ content at 36.6 percent.

A geologist's log from a well owned by the ANG and located on the base indicates the Mooreville Chalk is about 126 feet thick and is described as a grey, silty chalk containing glauconite, mica, and fossils. The basal 15 to 20 feet is slightly glauconitic and sandy.

The Eutaw Formation lies beneath the Mooreville Chalk and is comprised of more than 300 feet of sedimentary deposits consisting primarily of medium to coarse-grained quartz sand

and minor amounts of silt. The geologist's boring log description from the ANG well shows the top of the Eutaw was encountered at a depth of 137 feet below land surface.

Below the Eutaw Formation lies the Tuscaloosa Group, which is comprised of the Gordo and Coker Formations. These formations consists of over 600 feet of sand, gravel, clay, and a few thin beds of lignite; they overlie the igneous and metamorphic crystalline bedrock surface beneath the base.

3.2.2 Hydrogeology

3.2.2.1 Surface Water

The base is located within the Alabama River drainage basin. Surface drainage from the base flows north, through small unnamed streams, towards Catoma Creek. Catoma Creek, located approximately 1.5 miles northeast of the base, flows northwest towards the Alabama River, which is approximately 5 miles from the base. Officials of the Alabama Department of Conservation and Natural Resources stated that Catoma Creek is used for fishing and that tributaries to the creek in the area of the airport are probably fished. Man-made drainage ditches and storm drainage culverts channel storm runoff from the base into tributaries of Catoma Creek. According to sources at the Alabama Highway Department, Urban Planning Division, the base is not located within a floodplain associated with 100-year occurrence floods.

3.2.2.2 Groundwater

Sand and gravel beds within the Eutaw, Gordo, and Coker Formations are the principle aquifers underlying the base in Montgomery County. Sand and gravel within the shallow terrace and alluvial deposits are a secondary source of drinking water throughout Montgomery County; however, these deposits are not present at the base. Since the Mooreville chalk is the uppermost geologic unit beneath the base, there is no hydraulic connection between the base and the terrace and alluvial deposits that occur in other portions of Montgomery County.

Soil borings at the base indicate that the residual clay overlying the chalk typically was moist, although the moisture was apparent in the field only as condensation trapped inside soil collection jars. Analysis of three samples collected from borings at depths ranging from 8 to 12 feet indicated an average soil moisture content of 31.7 percent. Because the porosity of the residuum is estimated to be in the 30 percent range (John Scott, USGS, personal communication), the 31.7 percent average soil moisture content, analyzed at depths ranging from 8 to 12 feet, indicates that the residuum is at or near the saturation point even though the residuum did not yield groundwater in three of the five piezometers and the monitoring well. Geotechnical analysis (see Appendix B) of three samples collected at Sites 1 and 2 indicate the residuum is relatively impermeable, with an average vertical hydraulic conductivity value of 6.0E-08 cm/sec.

Beneath the residuum, the Mooreville Chalk was encountered at depths averaging 15 to 20 feet below ground surface. Typically, soil borings were terminated in the upper 2 to 5 feet of the Mooreville Chalk. Although the Mooreville Chalk porosity is estimated to be in the 30 percent range (John Scott, USGS, personal communication), the permeability or interconnection of the pore space is probably less than that in the overlying residuum. Therefore, the Mooreville Chalk does not have sufficient water-transmitting capacity to serve as an aquifer, but does provide an upper confining bed for the underlying Eutaw aquifer. The Eutaw aquifer beneath the base is, therefore, a confined aquifer, with its potentiometric surface occurring within the Mooreville Chalk at a depth of about 60 feet below land surface.

The primary source of recharge to the Eutaw aquifer is rainfall in the areas where the formation outcrops; however, where the Mooreville chalk is absent, the Eutaw receives considerable recharge by downward leakage from terrace and alluvial deposits associated with local fluvial systems. Although the Mooreville Chalk serves as a confining unit for the Eutaw aquifer, groundwater from the saturated zone within the Mooreville has a distinct downward gradient and contributes recharge to the Eutaw; however, the volume of recharge per unit area is very low. A USGS groundwater susceptibility study (Water-Resources Investigations Report B6-4360, Scott, John C., et al., 1987) shows that the recharge area for the Eutaw is located in extreme north Montgomery County and southern Elmore and Autauga counties, and lies north of the base location. The study also indicates that the base does not fall within a major aquifer recharge area that could be susceptible to groundwater contamination.

During the SI, four piezometers and one monitoring well were installed at the base. Approximately 4 weeks after the installation, only one piezometer and the monitoring well contained groundwater. Piezometer B2PS, completed as a shallow (10-foot), residuum piezometer, contained about 3.5 feet of water. Monitoring Well B6MW, completed across the chalk/residuum interval at a depth of 20 feet, contained about 11 feet of water. The remaining piezometers were completed within similar intervals but contained no measurable groundwater.

The results of the hydrogeologic investigation suggest that a relatively impermeable clay residuum and parent rock (Mooreville Chalk) overlie the uppermost aquifer (Eutaw) at the base. Analyzed vertical hydraulic conductivity values of the weathered residuum beneath the base are low, averaging 6.0E-08 cm/sec. Within the limits of this investigation, groundwater occurrence and migration were relatively insignificant.

Seepage velocity and hydraulic gradient estimates can be calculated to show the vertical groundwater flow seepage velocity through the saturated portions of the residuum and chalk. Based on the assumptions and calculations in Appendix E, the estimated groundwater seepage velocity through the chalk is 2.2×10^{-4} feet/day. This value calculates to a travel time of about 1,594 years for shallow groundwater to reach the Eutaw aquifer. The natural degradation and contaminant attenuation processes associated with filtration and sorption would reduce or eliminate the potential for contaminants to reach the Eutaw aquifer. Following a worst-case scenario, if contaminants were reaching the Eutaw aquifer

from a surface source, groundwater would be diluted by more than an estimated factor of 560.

3.3 BACKGROUND SAMPLING RESULTS

Both soil and groundwater samples were collected from the background piezometers and monitoring well locations shown on Figure 2.1. The samples were collected to provide data on the occurrence of organics as well as metals in the soil and groundwater and to estimate background soil and groundwater quality at the base. The locations of these sampling locations were not intended to represent upgradient positions at the investigation sites. Instead, they were selected as locations representative of areas unaffected by base activities. The final location of the background piezometers and monitoring well was selected in consultation with ANGRC and HAZWRAP staff.

3.3.1 Background Site Investigation Activities

In February 1991, soil samples were collected from boreholes before the installation of piezometers B1PS, B3PS, and B5PS. Soil samples were collected from three depth intervals at each of the piezometer locations. These samples were analyzed for the following parameters:

- VOCs (CLP)
- SVOCs
- Priority Pollutant Metals (CLP Target Analyte List (TAL))
- TPH (418.1)

Groundwater samples were collected from the background monitoring well as well as from piezometer B2P in April 1991. Samples collected were analyzed for the following parameters:

- VOCs (CLP)
- Priority Pollutant Metals (CLP TAL)

The background piezometers/monitoring well were installed in clayey residual soils that essentially contain very little permeability, resulting in little or no groundwater yield. Therefore, sufficient sample volume could not be collected for SVOCs (CLP) analysis as originally scoped in the WP.

Analytical results indicate that no detectable VOCs (CLP) or elevated levels of metals present in the groundwater sampled from the background monitoring well B6MW or background piezometer B2PS.

3.3.2 Soil Analysis

Soil samples collected from background locations were analyzed for both organic and inorganic compounds. The analytical data for background soil samples collected are presented in Appendix C.

Eleven separate compounds were detected in background soil samples. Compounds detected in these samples were either below the Contract Required Detection Limit (CRDL) for those compounds or were artifacts of sampling or laboratory procedures. Four compounds (methylene chloride, acetone, carbon disulfide and bis(2-ethylhexyl)phthalate) were detected in the background soil samples as well as the laboratory blanks. The source of carbon disulfide was identified as an inadequate water purification system in the laboratory, as indicated in Appendix F. Bis(2-ethylhexyl)phthalate is a common plasticizer found in sampling materials (i.e., gloves) and the two remaining compounds are common laboratory contaminants.

Background TPH concentrations ranged from (3.6-28.4 mg/kg) in all samples analyzed except for one (B3PS). The sample collected and analyzed from the 13.5- to 15-foot sampling interval in this borehole had a TPH concentration of 572 mg/kg. Samples collected at intervals above and below this sampling interval exhibited considerably lower TPH concentrations as shown in Table 3.1. A possible explanation for the high TPH concentration in B3PS is that pavement material (asphalt) from the parking lot where this boring was drilled could have entered the borehole and was present in the 13.5- to 15-foot sampling interval. This explanation is supported by the boring log for this boring, as shown in Appendix D.

Background metals analysis indicated the presence of 12 of the 14 metals analyzed for in the soil samples.

3.3.3 Groundwater Analysis

The results of groundwater samples collected from background piezometer B2P and monitoring well B6MW have been provided as Appendix C. VOCs, SVOCs and CLP metals analysis of the two background groundwater samples collected indicated that concentrations of these parameters were below the CRDL.

3.4 SITE 1 (POL FACILITY)--SOIL AND GROUNDWATER RESULTS

3.4.1 Screening Results

The screening efforts at this site included a magnetic survey and soil gas/groundwater survey within the fuel island in March 1991.

The purpose of the magnetic survey was to locate any underground objects that might interfere with performing the SOV survey or drilling. The survey was of limited use due to interference from above ground metal objects. The final locations for SOV sampling

Table 3.1
BACKGROUND INFORMATION
187th Fighter Group
DANNELLY ANG–Montgomery, Alabama[a]

Client Sample ID	B1PS	B3PS	B5PS
Lab Batch Number	17937	17931	17937
Matrix	Soil	Soil	Soil
Sample Date	2/26/91	2/26/91	2/26/91
Total Petroleum Hydrocarbons			
Sample Depth (Feet)			
0-2	4.8		10
8.5-10	3.9	5.4	4.8
13.5-15		572	
18.5-20	3.6		
23-25			4.2
28.5-30		28.4	

[a]Data reported in mg/kg.

Notes: 1) Indicates concentrations below method detection limit. Shaded areas indicate depth intervals not sampled.
2) Sample identification numbers for the above sample depths are provided in Appendix F.

were checked by use of a 5-foot probe. If no objects were encountered when pushing this probe, the locations were cleared for SOV probe installation. These probe locations were also reviewed and approved by the base POL Superintendent.

The soil gas/groundwater survey conducted at Site 1 found detectable soil gas and groundwater headspace concentrations of the following parameters:

- Benzene
- Toluene
- Ethylbenzene
- Meta- and para-xylene
- Ortho-xylene

A detailed discussion of soil gas/groundwater survey results as well as figures showing sampling locations is presented in Appendix A. The results of the SOV survey were used to evaluate if initial locations for borings should be revised.

3.4.2 Confirmation Results

Eight soil borings (P1BS through P8BS) were included at Site 1 to evaluate possible contaminant migration outside the fuel island as well as vertical migration beneath the backfill material. Three soil samples were collected for chemical analysis from each of the confirmation boreholes. Subsurface soil samples collected at Site 1 during the SI were analyzed for BTEX (Method 8020) and TPH (Method 418.1).

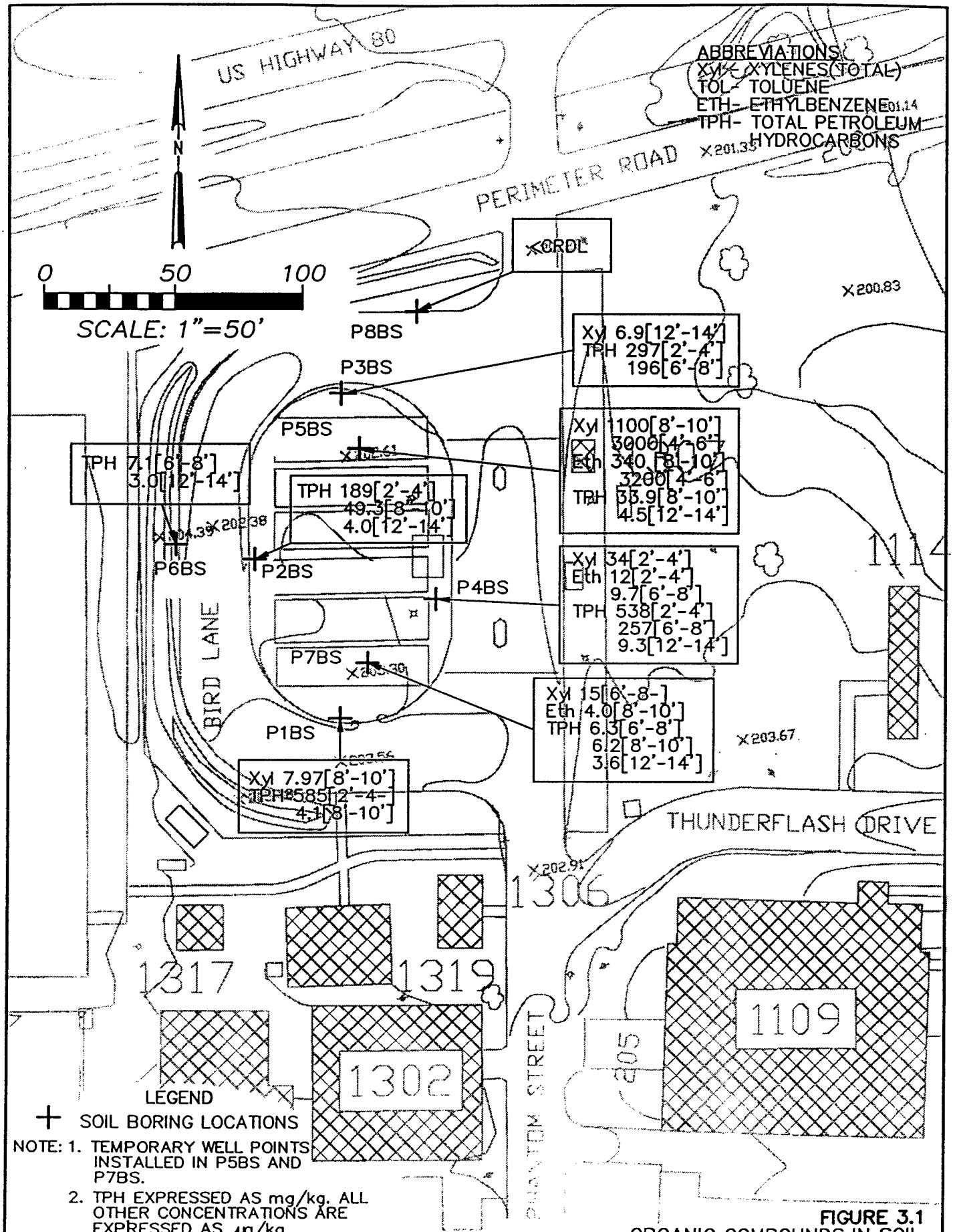
Analytical results from these samples were used to evaluate the possibility of petroleum product release.

Water samples were collected from soil borings drilled within the saturated POL backfill (P5BS and P7BS). Samples were collected from these borings using temporary well points. These samples were collected for analysis using Level B QC and analyzed for BTEX (Method 8020) and PAH (Method 8100).

3.4.2.1 Soil Analysis

The analytical data for soil samples collected at Site 1 are presented in Appendix C. The sampling locations and concentrations detected at Site 1 are shown in Figure 3.1. Two organic compounds (ethylbenzene, and total xylene) were detected in subsurface soil samples. These compounds are characteristic of fuel contaminants and were detected in borings P1BS, P3BS, P4BS, P5BS and P7BS. Concentrations detected in these borings were above levels detected in the background samples. A comparison between Site 1 organic concentrations and background is shown in Table 3.2.

Total xylene concentrations ranged from 6.9 μg/kg detected in one sample obtained from boring P3BS to 3,000 μg/kg detected in boring P5BS. Although xylene was detected



NOTE: 1. TEMPORARY WELL POINTS INSTALLED IN P5BS AND P7BS.

2. TPH EXPRESSED AS mg/kg. ALL OTHER CONCENTRATIONS ARE EXPRESSED AS µg/kg.

3. <CRDL=RESULTS LESS THAN CONTRACT REQUIRED DETECTION LIMIT

4. []-DENOTES SOIL DEPTH

FIGURE 3.1
ORGANIC COMPOUNDS IN SOIL
AT SITE 1: POL FACILITY
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Al

Table 3.2
CHEMICALS DETECTED IN SOIL
SITE 1, POL AREA
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Compound	Matrix	Concentrations µg/kg	Sample Location	Depth (Feet)	Range of Background Concentrations µg/kg
Xylenes(total)	Soil	7.9J	P1BS	8-10	1B-4J
	Soil	6.9	P3BS	12-14	1B-4J
	Soil	34	P4BS	2-4	1B-4J
	Soil	3,000	P5BS	4-6	1B-4J
	Soil	1,100	P5BS	8-10	1B-4J
	Soil	15	P7BS	6-8	1B-4J
Ethylbenzene	Soil	12	P4BS	2-4	6J
	Soil	9.7	P4BS	6-8	6J
	Soil	3,200	P5BS	12-14	6J
	Soil	340	P5BS	8-10	6J
	Soil	4	P7BS	8-10	6J

Notes: J - Estimated value—value detected is greater than zero but less than the CRDL.
B - Applies to organic data only. Present in the corresponding method blank.

in one sample collected from boring P1BS, it was below the PQL for that compound. Ethylbenzene was detected in borings P4BS and P7BS at low levels (4-12 μg/kg). Ethylbenzene was also detected in boring P5BS with the highest concentration (3,200 μg/kg) found at the 12- to 14-foot sampling interval. The elevated VOC concentrations (3,000-3,200 μg/kg) found in samples collected from boring P5BS all were taken from the tank backfill area.

The results of TPH analysis conducted on soil samples collected from Site 1 revealed four locations (P1BS, P2BS, P3BS, and P4BS) with measured concentrations of TPH greater than the Alabama Department of Environmental Management (ADEM) action level of 100 ppm. The highest concentrations of TPH were detected in borings P1BS and P4BS at a depth interval of 2 to 4 feet. Table 3.3 presents a summary of TPH analytical results for samples collected at the POL facility. Sampling locations and detected TPH concentrations at Site 1 are shown in Figure 3.1.

Samples also were collected from borings drilled at Site 1 for geotechnical analysis. One Shelby tube sample was collected from boring location P8BS at a depth interval of 10 to 12 feet. This sample was submitted to conduct grain size gradation and vertical conductivity analyses. Grain size analysis was also performed on the backfill material collected from boring P5BS. The gradation curve for this analysis is provided as Appendix B.

The results of soil analyses on the sample collected from Site 1 indicated that the natural soils are very impermeable (tight). The permeability coefficient of this particular sample was 7.2E-09 cm/sec.

3.4.2.2 Groundwater Analyses

The analytical data from the Level B water samples collected at Site 1 are presented in Appendix C. Seven organic compounds were detected in the two water samples collected within the saturated backfill material of the POL. The compounds and concentrations detected, as well as sample location are listed in the Table 3.4.

Temporary well point sampling locations P5BS and P7BS are identified on Figure 2.2.

3.4.3 Geologic and Hydrogeologic Investigation Results

Soil boring logs and geotechnical data collected during the investigation of Site 1 indicate that the site geology is consistent with regional geology, as described earlier in this report. Elevated TPH concentrations were detected in soil borings P1BS, P2BS, P3BS, and P4BS at Site 1.

Table 3.3
SITE 1, POL AREA
187th Fighter Group
DANNELLY ANG–Montgomery, Alabama[a]

Client Sample ID	P1BS	P1BSDUP	P2BS	P2BSDUP	P3BS	P4BS	P5BS	P6BS	P7BS	P8BS
Lab Batch Number	17966	17966	17946	17946	17946	17966	17946	17966	17966	17966
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	3/5/91	3/5/91	2/28/91	2/28/91	2/28/91	3/5/91	2/28/91	3/5/91	3/5/91	3/5/91
Total Petroleum Hydrocarbons										
Sample Depth (Feet)										
2-4	585		189		297	538				<1.1
6-8					196	275		7.1	6.3	<1.1
8-10	4.1	<1.1	<1.1	49.3			33.9	<1.1	6.2	
12-14	<1.1		4.0		<1.1	9.3	4.5	3.0	3.6	<1.1

[a]Data reported in mg/kg.

Notes: (1) *Indicates concentrations below method detection limit.
(2) Shaded areas indicate depth intervals not sampled.
(3) ADEM action level for TPH = 100 ppm.
(4) Sample identification numbers for the above sample depths are provided in Appendix F.

Table 3.4
ORGANIC COMPOUND CONCENTRATIONS IN WATER
SITE 1, POL AREA
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Compound	CRDL (μg/L)	MCL (μg/L)	Concentration (μg/L)	Sample Location
1-Methylnaphthalene	10	None	200 130	P5BW1 P7BW1
2-Methylnaphthalene	10	None	250 7	P5BW1 P7BW1
Benzene	5	5	400	P5BW1
Ethylbenzene	5	700	15	P5BW1 P7BW1
Naphthalene	10	None	87	P5BW1
Toluene	5	1,000	120	P5BW1
Xylene (total)	5	10,000	260 9.3	P5BW1 P7BW1

3.4.4 Summary

Site 1 (POL Facility) was identified during the PA as a possible source of JP-4 contamination. Strong JP-4 odors were reported by Base personnel when excavating a 2- to 3-feet deep hole on the fueling island, and a distinct smell of JP-4 in the water entering this hole was detected by the HMTC site visit in November 1986. Strong fuel odors were also reported in the storm drainage inlet that used to run along Phantom Street adjacent to the POL facility.

An SOV Survey indicated the presence of VOC contaminants within the saturated POL backfill.

Eight soil borings were installed and soil samples were collected and analyzed from three depth intervals in each of these borings. The results of the soil analysis indicated the presence of VOCs. Samples from four borings (P1BS, P2BS, P3BS and P4BS) contained TPH concentrations which exceeded the ADEM CAL of 100 mg/kg. Most of the soil contamination was present in the top 4 feet of soil at the sample locations. Elevated concentrations of ethylbenzene and total xylene were detected in samples collected from boring P5BS at both the 12- to 14-foot and 8- to 10-foot sampling intervals. The highest ethylbenzene (3,200 μg/kg) and total xylene (3,000 μg/kg) concentrations were detected at the 4- to 6-foot sampling interval. These compounds were detected in borings P3BS, P4BS, and P7BS but at much lower concentrations (9-34 μg/kg). Confirmation sampling activities, which are more representative of actual site conditions, did not indicate elevated concentrations of organic compounds at these sampling locations. It is possible that the concentrations of TPH seen in these borings could be from the loading and unloading of fuel.

Although these TPH concentrations are above the ADEM corrective action level of 100 ppm, this area will be excavated as part of the planned decommission of the POL because of its proximity to the backfill. Therefore, additional investigation is not recommended at this time.

Samples of water from the saturated backfill were collected from two of the borings (P5BW and P7BW) within the backfill material. VOCs were detected in both water samples that were not detected in the background groundwater sample. The highest concentrations were found in boring P5BW. Benzene was detected in this sample at a concentration of 400 μg/L. Toluene, ethylbenzene and xylene (total) were also present in this sample at concentrations of 120, 15, and 260 μg/L, respectively. Additionally, SVOCs were detected in the samples. Naphthalene was found with a concentration of 87 μg/L, 1-methylnaphthalene at 200 μg/L, and 2-methylnaphthalene at 250 μg/L.

3.5 SITE 2 (OIL/WATER SEPARATOR)--SOIL SAMPLE RESULTS

3.5.1 Screening Results

The screening activities at Site 2 consisted of conducting a magnetic survey at proposed boring locations. The purpose of the magnetic survey was to locate any underground objects (such as plumbing) that might be associated with the OWS holding tank and to confirm that the locations staked for drilling would not damage underground utilities in the area. When objects were detected below or near staked boring locations, the stake was repositioned to an area that was designated clear by the instruments.

3.5.2 Confirmation Results

Confirmation efforts involved the drilling and sampling of five borings at the site. These borings were used to collect samples for chemical analysis as well as to collect data on site hydrogeology. Three separate samples were collected from each boring. These soil samples were analyzed for the following parameters:

- VOCs (CLP)
- SVOCs (CLP)
- Priority pollutant metals (CLP)
- TPH (418.1)

3.5.2.1 Soil Analyses

Analytical data for the soil samples collected at Site 2 have been provided as Appendix C. Eleven metals of the 14 analyzed were detected in soil samples at Site 2. Metals concentrations detected at Site 2 were comparable with those found in background samples except for selenium, which was more than twice the background concentration as illustrated in the analytical data tables of Appendix C.

Thirty-three organic compounds were detected in subsurface soils collected from Site 2. Five compounds detected in the soil samples are believed to be artifacts of either sampling or laboratory procedures. These compounds are as follows:

- Acetone
- Carbon Disulfide
- Di-n-butylphthalate
- Methylene Chloride
- Bis(2- ethylhexyl)phthalate

Acetone, methylene chloride, and phthalates are common laboratory contaminants introduced during the preparation/extraction processes. Carbon disulfide has been detected in commercially purchased deionized/distilled water used in field equipment decontamination procedures.

Eleven additional organic compounds were detected above the method detection limit (MDL) in Site 2 soil samples but were below the CRDL. This is noted by a "J" qualifier as indicated in the data results of Appendix C.

Table 3.5 summarizes compounds positively detected in soil samples at Site 2 and were detected at levels significantly above the same compounds detected in sample blanks.

Concentrations followed by the "E" qualifier indicates the concentration is an estimated amount because the compound was above the linear range of the instrument. Figures 3.2, 3.3, and 3.4 show soil sampling locations and concentrations detected at Site 2.
The results of TPH analysis revealed elevated concentration at one sampling location (O4BS). The remaining sample locations exhibited low concentrations in comparison, with two locations (O1BS and O3BS) having concentrations below the method detection limit. A summary of the TPH results for Site 2 samples is shown in Table 3.6.

Samples also were collected at Site 2 and submitted for geotechnical laboratory analysis. Shelby tube samples were collected in the clay residuum borings O3BS and O4BS. A core sample also was collected of the top 3 feet of the Mooreville Chalk for percent $CaCO_3$ and vertical hydraulic conductivity analyses. The results of the geotechnical testing are contained in Table 3.7.

Table 3.7
HYDRAULIC CONDUCTIVITY DATA
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Sample I.D.	Depth (ft)	Hydraulic Conductivity Coefficient (cm/sec)	In Situ Unit Weight (lbs/ft^3)	Moisture Content
O3BS	8-10	2.3E-06	89.7	31.5%
O4BS	8-10	1.3E-08	91.6	29.0%

The core sample collected from boring location O3BS was analyzed for percent calcium carbonate ($CaCO_3$) content. The results revealed that the underlying Mooreville Chalk at Site 2 contains 35.6 percent $CaCO_3$, which is in the low to moderate range for $CaCO_3$. A major portion of the remaining balance probably consists of feldspars and silica, which do not react in a low pH environment.

Table 3.5
CHEMICALS DETECTED IN SOIL
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemicals	Frequency of Detections	Range of Detected Concentrations µg/kg	Range of Background Concentrations µg/kg
Acetone	15/17	17B - 13,000B	13B - 110B
Anthracene	1/17	120J	--
Benzene	3/17	3J - 1000J	--
Benzo(a)anthracene	3/17	52J - 770	--
Benzo(a)pyrene	3/17	57J - 660	--
Benzo(b)fluoranthene	3/17	83J - 690	--
Benzo(g,h,i)perylene	3/17	50J - 440	--
Benzo(k)fluoranthene	3/17	64J - 760	--
Benzoic Acid	1/17	780J	--
bis(2-Ethylhexyl)phthalate	17/17	270BJ - 6100B	730 - 3700
Chrysene	3/17	84J - 780	--
Dibenz(a,h)anthracene	1/17	120J	--
Di-n-butyl phthalate	3/17	42J - 50J	--
1,1-Dichloroethane	2/17	1J - 790	--
1,1-Dichloroethene	1/17	24J	--
1,2-Dichloroethene (total)	12/17	150 - 28,000	--
Ethyl benzene	5/17	15 - 11,000	6J
Fluoranthene	3/17	92J - 1,600	79J
Fluorene	1/17	100J	--
Indeno(1,2,3-cd)pyrene	3/17	56J - 400J	--
Methylene chloride	15/17	11B - 9,500B	7B - 35B
2-Methyl naphthalene	6/17	43J - 4,100	--
Naphthalene	8/17	48J - 8,800E	--
1,1,2,2-Tetrachloroethane	1/17	1,600	--
Nitrobenzene	1/17	270J	--

Table 3.5
CHEMICALS DETECTED IN SOIL
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemicals	Frequency of Detections	Range of Detected Concentrations µg/kg	Range of Background Concentrations µg/kg
n-Nitrosodiphenylamine	4/17	43J - 94J	--
Phenanthrene	3/17	49J - 510	52J
Pyrene	4/17	44J - 1,200	56J
Tetrachloroethene	3/17	400J - 1,100	--
Toluene	10/17	7 - 21,000	1J - 3J
Total Petroleum Hydrocarbons	11/21	5.5 - 2120*	3.0 - 585*
Trichloroethene	13/17	2BJ - 160,000E	--
Vinyl chloride	3/17	7J - 1,300J	--
Xylenes (total)	7/17	4J - 89,000	4J
Inorganic Chemicals			
Antimony	6/6	2.8B - 5.3B	2.7B - 6.2B
Arsenic	3/6	5.1 - 7.6	4.5 - 11.2
Barium	6/6	31.3B - 227	23.2B - 239
Cadmium	6/6	0.45B - 0.81B	0.32B - 0.78B
Chromium	6/6	14.9 - 21.5	13.7 - 54.8
Copper	6/6	8.6 - 37.4	11.6 - 23.6
Lead	6/6	5.2 - 8.8	4.8 - 37.1
Nickel	6/6	14.2 - 25.1	1.9B - 20.4
Selenium	4/6	0.4B - 3	0.22 - 0.65B
Thallium	2/6	0.23B - 0.28B	0.23B
Zinc	6/6	35.4 - 65.6	16.6B - 64.4

Notes:
(1) A "B" flag beside concentrations for organics is for blank contamination, but denotes concentrations below the contract detection limit for inorganic parameters.
(2) A "J" flag beside concentrations indicates that the concentration was above method detection limit but below CRDL.
(3) An "E" flag indicates that concentration is estimated because the compound concentration was above the linear range of the instrument.
(4) "*" beside the concentrations for TPH indicates that the values are given in units of mg/kg.

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01BS

Tet -1600[14-16]
DCA -1J[10-12]
1,2 DCE -180[10-12]
1500[14-16]
ACE -53[0-2]
19B[10-12]
1900B[14-16]
Ben -3J[0-2]
Eth -15[0-2]

Meth-14B[0-2]
11B[10-12
2000[14-1
Tete -450J[14-1
Tol -3300[14-16
TCE -2J[0-2]
680E[10-1
160,000E[
VC -7J[0-2]
Xyl -4J[0-2]
470J[14-16

1,2 DCE -700[0-2]
830[6-8]
730J[12-14]
ACE -30BJ[0-2]
1900[6-8]
2900B[12-14]
Meth -51B[0-2]
1300J[6-8]
3600B[12-14]

Tol -180J[12-14]
TCE -150[0-2]
12000[6-8]
27000[12-14]

1,1 DCE -24J[18-20]
1,2 DCE -150[12-14]
1000[18-20]
ACE -17B[12-14]
100B[18-20]
Car -18J[18-20]
Meth -13B[0-2]
21B[12-14]
120B[18-20]

Tol -7[0-2]
160[18-20]
TCE -100[12-14]
8400[18-20]
VC -18[12-14]
TPH -16[0-2]

1,2 DCE -28000[8-10]
ACE -5900[0-2]
2000[8-10]
Ben -390J[0-2]
Eth -2300[0-2]
220J[8-10]
Meth -3700B[0-2]
810J[8-10]
2600B[12-14]

Tol -5500[0-2]
640J[8-10]
TCE -4000[8-10]
13000[12-14]
VC -1300[8-10]
Xyl -17000[0-2]
1200[8-10]
TPH -5.5[0-2]
5.7[8-10]
12.1[12-14]

DCA -790[14-16D]
1,2 DCE -5400[6-8]
220J[14-16]
960[14-16D]
ACE -5000BJ[0-2]
13000B[6-8]
4800B[14-16]
Ben -1000J[0-2]
Eth -11000[0-2]
1300J[6-8]
Meth -9500B[0-2]
7900B[6-8]

Tol -21000[0-2]
5300[6-8]
310J[14-16]
1100[14-16D]
TCE -33000[14-16
65000E[14-1
Xyl -89000[0-2]
17000[6-8]
790J[14-16D]
Tete -1100[14-16]
400J[14-16]
TPH -2120[0-2]
69.1[6-8]
37.8[14-16]

ABBREVIATIONS

1,1,2,2-Tetrachloroethane	- Tet
1,1 Dichloroethane	- DCA
1,1 Dichloroethene	- 1,1 DCE
1,2 Dichloroethene(total)	- 1,2 DCE
Acetone	- ACE
Benzene	- Ben
Carbon Disulfide	- Car
Ethylbenzene	- Eth
Methylene Chloride	- Meth
Tetrachloroethene	- Tete
Toluene	- Tol
Trichloroethene	- TCE
Vinyl Choride	- VC
Xylene(total)	- Xyl
Total Petroleum Hydrocarbons	- TPH

NOTES:

1) B - INDICATES COMPOUND PRESENCE IN CORRESPO METHOD BLANK
2) J - INDICATES VALUE DETECTED IS GREATER THAN BUT LESS THAN THE CRDL
3) E - INDICATES COMPOUND ABOVE OR BELOW THE L RANGE OF THE INSTRUMENT
4) TPH IS EXPRESSED AS mg/kg. ALL OTHER CONCEN ARE EXPRESSED AS µg/kg.
5) [] BRACKETS DENOTE SOIL SAMPLING DEPTH IN FEE BELOW LAND SURFACE

01BS

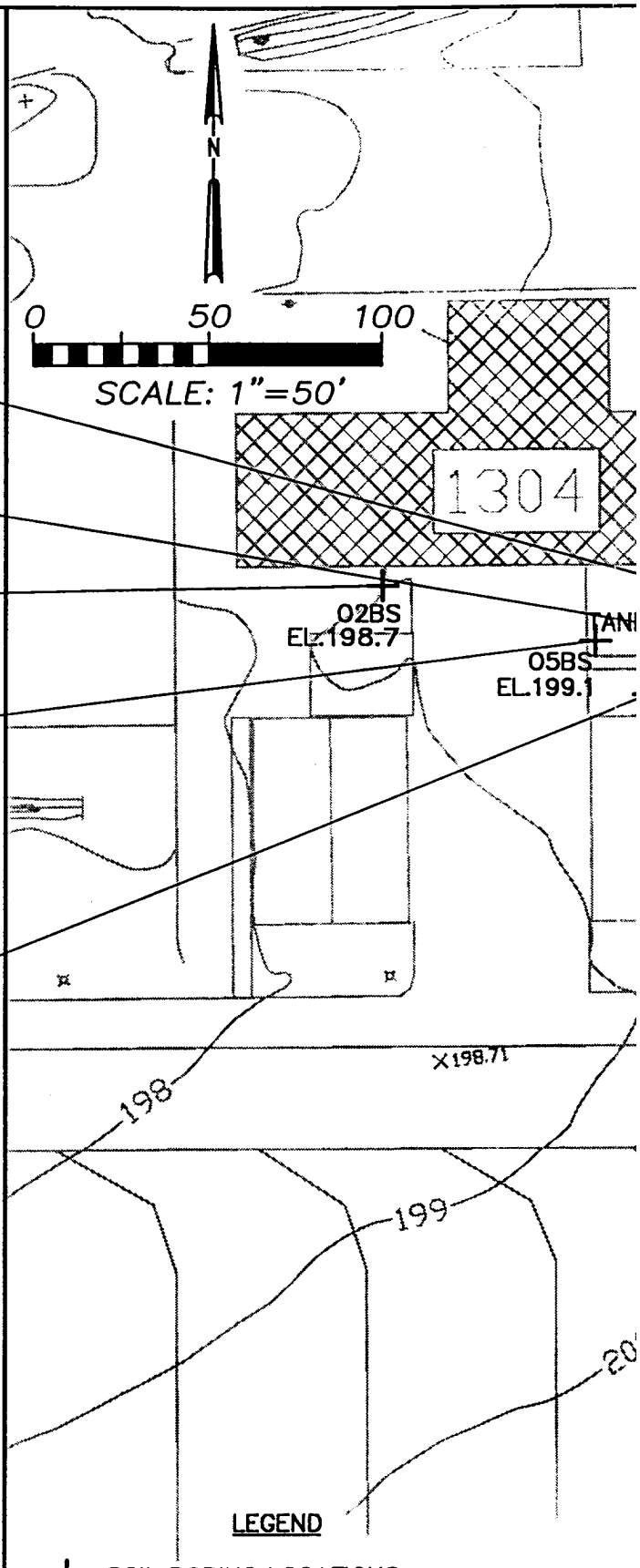
Tet -1600[14-16]
DCA -1J[10-12]
1,2 DCE -180[10-12]
1500[14-16]
ACE -53[0-2]
19B[10-12]
1900B[14-16]
Ben -3J[0-2]
Eth -15[0-2]
Meth-14B[0-2]
11B[10-12]
2000[14-16]
Tete -450J[14-16]
Tol -3300[14-16]
TCE -2J[0-2]
680E[10-12]
160,000E[14-16]
VC -7J[0-2]
Xyl -4J[0-2]
470J[14-16]

-14]
2]
6-8]
12-14]

20]
-14]
8-20]
4]
2]

]
0]
14]
]
]
]

DCA -790[14-16D]
1,2 DCE -5400[6-8]
220J[14-16]
960[14-16D]
ACE -5000BJ[0-2]
13000B[6-8]
4800B[14-16]
Ben -1000J[0-2]
Eth -11000[0-2]
1300J[6-8]
Meth -9500B[0-2]
7900B[6-8]
Tol -21000[0-2]
5300[6-8]
310J[14-16]
1100[14-16D]
TCE -33000[14-16]
65000E[14-16D]
Xyl -89000[0-2]
17000[6-8]
790J[14-16D]
Tete -1100[14-16]
400J[14-16]
TPH -2120[0-2]
69.1[6-8]
37.8[14-16]



NOTES:

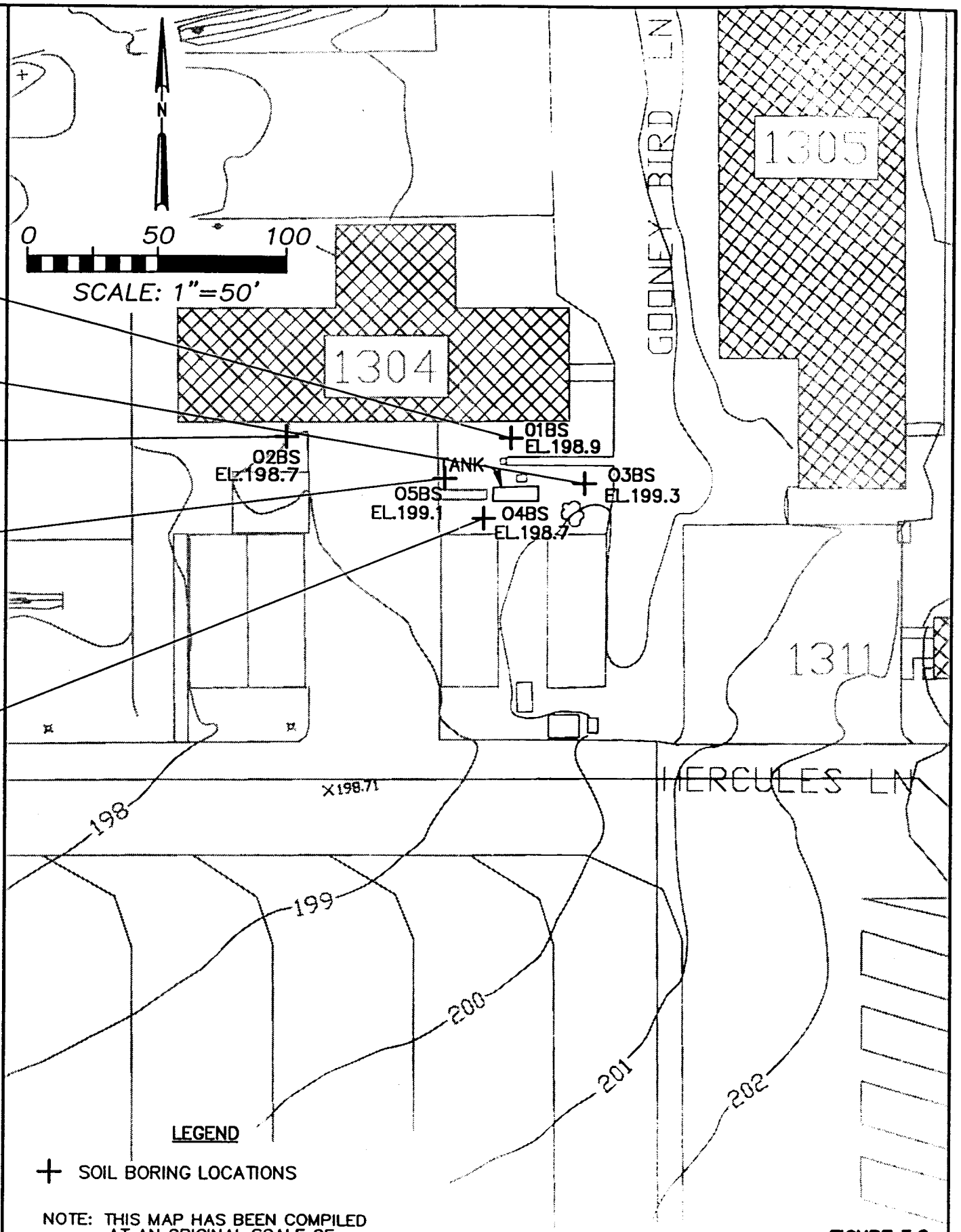
1) B - INDICATES COMPOUND PRESENCE IN CORRESPONDING METHOD BLANK
2) J - INDICATES VALUE DETECTED IS GREATER THAN ZERO BUT LESS THAN THE CRDL
3) E - INDICATES COMPOUND ABOVE OR BELOW THE LINEAR RANGE OF THE INSTRUMENT
4) TPH IS EXPRESSED AS mg/kg. ALL OTHER CONCENTRATIONS ARE EXPRESSED AS μg/kg.
5) [] BRACKETS DENOTE SOIL SAMPLING DEPTH IN FEET, BELOW LAND SURFACE

LEGEND

+ SOIL BORING LOCATIONS

NOTE: THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

Alabama



NOTE: THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.2
VOLATILE ORGANIC COMPOUNDS IN SOIL
AT SITE 2: OIL/WATER SEPARATOR SITE
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Al

Nap-48J[12-14]
Bis-440B[0-2]
3900B[6-8]
320BJ[12-14]

Bis-310J[0-2]
2900B[10-12]
1000B[14-16]

ANT-120J[12-14
Bena-69J[0-2]
770[12-14]
Benp-75J[0-2]
660[12-14]
Benf-96J[0-2]
690[12-14]
Beng-60J[0-2]
440[12-14]
Benk-94J[0-2]
760[12-14]
Chr-94J[0-2]
780[12-14]

Dip-42J[0-2]
Dia-120J[12-14]
Flua-140J[0-2]
1600[12-14]
Ind-56J[0-2]
400J[12-14]
Nits-43J[12-14]
Phen-510[12-14]
Phr-110J[0-2]
1200[12-14]
Bis-3000B[0-2]
2800B[12-14]
1900B[18-20]

2 Meth-1200[8-10]
69J[12-14]
Bena-52J[8-10]
Benp-57J[8-10]
Benf-83J[8-10]
Beng-50J[8-10]
Benk-64J[8-10]
Benac-789J[12-14]
Chr-84J[8-10]
Flua-92J[8-10]

Ind-57J[8-10]
Nits-82J[8-10]
Nap-1100[8-10]
92J[12-14]
Phen-49J[8-10]
Pyr-67J[8-10]
Bis-1000B[0-2]
6100B[8-10]
2700B[12-14

2 Meth-4100[0-2]
43J[6-8]
180J[14-16]
Dip-50J[6-8]
48J[14-16
Flue-100J[0-2]
Nits-94J[0-2]
56J[14-16]

Nap-8800E[0-
60J[6-8]
420[14-1
Phen-110J[0-2
Pyr-44J[0-2]
Bis-540B[0-2]
820B[6-8]
2300B[14-1

ABBREVIATIONS

2 Methylnapthalene	- 2 Meth
Anthracene	- Ant
Benzo(a)anthracene	- Bena
Benzo(a)pyrene	- Benp
Benzo(b)fluoranthene	- Benf
Benzo(g,h,i)perylene	- Beng
Benzo(k)fluoranthene	- Benk
Benzoic Acid	- Benac
Chrysene	- Chr
Di-n-butylphthalate	- Dip
Dibenz(a,h)anthracene	- Dia
Fluoranthene	- Flua
Fluorene	- Flue
Indeno(1,2,3-cd)pyrene	- Ind
N-Nitrosodiphonylamine	- Nits
Napthalene	- Nap
Phenanthrene	- Phen
Pyrene	- Pyr
Bis 2-Ethylhexylphthalate	- Bis

NOTES:

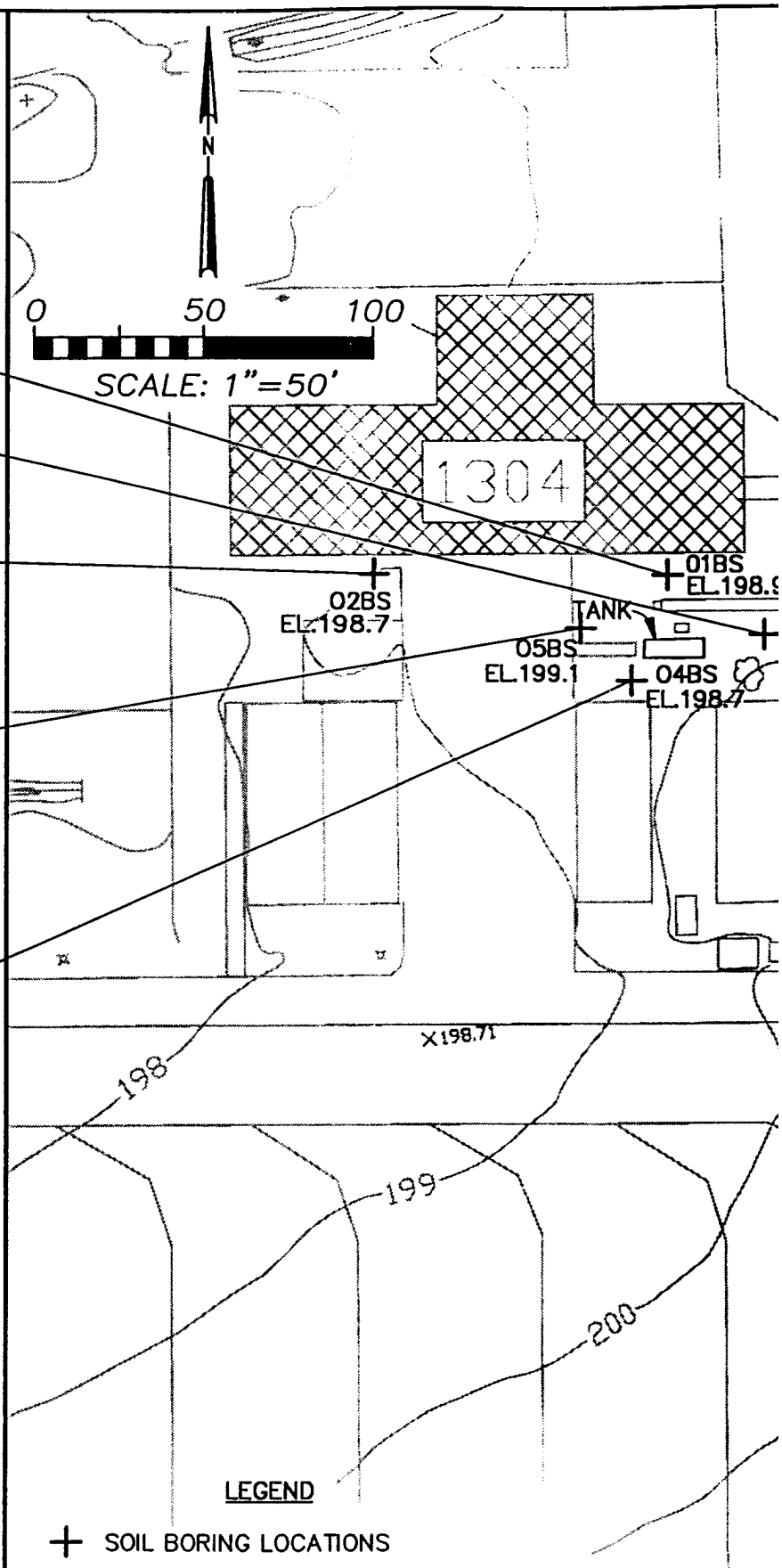
1) B - INDICATES COMPOUND PRESENCE IN CORRE METHOD BLANK
2) J - INDICATES VALUE DETECTED IS GREATER TH BUT LESS THAN THE CRDL
3) E - INDICATES COMPOUND ABOVE OR BELOW TH RANGE OF THE INSTRUMENT
4) ALL CONCENTRATIONS EXPRESSED IN UG/KG
5) [] BRACKETS DENOTE SOIL SAMPLING DEPTH IN BELOW LAND SURFACE

Bis-310J[0-2]
2900B[10-12]
1000B[14-16]

2 Meth-1200[8-10]
69J[12-14]
Bena-52J[8-10]
Benp-57J[8-10]
Benf-83J[8-10]
Beng-50J[8-10]
Benk-64J[8-10]
Benac-789J[12-14]
Chr-84J[8-10]
Flua-92J[8-10]
Ind-57J[8-10]
Nits-82J[8-10]
Nap-1100[8-10]
92J[12-14]
Phen-49J[8-10]
Pyr-67J[8-10]
Bis-1000B[0-2]
6100B[8-10]
2700B[12-14]

2 Meth-4100[0-2]
43J [6-8]
180J[14-16]
Dip-50J[6-8]
48J[14-16
Flue-100J[0-2]
Nits-94J[0-2]
56J[14-16]
Nap-8800E[0-2]
60J[6-8]
420[14-16]
Phen-110J[0-2]
Pyr-44J[0-2]
Bis-540B[0-2]
820B[6-8]
2300B[14-16]

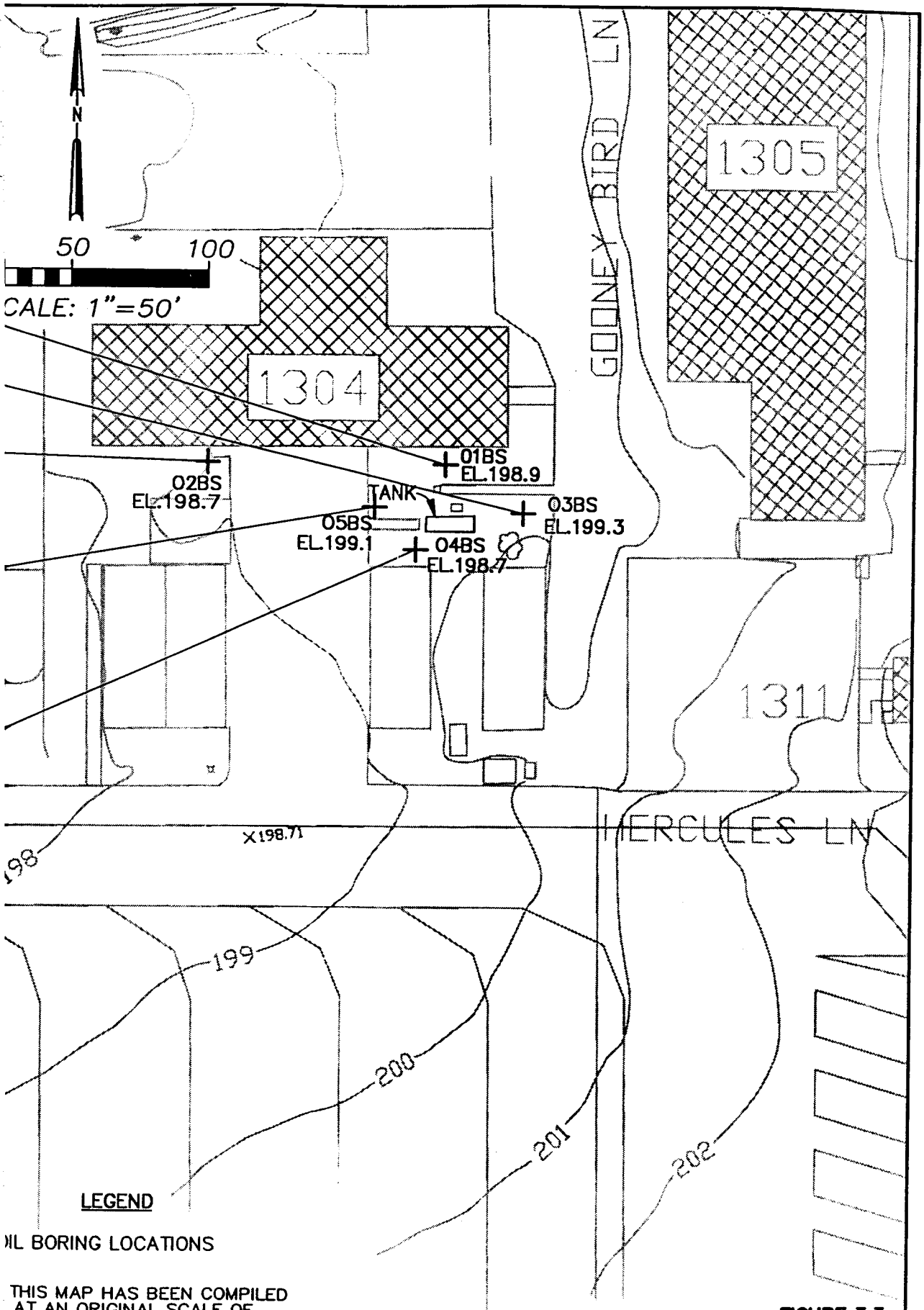
)ICATES COMPOUND PRESENCE IN CORRESPONDING
) BLANK
)ICATES VALUE DETECTED IS GREATER THAN ZERO
SS THAN THE CRDL
)ICATES COMPOUND ABOVE OR BELOW THE LINEAR
OF THE INSTRUMENT
)NCENTRATIONS EXPRESSED IN UG/KG
CKETS DENOTE SOIL SAMPLING DEPTH IN FEET,
/ LAND SURFACE



NOTE: THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

SEMI - VO
AT

Alabama Air National



THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.3
SEMI - VOLATILE ORGANIC COMPOUNDS IN SOIL AT SITE 2: OIL/WATER SEPARATOR SITE
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Al

Sb - 5.3 [14-16]	Ni - 25.1 [14-16]
Ar - 5.1 [14-16]	Se - 0.71B [14-16]
Ba 33.6B [14-16]	Ti - 0.28B [14-16]
Cd - 0.81B [14-16]	Pb - 5.6 [14-16]
Cr - 19.0 [14-16]	Zn - 65.6 [14-16]
Cu - 32.4 [14-16]	

Sb - 4.1B [12-14]	Pb - 8.8 [12-14]
Ba - 31.3B [12-14]	Ni - 16.3 [12-14]
Cd - 0.65B [12-14]	Si - 0.97B [12-14]
Cr - 19.2 [12-14]	Zn - 39.6 [12-14]
Cu - 18.9 [12-14]	

Sb -3.7B [18-20]	Cu - 13.8 [18-20]
Ar - 7.6 [18-20]	Pb - 7.8 [18-20]
Ba - 87.1 [18-20]	Ni - 19.8 [18-20]
Cd - 0.75B [18-20]	Zn - 53.5 [18-20]
Cr - 21.5 [18-20]	

Sb - 2.8B [0-2]	Cu - 8.6 [0-2]
Ar - 5.5 [0-2]	Pb - 5.5 [0-2]
Ba - 227 [0-2]	Ni - 14.2 [0-2]
Cd - 0.47B [0-2]	Zn - 35.4 [0-2]
Cr - 14.9 [0-2]	

Sb - 5.2B [6-8]	Pb - 5.2 [6-8]
Ba - 55.7 [6-8]	Ni - 15.4 [6-8]
Cd - 0.45B [6-8]	Si - 0.40B [6-8]
Cr - 16.8 [6-8]	Zn - 48 [6-8]
Cu - 11.3 [6-8]	

ABBREVIATIONS

ANTIMONY	-Sb
ARENSIC	-Ar
BARIUM	-Ba
CADMIUM	-Cd
CHORMIUM	-Cr
COPPER	-Cu
LEAD	-Pb
NICKLE	-Ni
SELENIUM	-Se
THALLIUM	-Ti
ZINC	-Zn

NOTES:

1) B - INDICATES VALUE DETECTED IS LESS THAN THE
BUT GREATER THAN OR EQUAL TO THE MDL.

2) ALL CONCENTRATIONS EXPRESSED IN mg/kg

3) [] BRACKETS DENOTE SOIL SAMPLING DEPTHS IN F
BELOW LAND SURFACE

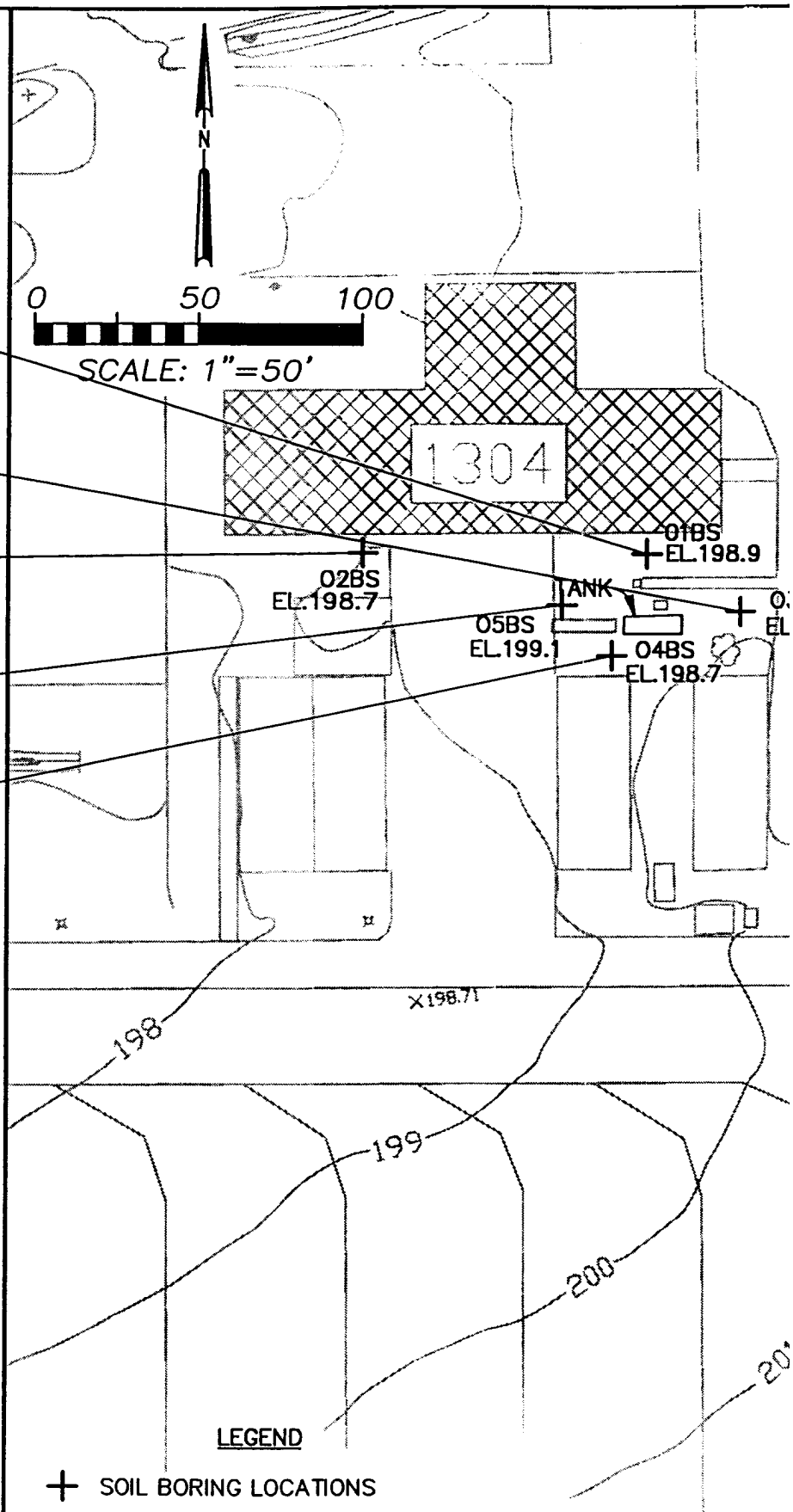
I [14-16]
1B [14-16]
3B [14-16]
[14-16]
6 [14-16]

[12-14]
[12-14]
7B [12-14]
6 [12-14]

8 [18-20]
[18-20]
[18-20]
5 [18-20]

[0-2]
[0-2]
[0-2]
4 [0-2]

[6-8]
[6-8]
B [6-8]
[6-8]



NOTE: THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

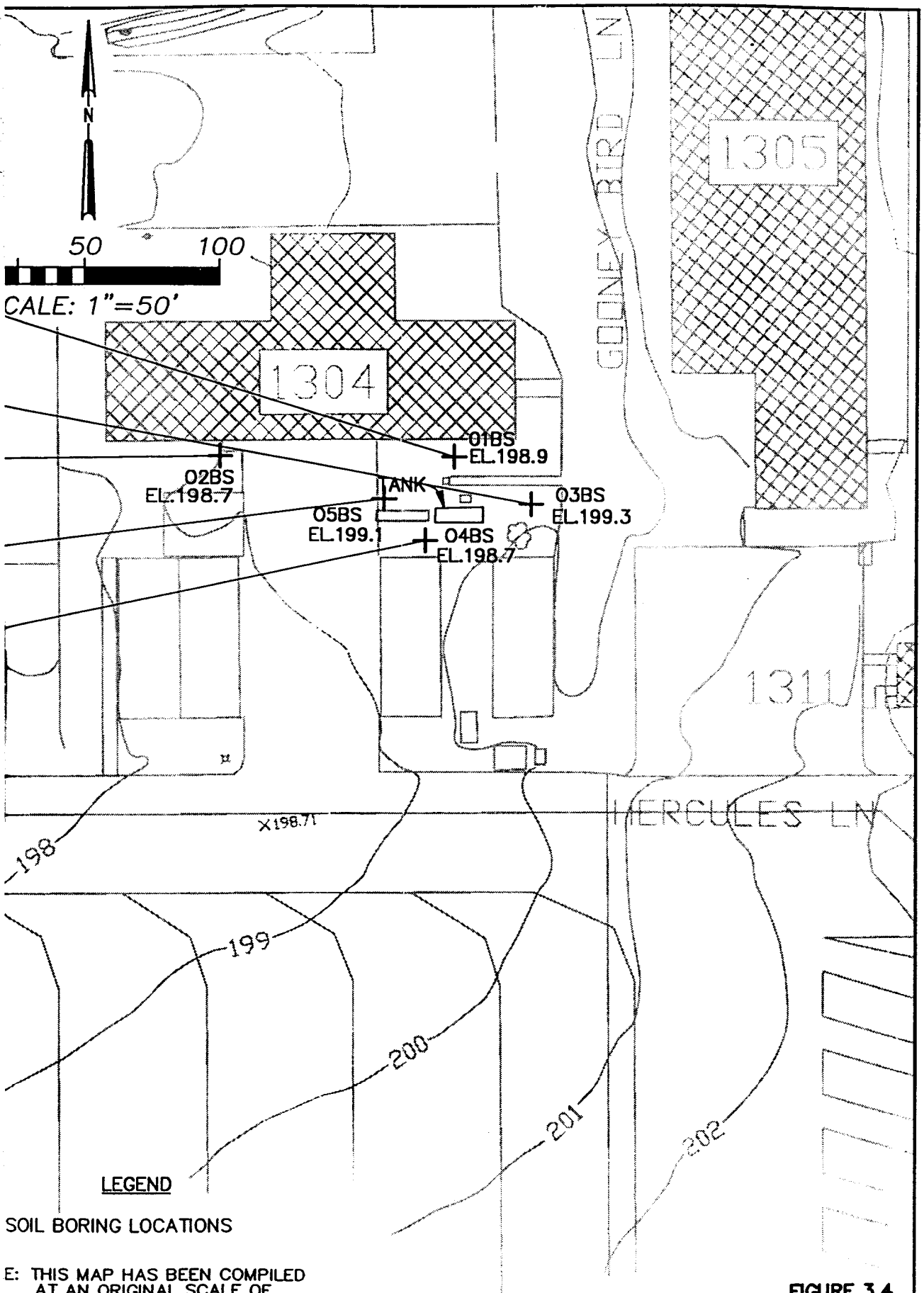
TES VALUE DETECTED IS LESS THAN THE CRDL
TER THAN OR EQUAL TO THE MDL.

ENTRATIONS EXPRESSED IN mg/kg

TS DENOTE SOIL SAMPLING DEPTHS IN FEET,
ND SURFACE

AT SIT

Alabama Air National Gua



E: THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1"=100' FROM FIELD SURVEYS AND EXISTING MAPS.

FIGURE 3.4
INORGANIC COMPOUNDS IN SOIL
AT SITE 2: OIL/WATER SEPARATOR SITE
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, Al

Table 3.6
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG – Montgomery, Alabama[a]

Client Sample ID	01BS	02BS	03BS	03BSDUP	04BS	04BSDUP	04BS**	04BSDUP**	05BS
Lab Sample Number	17978	17946	17978	17978	17947	17947	17978	17978	17978
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	3/6/91	2/28/91	3/6/91	3/6/91	3/1/91	3/1/91	3/6/91	3/6/91	3/6/91
Total Petroleum Hydrocarbons									
Sample Depth (Feet)									
0-2	<1.1	16	<1.1		12.8		2120		5.5
6-8			<1.1		95.1		69.1		
8-10									5.7
10-12	<1.1								
12-14		<1.1	<1.1	<1.1					12.1
14-16	<1.1				37.8	11.3	<1.1	6.6	
18-20		<1.1							

[a]Data reported in mg/kg.

Notes: (1) * Indicates concentrations below method detection limit.
(2) **Indicates that the boring was redrilled and sampled.
(3) Shaded areas indicate depth intervals not sampled.
(4) Sample identification numbers for the above sample depths are provided in Appendix F.

3.5.3 Geologic and Hydrogeologic Investigation Results

Soil boring logs and geotechnical data collected during the investigation of Site 2 indicate that site geology is consistent with regional geology.

3.5.4 Summary

Five soil borings were installed and samples were collected and analyzed from three depth intervals in each of these borings. Samples were analyzed for both organic (VOCs and SVOCS) and inorganic (metals) compounds. The results of metals analysis exhibited metals concentrations that were comparable with those found in Background soils samples. Based on this comparison, it appears that metals contamination at this site is not an issue.

Eighteen organic compounds were detected in samples collected from the five borings installed at this site that are not artifacts of sampling or laboratory procedures. These compounds were present above the PQL and were above concentrations observed in background soil samples.

TPH analysis (EPA Method 418.1) revealed elevated concentrations (2,120 mg/kg) at boring location O4BS at a sample depth of 0 to 2 feet. The remaining sample locations exhibited low concentrations in comparison with two locations (O1BS and O3BS) having concentrations below the method detection limit.

The residual clays at Site 2 exhibit a low vertical hydraulic conductivity, as shown in the geotechnical analysis. The horizontal hydraulic conductivity also probably is comparatively low in value such that the lateral transport of contaminants in the clay residuum is restricted. The Mooreville chalk serves as an impermeable barrier for vertical contaminant migration through to the aquifer (Eutaw formation) below. No groundwater was encountered above the chalk in any of the five borings installed at this site, so groundwater contamination at this site does not appear to be an issue.

3.6 SITE 4 (EDGE OF AIRCRAFT PARKING APRON)—SOIL SAMPLE RESULTS

3.6.1 Confirmation Results

Confirmation efforts consisted of collecting composite surface soil samples from 8 locations and the drilling and sampling of three borings. Boring logs have been provided as Appendix D. Soil samples collected at Site 4 during the SI were analyzed for the following parameters:

- BTEX
- PAH
- TPH

TPH samples were collected from three selected surface soil locations (A1-SS, A4-SS and A7-SS) at the 6- to 24-inch composite interval depth.

3.6.1.1 Soil Analysis

The results of chemical analyses conducted on confirmation samples collected from Site 4 has been provided as Appendix C. Table 3.8 summarizes the chemicals that were positively detected in the surface soil samples collected from Site 4. These chemicals were detected at levels significantly above the same chemicals detected in the sample blanks. A preliminary analysis of these chemicals indicates the presence of PAHs similar to what would be expected to be in asphalt. Because the samples were collected at shallow depths (0-2 ft), the presence of these PAHs could be from the extraction of the nearby asphalt runway by spilled JP-4 fuel or from weathering by rainwater. Also, the exhaust from airplanes and subsequent deposition on soil could be another source of these PAHs.

Subsurface samples from this site did not indicated VOCs and PAH concentrations above the PQL. The results of all soil boring samples submitted for TPH analysis revealed TPH concentrations below the method detection limit. Compounds and concentrations detected in samples collected from Site 4 are shown in Figure 3.5.

3.6.2 Geologic and Hydrogeologic Investigation Results

Soil boring logs from Site 4 indicate that the site geology is consistent with regional geology.

3.6.3 Summary

The data indicate that contamination present at Site 4 is limited to the upper 2 ft of soil. Site 4 is located at the southern edge of the aircraft parking apron. In the past, leaks and spills of hydraulic fluid and JP-4 fuel from aircraft and Aerospace Ground Equipment (AGE) were cleansed from the edge of aircraft parking apron with PD-680 solvent. As a result, the hydraulic fluid and PD-680 solvent have been washed to this area. The low hydraulic conductivity exhibited by the native soils found in this area inhibit the lateral and vertical migration of contaminants.

Eight composite surface soil samples were collected along the perimeter and low area at this site for chemical analysis as a screening activity. In addition, three soil borings were installed and samples collected for analysis. Results of the surface soil analyses indicate the presence of 13 organic compounds in the surface soils. However, no organic compounds were detected above method detection limits in the subsurface samples collected from the boreholes. Organic compound contamination appears to be present only in the upper 2 feet of surface soils at this site with the highest concentrations typically found in the top 6 inches of soil.

Table 3.8
PARAMETERS DETECTED IN SOIL
SITE 4, EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Parameter	Frequency of Detection	Range of Detected Concentrations (μg/kg)	Maximum Concentration Location	Range of Back-ground Concen-tration
Anthracene	2/29	920 - 1,000	A5-SS-0-6"	
Benzo(a)anthracene	12/29	110 - 6,000	A3-SS-0-6"	
Benzo(a)pyrene	13/29	220 - 12,000	A3-SS-0-6"	
Benzo(b)fluoranthene	13/29	240 - 9,500	A3-SS-0-6"	
Benzo(g,h,i)perylene	14/29	45JX - 8,800	A3-SS-0-6"	
Benzo(k)fluoranthene	13/29	120 - 5,000	A3-SS-0-6"	
Chrysene	13/29	230 - 7,900	A3-SS-0-6"	
Dibenzo(a,h)anthracene	11/29	39JX - 950	A3-SS-0-6"	
Fluoranthene	16/29	37JX - 10,000	A6-SS-6-24"	79J
Fluorene	1/29	300JX	A5-SS-6-24"	
Indeno(1,2,3-cd)pyrene	14/29	68 - 10,000	A3-SS-0-6"	
Phenanthrene	12/29	79 - 4,000	A6-SS-6-24"	52J
Pyrene	15/29	38JX - 8,600	A3-SS-0-6"	56J

Note: JX—The compound was detected and quantitated below the CRDL.

A1-SS

Flua 37Jx[0-6"]
Pyr 38Jx [0-6"]

A2-SS

Bena 880[0-6"]
190[6-24"]
Benp 3000[0-6"]
220[6-24"]
Benf 1500[0-6"]
240[6-24"]
Beng 1700[0-6"]
250[6-24"]
Chr 1900[0-6"]
260[6-24"]
Benk 880[0-6"]
130[6-24"]
Flua 1900[0-6"]
340[6-24"]
Indp 2200[0-6"]
260[6-24"]
Phen 420[0-6"]
140[6-24"]
Pyr 1500[0-6"]
280[6-24"]
Dia 390[0-6"]
38Jx[6-24"]

A3-SS

Bena 6000[0-6"]
110[6-24"]
Benp12000[0-6"]
230[6-24"]
Benf 9800[0-6"]
260[6-24"]
Beng 8800[0-6"]
420[6-24"]
Benk 5000[0-6"]
120[6-24"]
Chr 7900[0-6"]
230[6-24"]
Dia 950[0-6"]
56[6-24"]
Flua 7400[0-6"]
260[6-24"]
Indp 10000[0-6"]
390[6-24"]
Phen 500Jx[0-6"]
91[6-24"]
Pyr 8600[0-6"]
240[6-24"]

A4-SS

Bena 720[0-6"]
750[6-24"]
Benp 1200[0-6"]
1000[6-24"]
Benf 1600[0-6"]
880[6-24"]
Beng 1500[0-6"]
940[6-24"]
Benk 700[0-6"]
490[6-24"]
Chr 1400[0-6"]
960[6-24"]
Dia 200Jx[0-6
140Jx[6-2
Flua 2200[0-6
1600[6-2
Indp 1400[0-6
900[6-24
Phen 830[0-6
840[6-2
Pyr 1800[0-6"
1400[6-24

A5-SS

Ant 1000[0-6"]
920[6-24"]
Bena 4100[0-6"]
3800[6-24"]
Benp 5000[0-6"]
4600[6-24"]
Benf 4100[0-6"]
3700[6-24"]
Beng 3400[0-6"]
3000[6-24"]
Benk 2200[0-6"]
2000[6-24"]
Chr 5300[0-6"]
4800[6-24"]
Dia 530Jx[0-6"]
780Jx[6-24"]
Flua 9400[0-6"]
8400[6-24"]
Indp 4100[0-6"]
3800[6-24"]
Phen 3300[0-6"]
3900[6-24"]
Pyr 7600[0-6"]
71200[6-24"]
Flue 300Jx[6-24"]

A6-SS

Bena 710[0-6"]
4200[6-24"]
Benp 1400[0-6"]
4500[6-24"]
Benf 1500[0-6"]
4700[6-24"]
Beng 1200[0-6"]
3600[6-24"]
Benk 810[0-6"]
2500[6-24"]
Chr 1600[0-6"]
5900[6-24"]
Dia 220Jx[0-6
700[6-24"
Flua 2700[0-6
10000[6-
Indp 1300[0-6
4200[6-2
Phen 910[0-6"
4000[6-
Pyr 2200[0-6"
8300[6-24

A7-SS

Bena 330Jx[0-6"]
890[6-24"]
Benp 640[0-6"]
1100[6-24"]
Benf 470[0-6"]
820[6-24"]
Beng 1000[0-6"]
860[6-24"]
Benk 250Jx[0-6"]
480[6-24"]
Chr 690[0-6"]
1100[6-24"]
Flua 580[0-6"]
1200[6-24"]
Indp 1600[0-6"]
910[6-24"]
Phen 230Jx[6-24"]
Pyr 560[0-6"]
1200[6-24"]

A8-SS

Flua 43Jx[0-6"]
Pyr 59Jx[0-6"]

ABBREVIATIONS

Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Chrysene
Diberzo(g,h)anthracene
Fluorathene
Indeno(1,2,3-cd)pyrene
Phenanthrene
Pyrene
Fluorene

NOTES:

1) Jx -INDICATES THE COMPOUND WAS DETECTED AND QUANTITATED BELOW crdl

2) ALL CONCENTRATIONS EXPRESSED IN UG/KG

3) [] BRACKETS DENOTE SOIL SAMPLING DEPTH IN FEET, BELOW LAND SURFACE

A2-SS

Bena 880[0-6"]
190[6-24"]
Benp 3000[0-6"]
220[6-24"]
Benf 1500[0-6"]
240[6-24"]
Beng 1700[0-6"]
250[6-24"]
Chr 1900[0-6"]
260[6-24"]
Benk 880[0-6"]
130[6-24"]

Flua 1900[0-6"]
340[6-24"]
Indp 2200[0-6"]
260[6-24"]
Phen 420[0-6"]
140[6-24"]
Pyr 1500[0-6"]
280[6-24"]
Dia 390[0-6"]
38Jx[6-24"]

A4-SS

Bena 720[0-6"]
750[6-24"]
Benp 1200[0-6"]
1000[6-24"]
Benf 1600[0-6"]
880[6-24"]
Beng 1500[0-6"]
940[6-24"]
Benk 700[0-6"]
490[6-24"]
Chr 1400[0-6"]
960[6-24"]

Dia 200Jx[0-6"]
140Jx[6-24"]
Flua 2200[0-6"]
1600[6-24"]
Indp 1400[0-6"]
900[6-24"]
Phen 830[0-6"]
840[6-24"]
Pyr 1800[0-6"]
1400[6-24"]

A6-SS

Bena 710[0-6"]
4200[6-24"]
Benp 1400[0-6"]
4500[6-24"]
Benf 1500[0-6"]
4700[6-24"]
Beng 1200[0-6"]
3600[6-24"]
Benk 810[0-6"]
2500[6-24"]
Chr 1600[0-6"]
5900[6-24"]

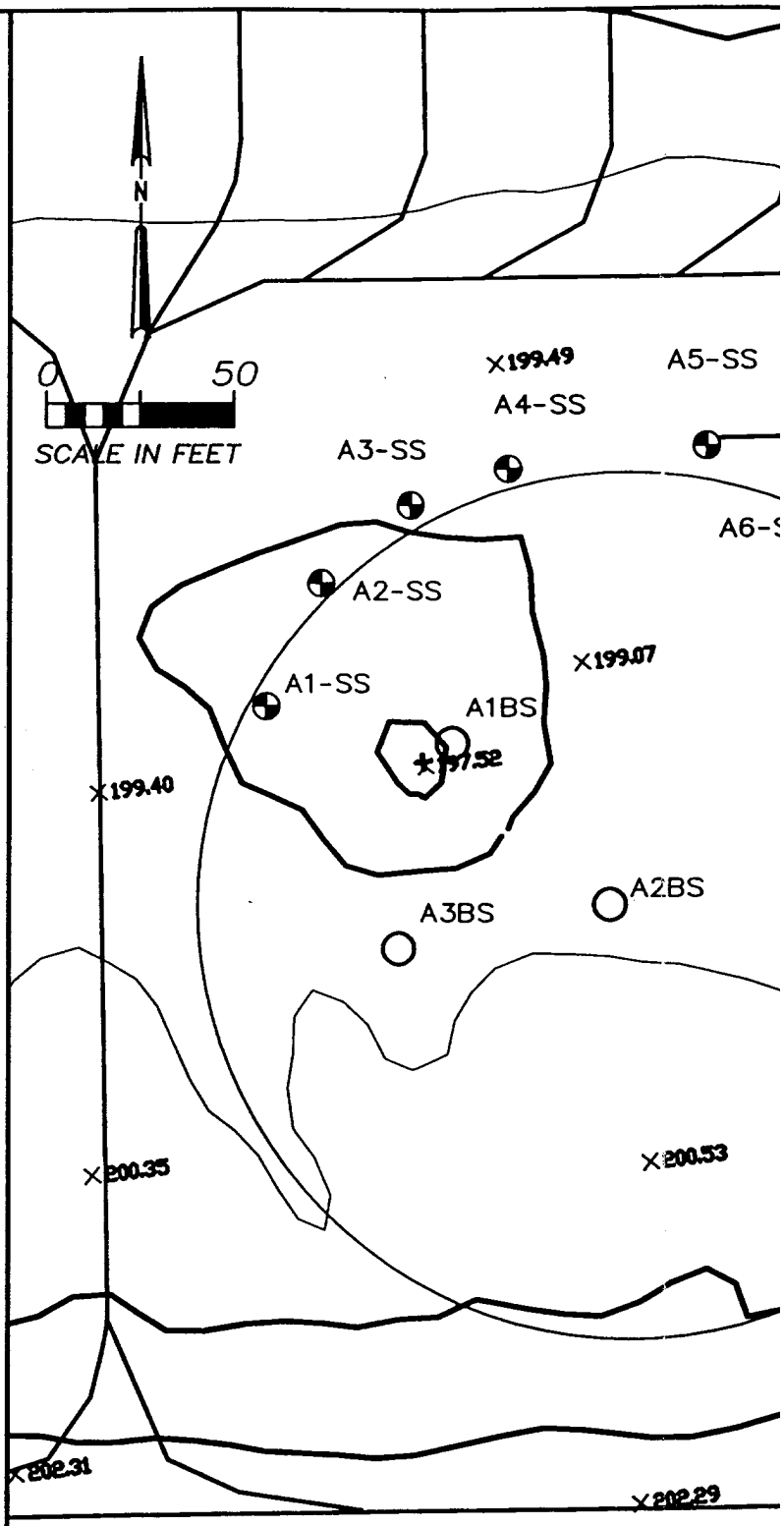
Dia 220Jx[0-6"]
700[6-24"]
Flua 2700[0-6"]
10000[6-24"]
Indp 1300[0-6"]
4200[6-24"]
Phen 910[0-6"]
4000[6-24"]
Pyr 2200[0-6"]
8300[6-24"]

A8-SS

Flua 43Jx[0-6"]
Pyr 59Jx[0-6"]

ABBREVIATIONS

Benzo(a)anthracene	- Bena
Benzo(a)pyrene	- Benp
Benzo(b)fluoranthene	- Benf
Benzo(g,h,i)perylene	- Beng
Benzo(k)fluoranthene	- Benk
Chrysene	- Chr
Diberzo(g,h)anthracene	- Dia
Fluorathene	- Flua
Indeno(1,2,3-cd)pyrene	- Indp
Phenanthrene	- Phen
Pyrene	- Pyr
Fluorene	- Fluc



LEGEND

SOIL BORING LOCATIONS

SURFACE SOIL SAMPLING LOCATIONS

NOTE: 1. THIS MAP HAS BEEN COMPILED AT
AN ORIGINAL SCALE OF 1" = 100'
FROM FIELD SURVEY AND EXISTING
MAPS.

OR

Alabama Air National

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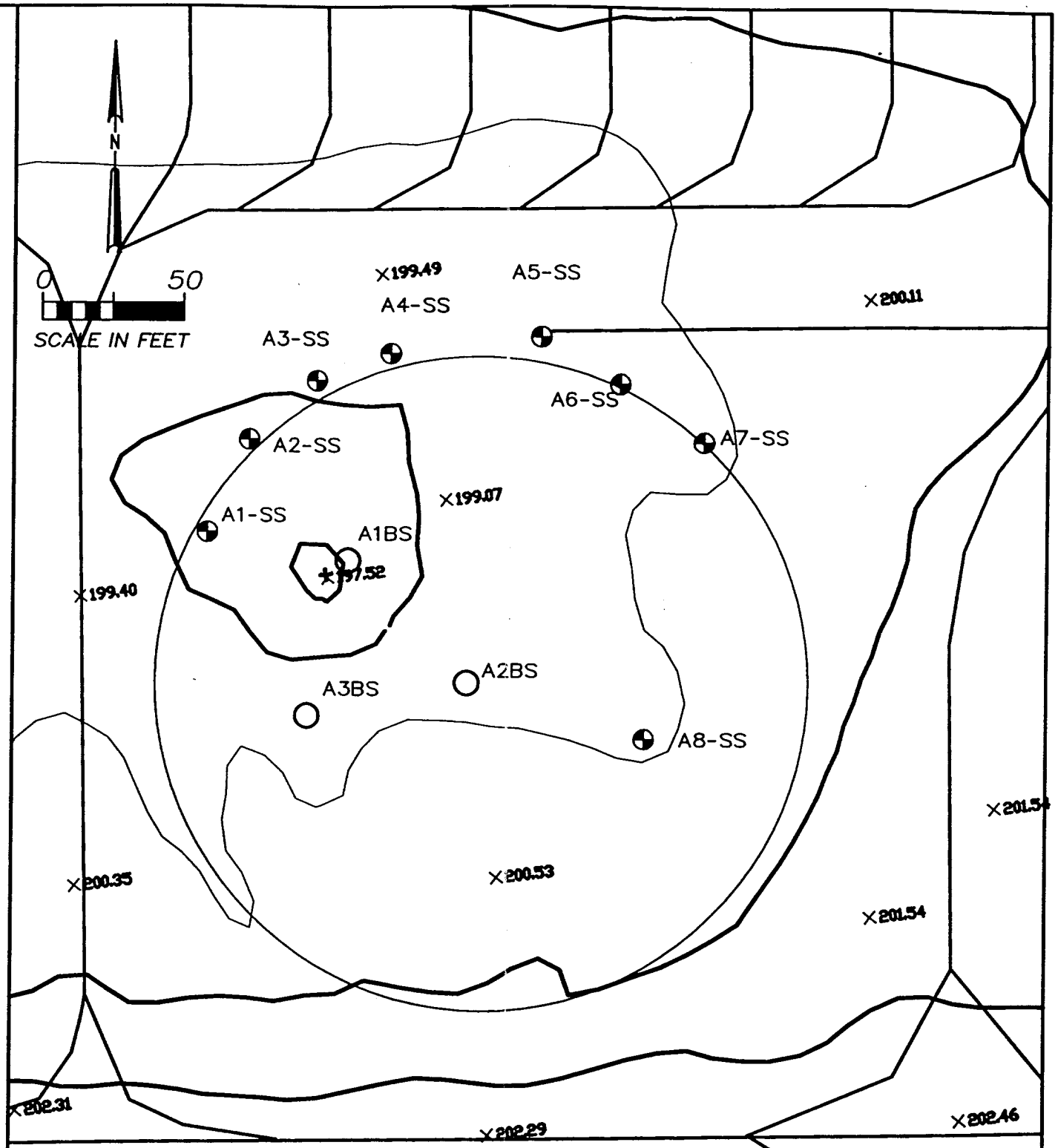

LEGEND

○ SOIL BORING LOCATIONS

◐ SURFACE SOIL SAMPLING LOCATIONS

NOTE: 1. THIS MAP HAS BEEN COMPILED AT AN ORIGINAL SCALE OF 1" = 100' FROM FIELD SURVEY AND EXISTING MAPS.

- Bena
- Benp
- Benf
- Beng
- Benk
- Chr
- Dla
- Flua
- Indp
- Phen
- Pyr
- Fluc

FIGURE 3.5
ORGANIC COMPOUNDS IN SOILS AT SITE 4: AIRCRAFT PARKING APRON
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

4. PRELIMINARY RISK EVALUATION

4.1 INTRODUCTION

4.1.1 Risk Evaluation Process

This PRE is based on data collected during the SI from the three areas of potential contamination identified at the base. The objectives of this evaluation are as follows:

- Evaluate public health risks posed by the sites, assuming no further remedial action is taken
- Evaluate potential human health risks, assuming changes in future site usage, by considering risks associated with alternative future land uses
- Identify additional data needed to define the risks and evaluate the completeness of possible exposure pathways

A separate risk evaluation was performed for each of the three sites. This evaluation was done in accordance with guidance provided in the *U.S. EPA Risk Assessment Guidance for Superfund Volume 1—Human Health Evaluation Manual* (HHEM) Part A, December 1989, and with reference to the revised National Contingency Plan 55 FR 8666. The results of these evaluations are presented in Sections 4.2 through 4.4. The rest of section 4.1 addresses approaches to the evaluation and provides sitewide information that may be referenced in the site-specific analyses.

A risk evaluation for human health includes the following components:

- Identification of Potential Contaminants of Concern
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization

A brief discussion of potential environmental impacts in this area is presented in Section 4.1.6.

4.1.2 Identification of Potential Contaminants of Concern

4.1.2.1 Approach

Potential contaminants at each site were identified according to a specific approach. Hazardous constituents reported in at least one sample were summarized. Data that may represent field or laboratory contamination of samples or samples that failed to meet quality control guidelines were not included in the evaluation. Data validation did not result in

rejection of the data collected during the SI. Estimated results (data with a "J" qualifier) that met data validation requirements were retained.

Parameters that were undetected at levels significantly above the concentrations reported in sample blanks were eliminated as constituents of potential concern. For common laboratory contaminants, a value 10 times the concentration reported in any blank was compared with the concentration measured in the laboratory before multipliers that address sample dilution were added (i.e., the common range in instrument response associated with the presence of laboratory contaminants). Acetone, methylene chloride, and bis(2-ethylhexyl) phthalate were retained based on this criterion.

For chemicals that are not common laboratory contaminants, the site sampling results were considered not positive if the concentration of the chemical did not exceed 5 times the maximum amount detected in any blank. Carbon disulfide was dropped based on this criterion.

A discussion of basewide soil and groundwater sampling is found in Section 2, and soil and groundwater sample results are found in Section 3. Background levels of organics and inorganics were measured, and these levels are included for comparison in the site-specific data summary tables in Sections 4.2 through 4.4. It should be noted that there were not enough positive detections for most of the organic chemicals to calculate a mean value. In fact, some of the organic chemicals could be dropped from the risk evaluation because they were detected in less than 10 percent of the samples; however, all positive detects were included in order to construct a conservative risk evaluation.

4.1.2.2 Findings at Each Site

Site 1 is the only site where water samples could be taken because there was not enough water to collect for analyses at the other sites sampled. A soil gas and groundwater survey was also conducted at Site 1. The complete results of this survey are included in Appendix A. Elevated levels of toluene, ethylbenzene, and xylenes were found in all groundwater and most soil gas samples. No chlorinated hydrocarbons were detected in either groundwater or soil gas samples.

Site 2 shows the most diversity of chemicals detected of the three sites with a mixture of VOCs and SVOCs. The inorganics measured at Site 2 are not significantly above the background levels of the base; however, they were still included in the risk evaluation.

Site 4 contains a number of PAHs in surface soil. These PAHs are also the constituents of asphalt. The proximity of this site to an airport runway suggests that dissolution of the asphalt in the runway could be the source of these PAHs in the soil. Also, the exhaust from planes and deposition on the soil could potentially be the source of these PAHs.

Additional samples of soil and surface water were taken outside the perimeter of the base near highway U.S. 80. These samples were taken before highway construction to determine if surface water drainage or disposal from the base had affected the area along

the perimeter fence (old Sites 3 and 5). The complete report is reproduced in Appendix G. The conclusions of the report, in brief, are that no base neutrals, metals or VOCs were found; TPH was found at low levels in some samples.

4.1.3 Exposure Assessment

An exposure assessment provides qualitative or quantitative information on individuals, populations, or ecosystems that are or may be exposed to a risk agent, and predicts the duration and other characteristics of exposure. Two key factors influence current or potential future exposures at the ANG sites that are located in the Dannelly Field Municipal Airport. These factors include (1) current and projected receptor populations based on land use, and (2) the potential for offsite migration of contaminants from the sites.

An exposure pathway analysis describes the course a chemical takes from the source to the exposed individual. An exposure pathway consists of the following four elements:

- A source and mechanism of chemical release to the environment
- A relevant environmental transport medium (e.g., volatilization in air, groundwater, surface soil)
- A relevant point of human exposure to the chemicals present in that medium
- A route of uptake at the exposure point (e.g., ingestion of soil)

A pathway is considered complete if all four elements are present, and incomplete if one or more of these elements is missing. Implicit in a complete exposure pathway is an estimation of the expected degree of human population contact with onsite chemicals. A similar analysis would apply to defining completed exposure pathways for environmental receptors.

Figures 4.1 and 4.2 show graphically the potential exposure pathways resulting from contaminated surface and subsurface soil. The various pathways represent all the conceivable release and transport mechanisms from the two sources. Both human and environmental receptors are included as either the primary or secondary receptor.

The exposure analysis serves to highlight potential exposure pathways that are complete or may become complete. Pathways that are not complete and could not be complete are dropped from further consideration.

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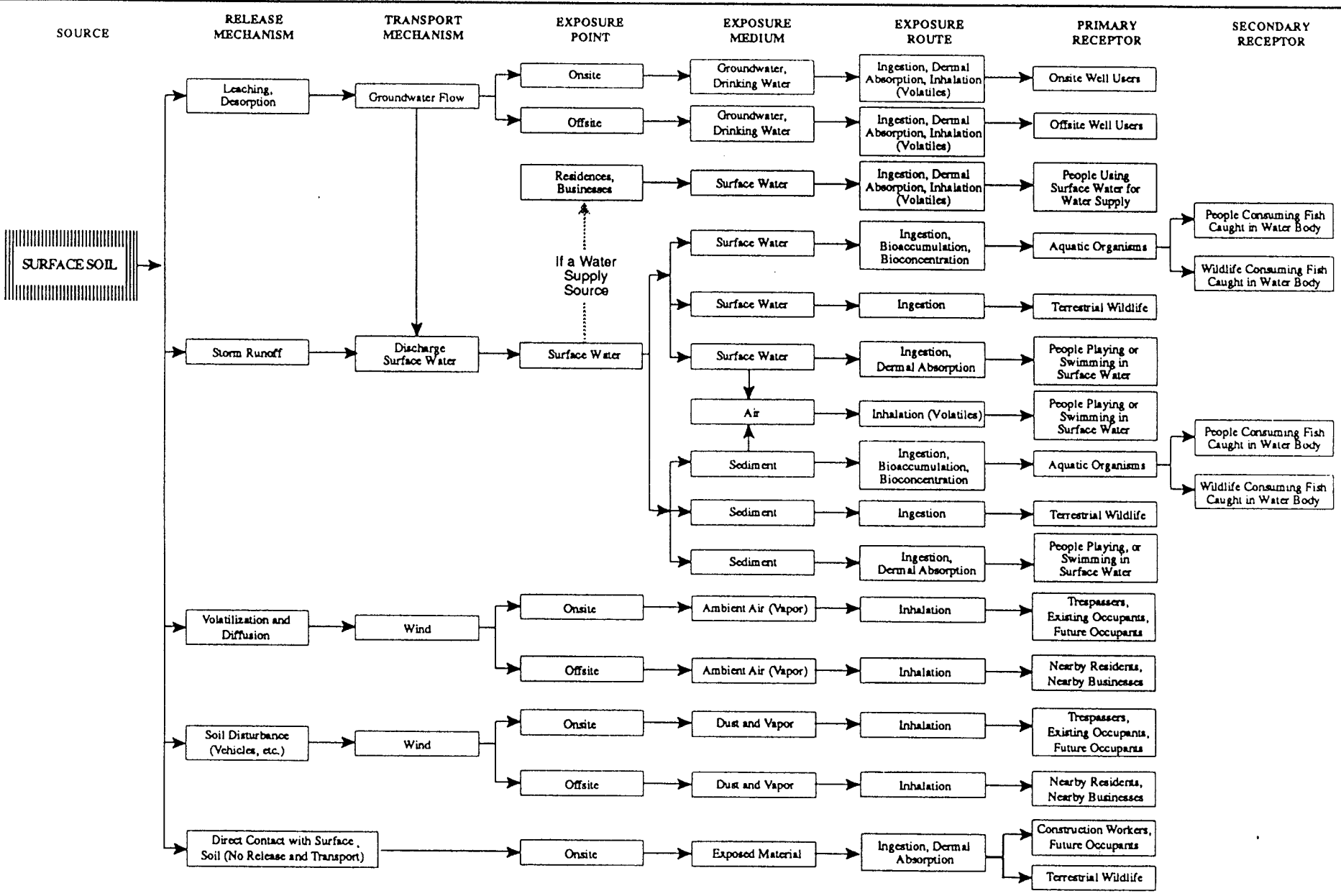

FIGURE 4-1
POTENTIAL EXPOSURE PATHWAYS: SURFACE SOIL
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

MGM27526.S1/D1/02/WDC

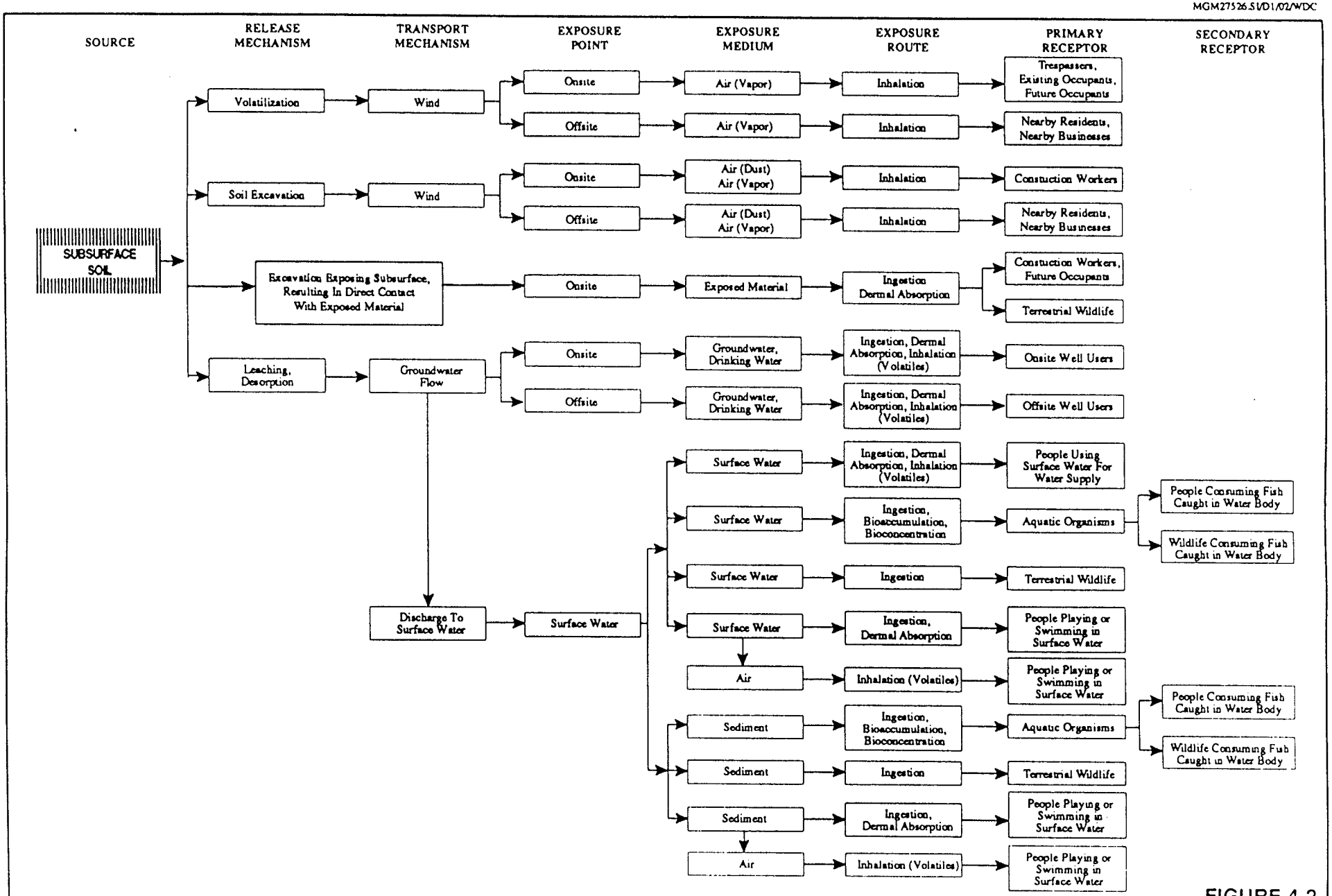

FIGURE 4-2
POTENTIAL EXPOSURE PATHWAYS: SUBSURFACE SOIL
187th Fighter Group
Alabama Air National Guard, Dannelly Field, Montgomery, AL

4.1.3.1 Regional and Sitewide Considerations

Regional or sitewide considerations that influence site-specific evaluations of exposure pathways are described in the sections below.

Land use and receptors

Discussions with ANG personnel indicate that the facility will continue to be used by the government and is not expected to be developed for any residential purpose. It is also assumed that the specific sites evaluated in this report will not be developed for housing military personnel. Disturbances in these areas may occur if alternative light industrial or commercial uses are implemented.

The Master Plan for Dannelly Field ANG gives the plans for the use of the base for the next 30 years. Site 1, the POL Facility, was scheduled for closure in 1993. After excavation, the site was planned to be paved over and turned into a parking lot. Sites 2 and 4 will remain unchanged.

Access to base property is restricted, and potential exposures to trespassers would not be frequent and would not exceed the worker exposures assumed in this evaluation.

Groundwater

The discussion of the base geology and hydrology in Section 3 indicates that the groundwater exposure pathway can be eliminated from both current and future use considerations. The thickness and very low hydraulic conductivity of the Mooreville Chalk layer restricts the connection between any shallow groundwater with the deeper Eutaw Formation. This means that the relatively impermeable chalk impedes potential surficial contaminants from percolating to the groundwater of the Eutaw Formation with eventual residential or environmental use. The Mooreville Chalk layer does not provide sufficient yield for residential water either. Also, the discussion in Section 3 shows that there is no connection with the private water wells screened in the terrace deposits with any aquifer source on the base because of extremely slow horizontal movement of any water in the Mooreville Chalk layer and the fact that Mooreville Chalk layer is directly beneath the surface at the base (i.e., no terrace layer). A computation of vertical hydraulic gradient and seepage velocity for the Mooreville Chalk has been provided in Appendix E.

Air

In selected sites, volatile compounds were reported in the subsurface soils. Compounds with Henry's Law Constants greater than about 10^{-3} are considered highly volatile. If these constituents were discharged to a surface water body, for example, volatilization would be a primary fate mechanism. Releases of these constituents to air from contaminated subsurface soils or groundwater occurs, but the rate of the emission from the ground surface would not be significant if the surface was covered by an essentially impermeable cover such as the asphalt paving. In areas that are not paved, the diffusion to the soil

surface and subsequent release to the air would be slowed by the low permeability of the soil. The concentration of these constituents in ambient air above these soils would depend on the emission rate, dispersion coefficients, and wind speed.

Although these constituents would diffuse through the soils and be released to the air, their contribution to air concentrations would be low compared to the contributions from normal operation of the airport. Air pollutants at the airport generally result from incomplete combustion of fossil fuels and from various sources such as ground vehicles, fuel storage and handling facilities, and heating and cooling plants.

Dust generated from base activities also could be transported by air. Exposure to airborne dust would most likely be base-specific as there are no residents in the immediate vicinity. Worker exposure to airborne dust will be considered to be part of soil ingestion and dermal exposure.

4.1.3.2 Exposure Assessment Formulas and Assumptions

The only current or potential completed exposure pathways for all three sites are ingestion of soil and direct dermal contact. The ingestion of soil is not corrected for absorption thus the exposure estimates are expressed as intakes. The amount of chemical intake from soil by the dermal route is corrected for absorption because the amount of a chemical in soil absorbed through the skin is very low. These exposure estimates are expressed as an absorbed dose. The general formulas and assumptions used for calculating oral and dermal exposure to soil are presented in Tables 4.1 and 4.2. Specific variable values will be given for each site in the exposure summary.

The general formulas for soil ingestion and dermal absorption are from the HHEM. EPA recently revised the exposure assumptions to be used for workers in the HHEM, Supplemental Guidance: "Standard Default Exposure Factors," March 1991. These revised assumptions are used for the intake calculations.

Exposure assumptions for direct dermal contact with contaminated soil can be characterized for installation personnel who may contact soils after the sites have been disturbed. Dermal absorption is a complex process, with considerable uncertainty associated with estimating its magnitude. For this evaluation, dermal absorption from soil is a function of the concentration of contaminant in the soil, the amount of soil in contact with the skin, the duration and frequency of the contact, and the type of contaminant. Schaum (1984) estimated that 2,940 cm^2/day of skin would be exposed by an individual wearing short-sleeved, open-necked shirts; pants; shoes; and no gloves or hat. Regional default values for absorption factors from soil (EPA Region IV, personal communication, April 1990) are 1 percent for metals and 10 percent for organic compounds.

4.1.4 Toxicity Assessment

This section presents the chemical-specific toxicity information used in the risk evaluation process. The contaminant classifications and the identified critical toxicity values for the

Table 4.1
INGESTION OF CHEMICALS IN SOIL
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Equation: Intake (mg/kg-day) - $\frac{CS \times IR \times CR \times FI \times EF \times ED}{BW \times AT}$

Where:

CS	=	Chemical Concentration in Soil (mg/kg)
IR	=	Ingestion Rate (mg soil/day)
CF	=	Conversion Factor (10^{-6} kg/mg)
FI	=	Fraction Ingested from Contaminated Source (unitless)
EF	=	Exposure Frequency (days/years)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged--days)

Variable Values:

CS: Site-specific measured value

IR: 50 mg/day Adult Worker

NOTE: IR values are default values and could change based on site-specific or other information. Research is ongoing to define ingestion rates better. IR values do not apply to individuals with abnormally high ingestion rates (i.e., pica).

CF: 10^{-6} kg/mg

FI: Pathway-specific value (should consider contaminant location and population activity patterns). Worst-case estimate is 1.

EF: 250 days/year

ED: 25 years (assumed maximum worker exposure duration)

BW: 70 kg (adult, average)

AT: Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days year) and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year).

Adapted from HHEM, EPA, 1989, and Supplemental Guidance: "Standard Default Exposure Factors", March 1991.

Table 4.2
DERMAL CONTACT WITH CHEMICALS IN SOIL
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Equation:

$$\text{Absorbed Dose (mg/kg/day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil (mg/kg)
CF	=	Conversion Factor (1.2E-03 kg/mg)
SA	=	Skin Surface Area Available for Contact (cm^2/event)
AF	=	Soil to Skin Adherence Factor (mg/cm^2)
ABS	=	Absorption Factor (unitless)
EF	=	Exposure Frequency (events/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged [days])

Variable Values:

CS:	Site-data
CF:	1.2E-03kg/mg
SA:	2,940 cm^2/event (Schaum, 1984)
AF:	1.45 mg/cm^2
ABS:	00.1 Organic compounds 00.01 Metals (EPA Region IV, default values)
EF:	12 events/year
ED:	Adult--25 year worker exposure
BW:	70 kg adult
AT:	For non-carcinogens: ED years x 365 days/year For carcinogens: 70 years x 365 days/year

Adapted from HHEM, EPA, 1989, and Supplemental Guidance: "Standard Default Exposure Factors," March 1991.

contaminants of concern along with the exposure assumptions determine the baseline risk for the site.

For purposes of this assessment, human health effects are divided into two broad groups: carcinogenic or noncarcinogenic. Consequently, human health risks are evaluated in this assessment in terms of cancer and noncancer risks. Chemicals are divided (based on associated effects) into carcinogens or noncarcinogens, although some chemicals are considered both. The distinction relates to the mechanism of action currently associated with each category.

The EPA currently considers carcinogenicity to demonstrate a nonthreshold mechanism. In this approach, there is no level of exposure (or threshold) to a carcinogen at which the possibility of developing cancer does not exist. U.S. EPA has developed a carcinogen classification scheme using a weight-of-evidence approach to classify the likelihood of a chemical to be a human carcinogen. Information considered in developing the classification includes human studies of the association between cancer incidence and exposure as well as long term animal studies under controlled laboratory conditions. Other supporting evidence considered includes short term tests for genotoxicity, metabolic and pharmacokinetics properties, toxicological effects other than cancer, structure-activity relationships, and physical/chemical properties of the chemical. Chemicals are classified as known (Class A), probable (Class B1 and B2), or possible (Class C) human carcinogens by the U.S. EPA Carcinogen Assessment Group (CAG).

Chemicals causing noncarcinogenic effects (systemic toxicants), in contrast, exhibit a level of exposure from above zero to some finite value that can be tolerated by the organism without causing observed health effects.

Toxicity depends upon the dose or concentration of the substance (i.e., the dose-response relationship). Critical toxicity values are a quantitative expression of the dose-response relationship for a chemical. Critical toxicity values take the form of reference doses (RfDs) and cancer potency factors, both of which are specific to the exposure routes. For each site, these values are summarized for the site-specific chemicals of potential concern at the end of each Risk Characterization section.

The critical toxicity value describing the dose-response relationship for noncancer effects is the RfD. The contaminants of potential concern at the base include fuel components, solvents and metals. Of the contaminants of potential concern, benzene and vinyl chloride are known human carcinogens (Group A) by the ingestion pathway. The critical toxicity values for contaminants reflect their relative toxicity; lower RfD values pose higher noncancer risks while higher cancer potency factors would result in higher excess lifetime cancer risks for a specified intake. Standards and guidelines which are potential ARARs at these sites generally reflect the relative toxicity of these constituents, with the more toxic compounds having the lower exposure standards or guidelines.

The dose-response relationship for carcinogens is expressed as a carcinogenic potency factor (CPF), slope factor, or unit risk. CPFs are presented in units of the inverse of milligrams of chemical per kilogram of body weight per day.

The following PAHs do not have cancer potency factors: benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, indeno[1,2[3-cd]pyrene, and chrysene. The guidance from EPA has been to apply the benzo[a]pyrene factor for these chemicals. In this assessment, the risks presented for carcinogenic PAHs are based on this guidance.

Several sources of critical toxicity values are used. The primary source is EPA's Integrated Risk Information System (IRIS) database. IRIS is the EPA's repository of agencywide verified toxicity values, with the most recently updated values being May 1991. Whenever a toxicity value was not available through IRIS, the other data source consulted was the Health Effects Assessments Summary Table--Yearly 1991 (HEAST) issued by the EPA's Office of Research and Development.

A summary of toxicity information for all of the chemicals detected at the three sites is presented in Table 4.3. Toxicity profiles giving qualitative and/or background information on the chemicals of concern (where available) are presented in Appendix I.

4.1.5 Toxicity/Risk Characterization

All chemicals are toxic at some dose; thus, the key issue in risk evaluation is not establishing toxicity, but rather in defining the levels of exposure that will cause undesirable effects. In this section, toxicity is evaluated in terms of the anticipated exposure levels.

Quantitative risk characterization is based on the 95 percent interval or maximum concentration reported for that compound in that medium, or the estimated concentrations at the exposure point based on those concentrations in the source materials.

Noncarcinogenic risk is assessed by comparison of the estimated daily intake of a contaminant to its RfD. This comparison serves as a measure of the potential for noncarcinogenic health effects.

A "hazard index" approach has been adopted to assess the potential for noncarcinogenic effects posed by multiple chemicals. The method assumes dose additivity.

The estimated daily intake of each chemical (by route of exposure) is divided by the chemical's RfD. This is called a hazard quotient. The resulting hazard quotients are summed to provide a hazard index. Any single chemical with a daily intake greater than the RfD (i.e., a hazard quotient greater than one) has a hazard index greater than one. When the hazard index exceeds one, there is potential for health risk.

Table 4.3
SUMMARY OF TOXICITY INFORMATION
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

	REFERENCE DOSES: ORAL ROUTE			CARCINOGENIC POTENCIES: ORAL ROUTE			
Semi Volatile Chemicals	Reference Dose (RfD) mg/kg/day	Source[a]	Date	Weight-of Evidence	Slope Factor (mg/kg-day)-1	Source[a]	Date
Volatile Chemicals							
Acetone	0.1	IRIS	7-1-90	-	-	-	-
Bromodichloromethane	0.02	IRIS	10-1-90	B2	0.13	IRIS	10-1-90
Bromoform	0.02	IRIS	1-1-91	B2	0.0079	IRIS	1-1-91
2-Butanone (MEK)	0.05	IRIS	6-1-90	-	-	-	-
Chloroform	0.01	IRIS	1-1-91	B2	0.0061	IRIS	1-1-91
Dibromochloromethane	-	-	-	B2	0.45	HEAST	10-1-90
1,1-Dichloroethane	0.1b	HEAST	10-1-90	C	-	IRIS	10-1-90
1,2-Dichloroethene	-	-	-	B2	0.091	IRIS	1-1-91
1,1-Dichloroethene	0.009b	IRIS	1-1-91	C	0.6	IRIS	3-1-90
Methylene chloride	0.06b	IRIS	1-1-91	B2	0.0075	IRIS	1-1-91
1,1,2,2 Tetrachloroethane	–b	IRIS	1-1-91	C	0.2	IRIS	1-1-91
Tetrachloroethene	0.01	IRIS	6-1-90	B2	0.051d	HEAST	10-1-90
Toluene	0.2	IRIS	8-1-90	-	-	-	-
Trichloroethene	–b	IRIS	6-1-90	B2	0.011i	HEAST	10-1-90
Vinyl chloride	-	-	-	A	1.9f	HEAST	10-1-90
Xylenes	2	IRIS	7-1-89	-	-	-	-
Semi-Volatiles							
Anthracene	0.3	IRIS	1-1-91	-	-	IRIS	1-1-91
Benzo[a]anthracene	-	-	-	B2	11.53	c	-

Table 4.3
SUMMARY OF TOXICITY INFORMATION
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

	REFERENCE DOSES: ORAL ROUTE			CARCINOGENIC POTENCIES: ORAL ROUTE			
Semi Volatile Chemicals	Reference Dose (RfD) mg/kg/day	Source[a]	Date	Weight-of Evidence	Slope Factor (mg/kg-day)-1	Source[a]	Date
Benzo[b]fluoranthene	-	-	-	B2	11.53	c	-
Benzo[k]fluoranthene	-	-	-	B2	11.53	c	-
Benzoic acid	4	IRIS	8-1-89	-	-	-	-
Benzo[a]pyrene	-	-	-	B2	11.53	EPA	1980
Benzo[g,h,i]perlyene	-	-	-	B2	11.53	c	-
Chrysene	-	-	-	B2	11.53	c	-
Dibenz[a,h]anthracene	-	-	-	B2	11.53	c	-
Di-n-butylphthalate	0.1 b	IRIS	8-1-90	-	-	-	-
bis(2-Ethylhexyl)phthalate	0.02	IRIS	5-1-90	B2	0.014	IRIS	5-1-90
Fluoranthene	0.04	IRIS	12-1-90	-	-	-	-
Fluorene	0.04	IRIS	12-1-90	-	- b	IRIS	11-1-90
Indeno[1,2,3-cd]pyrene	-	-	-	B2	11.53	c	-
1-Methylnaphthalene	-	-	-	-	-	-	-
2-Methylnaphthalene	-	-	-	-	-	-	-
Naphthalene	0.004 b	HEAST	10-1-90	-	-	-	-
Nitrobenzene	0.0005 f	IRIS	12-1-90	-	-	IRIS	6-1-90
N-Nitrosodiphenylamine	-	-	-	B2	0.0049	IRIS	4-1-90
Phenanthrene	-	-	-	-	-	-	-
Pyrene	0.03	IRIS	1-1-91	-	-	IRIS	1-1-91
Inorganic Chemicals							

Table 4.3
SUMMARY OF TOXICITY INFORMATION
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

	REFERENCE DOSES: ORAL ROUTE			CARCINOGENIC POTENCIES: ORAL ROUTE			
Semi Volatile Chemicals	Reference Dose (RfD) mg/kg/day	Source[a]	Date	Weight-of Evidence	Slope Factor (mg/kg-day)-1	Source[a]	Date
Antimony	0.0004	IRIS	8-1-89	-	-	-	-
Arsenic	0.001	HEAST	10-1-90	A	1.5	EPA	1988
Barium	0.05	HEAST	10-1-90	-	-	-	-
Cadmium	0.0005 g	IRIS	6-1-90	-	-	-	-
Chromium	0.005 h	IRIS	6-1-90	-	-	-	-
Copper	0.037 j	HEAST	10-1-90	-	-	-	-
Lead	- k	IRIS	7-1-90	B2	m	-	-
Nickel	0.02f	IRIS	6-1-90	-	-	-	-
Selenium	0.0031	IRIS	1-1-90	-	-	-	-
Thallium	0.00007	HEAST	10-1-90	-	-	-	-
Zinc	0.2	HEAST	10-1-90	-	-	-	-

Table 4.3
SUMMARY OF TOXICITY INFORMATION
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

	REFERENCE DOSES: ORAL ROUTE			CARCINOGENIC POTENCIES: ORAL ROUTE			
Semi Volatile Chemicals	Reference Dose (RfD) mg/kg/day	Source[a]	Date	Weight-of Evidence	Slope Factor (mg/kg-day)-1	Source[a]	Date

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables - Quarterly Summary. USEPA
EPA 1980--Ambient Water Quality Criteria for PAH risk estimates
EPA 1988--Special Report on Ingested Inorganic Arsenic
[b]Under review by EPA workgroup.
[c]Based on Benzo[a]pyrene.
[d]Under review by CRAVE workgroup.
[e]Listed on HEAST but withdrawn from IRIS.
[f]The oral RfD is being reconsidered by the RfD Workgroup.
[g]0.0005 mg/kg/day cadmium for water; 0.001 mg/kg/day for food (HEAST).
[h]As Chromium VI, to be most protective.
[i]Based on metabolized dose.
[j]Calculated from proposed drinking water standard of 1.3 mg/L.
[k]EPA work group considers it inappropriate to develop an RfD for lead.
[l]Modifying Factor is 1.5, as Se seems to be adsorbed more efficiently in water than in food.
[m]Cancer Advisory Group recommends a numerical estimate not be used as estimates derived bystandard procedures will not truly describe risk.

The hazard index can exceed one even if no single chemical intake exceeds its RfD. If this occurs, the chemicals are segregated by similar critical effect or target organ and separate hazard indexes are derived for each effect.

The potential for carcinogenic effects is evaluated by estimating excess lifetime cancer risk. Excess lifetime cancer risk is the incremental increase in the probability of developing cancer during one's lifetime over the background probability of developing cancer (i.e., if no exposure to site contaminants occurred). For example, a 1.2E-03 excess lifetime cancer risk means that for every 1 million people exposed to the carcinogen throughout their lifetime (which is typically assumed to be 70 years), the average incidence of cancer is increased by one extra case of cancer. Because of the methods followed by the U.S. EPA in estimating cancer potency factors, the excess life cancer risks estimated in the assessment should be regarded as upper bounds on the potential cancer risks rather than accurate representations of true cancer risk.

While synergistic or antagonistic interactions might occur between carcinogens and other chemicals at the site, there is insufficient information in the toxicological literature to predict the effects of such interactions. Therefore, consistent with EPA guidelines on chemical mixtures, carcinogenic risks were treated as additive in the assessment within a route of exposure.

4.1.6 Environmental Assessment

An environmental assessment has not been performed for the base. The discussion in the exposure pathways section indicated that the leaching to groundwater pathway is unlikely because of the impermeable layer separating the shallow aquifer from the Eutaw Formation. Also the surface water runoff pathway was eliminated because of the sampling (and eventual highway construction) conducted for the Alabama Highway Department. Thus, the transport of contaminants from the base to offsite receptors, both humans and the environment, is shown not to be an exposure route.

Environmental receptors would have to come into direct contact with contaminated soil at the three sites in order for exposure to occur. Although this may be possible for some species, the restricted access and limited vegetation make the three sites unattractive.

4.2 SITE 1–POL FACILITY

4.2.1 Identification of Potential Contaminants of Concern

The purpose of this section is to identify chemicals that are potentially site-related and for which data are of sufficient quality for use in the risk evaluation. This risk evaluation is based on the data collected during the SI and presented in Section 3.

Table 4.4 summarizes the chemicals that were positively detected in at least one soil sample at Site 1. These aromatic organic compounds are commonly found in aircraft fuel.

Table 4.4
PARAMETERS DETECTED IN SOIL
SITE 1, POL AREA
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Parameters	Frequency of Detections	Range of Detected Concentrations µg/kg	Background Concentrations µg/kg
Ethylbenzene	5/26	4 - 3200	6J
Toluene	0/26	--	1J - 3J
Xylene (total)	6/26	6.9 - 3,000	4J

4.2.2 Exposure Assessment

4.2.2.1 Potentially Exposed Populations

Sitewide exposure considerations were presented in Section 4.1 and are as follows for Site 1:

- Current land use is light industrial.
- Site access is restricted.
- The saturated strata above the Eutaw is not suitable for water supply.

The POL facility is located at the north end of Phantom Street, adjacent to Perimeter Road. The facility consists of an asphalt paved area with a raised, curbed fueling island in the center. Below the fueling island are six 25,000-gallon underground storage tanks containing JP-4.

The facility was excavated and back-filled with loose gravel on top of the Mooreville Chalk layer before the storage tanks were installed. This alignment has resulted in the retention of rainwater. There is limited, if any, direct contact with the saturated water at the site.

4.2.2.2 Identification of Exposure Pathways

The sitewide discussion of potential exposure pathways in Section 4.1 explained why the leaching of contaminants to groundwater and surface water runoff are not pathways of concern for any of the three sites. For Site 1, there is water at the site from residual rainwater, but this water is not ingested, and direct dermal contact would be limited. The water at Site 1 will not be included in the exposure assessment or risk characterization.

Potential exposures to site contaminants can be evaluated by assuming that surface soils are excavated during construction, allowing exposure to subsurface soil. The potentially complete exposure pathways under these conditions are unintentional ingestion of soil and dermal contact with soil. Inhalation of dust or vapors resulting from excavation will be qualitatively discussed.

4.2.2.3 Potential Chemical Exposure Levels for Human Receptors

Levels of possible human exposure to site contaminants are assessed after potential exposure pathways and human receptors have been identified. For the exposure assessment, the magnitude, frequency, and duration of exposure for the population and exposure pathways selected above were quantified. Quantification is performed in two stages: (1) exposure concentrations are estimated and (2) quantitative estimates of pathway specific intakes are determined.

The maximum (or worst case) concentrations of chemicals in soil at Site 1 are listed in Table 4.4. The contaminant concentration at specific depths is given in the summary table

in Section 3; this table indicates that there are very few samples with contaminants, and these are in the subsurface. It is assumed that these soil concentrations represent potential chronic exposure levels for workers that may result from incidental ingestion or dermal absorption when the soils are excavated. Vapors would not persist after excavation because of the short half-life of the VOCs in the surface soil.

4.2.3 Toxicity/Risk Characterization

Potential human health risks resulting from the previously outlined exposure routes are qualitatively and/or quantitatively evaluated in this section. Exposures theoretically could occur if the area is disturbed during construction or excavation of the surface soil. For the evaluation of potential risk, it is assumed that workers can come into contact with the subsurface soil.

4.2.3.1 Carcinogenic Risks Posed by Exposure to Chemicals in Soil under the Hypothetical Future-Use Scenario

None of the chemicals detected in the soil at Site 1 are carcinogens; thus, there is no carcinogenic risk from exposure to the chemicals.

4.2.3.2 Noncarcinogenic Hazard Index Posed by Exposure to Chemicals in Soil under the Hypothetical Future-Use Scenario

For assessment of the noncarcinogenic effects of the chemicals of concern, a hazard index approach was used according to methods outlined in the HHEM. The hazard index approach compares the average daily intake for each chemical to a published acceptable intake for chronic exposure (RfD). These values represent the highest chronic exposure level not causing adverse effects (no observable adverse effect level [NOAEL]). Each RfD value contains a safety factor that accounts for the uncertainty associated with extrapolation of animal data to human. To assess the overall potential for noncarcinogenic effects using the hazard index, a person's chronic daily intake (CDI) is divided by the RfD. A potential human health risk is indicated if the hazard index is greater than one.

The noncarcinogenic hazard indices for each chemical of potential concern are presented in Tables 4.5 and 4.6. The hazard indices from ingestion and dermal exposure to soil are 1E-05 and 1.1E-03, respectively.

4.2.4 Summary and Conclusions for Site 1

The only potential exposure pathways for this site are ingestion of soil and direct dermal contact with soil. No carcinogenic chemicals have been detected at the site. The noncarcinogenic health risk evaluation shows that even under the conservative assumptions used in the calculation of chronic intakes, the potential risk from the contaminants is very low.

Table 4.5
NONCARCINOGENIC HEALTH RISK EVALUATION—SOIL INGESTION (ADULT)
SITE 1, POL AREA
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Ethylbenzene	0.1	IRIS	12	0.0000000	0.00000	NO
Toluene	0.2	IRIS	3200	0.0000016	0.00001	NO
Xylenes	2	IRIS	3000	0.0000015	0.00000	NO
Hazard Index (Sum of DI/RfD)					0.00001	

Exposure Assumptions	
Exposure Setting	**Occupational**
Exposed individual	Adult
Soil intake (grams/day)	0.05
Body weight (kilograms)	70
Number of days/year exposed	250
Number of years exposed	25

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
[b]Sources of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"

Table 4.6
NONCARCINOGENIC HEALTH RISK EVALUATION--DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 1, POL AREA
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Ethylbenzene	0.1	IRIS	11000	4.6E-05	4.6E-04	NO
Toluene	0.2	IRIS	21000	8.7E-05	4.4E-04	NO
Xylenes	2	IRIS	89000	3.7E-04	1.8E-04	NO
Hazard Index (Sum of DI/RfD)					1.1E-03	

Exposure Assumptions

Exposure Setting	Occupational
Exposed individual	Adult
Surface Area Exposed (cm2/event)	2940
Soil to Skin Adherence Factor (mg/cm2)	1.45
Absorption Factor--Organics	0.1
Exposure Frequency (events/year)	250
Exposure Duration (years)	25
Body weight (kilograms)	70
Averaging time (ED x 365 days)	9125

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables - Quarterly Summary. USEPA
[b]Sources of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"

4.3 SITE 2--OIL/WATER SEPARATOR

4.3.1 Identification of Potential Contaminants of Concern

This section identifies chemicals that are potentially site-related and for which data are of sufficient quality for use in the risk evaluation. The risk evaluation is based on the data collected during the SI and presented in Section 3.

Table 4.7 summarizes the chemicals that were positively detected in at least one soil sample at Site 2 and were detected at levels significantly above the same chemicals detected in sample blanks. As discussed in Section 3 and in Section 4.1, there is insufficient underground water at this site to take water samples. Soil samples were also analyzed for inorganic constituents at this site; the metal concentrations found in the soil samples are not significantly higher than the basewide sample concentrations except for selenium, which is more than twice the background concentration.

4.3.2 Exposure Assessment

Sitewide exposure considerations were presented in Section 4.1 and are as follows for Site 2:

- Current land use is light industrial.
- Site access is restricted.
- There is insufficient water in the Mooreville chalk layer beneath the site for a water supply and no connection of water in this layer with deeper aquifers

Elevated concentrations of contaminants were measured in both surface and subsurface soil samples. Under current land-use conditions there is the possibility of soil ingestion and dermal exposure to surface soils. For future land use the same two pathways could be completed for exposure to subsurface soils following construction or excavation.

4.3.3 Toxicity/Risk Characterization

Potential human health risks resulting from the previously outlined exposure routes are qualitatively and/or quantitatively evaluated in this section. Direct contact with chemicals of potential concern in surficial soils may occur during onsite activities. In addition, direct contact exposures to subsurface soil possibly could occur in the future if the area were disturbed by construction or excavation activities.

Both carcinogens and noncarcinogens were detected in the surface and subsurface soils at this site. The chronic daily intakes for ingestion of soil and dermal contact with soil are given in Tables 4.8 through 4.11. The assumptions used for calculating these intakes are discussed in Section 4.1 and follow the recent supplemental guidance to HHEM on the standard default exposure factors to use in the equations in HHEM.

Table 4.7
CHEMICALS DETECTED IN SOIL
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemicals	Frequency of Detections	Range of Detected Concentrations µg/kg	Background Concentrations µg/kg
Acetone	15/17	17B - 13,000B	13B - 110B
Anthracene	1/17	120J	--
Benzene	3/17	3J - 1000J	--
Benzo(a)anthracene	3/17	52J - 770	--
Benzo(a)pyrene	3/17	57J - 660	--
Benzo(b)fluoranthene	3/17	83J - 690	--
Benzo(g,h,i)perylene	3/17	50J - 440	--
Benzo(k)fluoranthene	3/17	64J - 760	--
Benzoic Acid	1/17	780J	--
bis(2-Ethylhexyl)phthalate	17/17	270BJ - 6100B	730 - 3700
Chrysene	3/17	84J - 780	--
Dibenz(a,h)anthracene	1/17	120J	--
Di-n-butyl phthalate	3/17	42J - 50J	--
1,1-Dichloroethane	2/17	1J - 790	--
1,1-Dichloroethene	1/17	24J	--
1,2-Dichloroethene (total)	12/17	150 - 28,000	--
Ethyl benzene	5/17	15 - 11,000	6J
Fluoranthene	3/17	92J - 1,600	79J
Fluorene	1/17	100J	--
Indeno(1,2,3-cd)pyrene	3/17	56J - 400J	--
Methylene chloride	15/17	11B - 9,500B	7B - 35B
2-Methyl naphthalene	6/17	43J - 4,100	--
Naphthalene	8/17	48J - 8,800E	--
Nitrobenzene	1/17	270J	--
n-Nitrosodiphenylamine	4/17	43J - 94J	--

Table 4.7
CHEMICALS DETECTED IN SOIL
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemicals	Frequency of Detections	Range of Detected Concentrations µg/kg	Background Concentrations µg/kg
Phenanthrene	3/17	49J - 510	52J
Pyrene	4/17	44J - 1,200	56J
Tetrachloroethene	3/17	400J - 1,100	--
Total Petroleum Hydrocarbons	11/21	5.5 - 2120*	3.0 - 585*
Toluene	10/17	7 - 21,000	1J - 3J
Trichloroethene	13/17	2BJ - 160,000E	--
Vinyl chloride	3/17	7J - 1,300J	--
Xylenes (total)	7/17	4J - 89,000	4J
Inorganic Chemicals			
Antimony	6/6	2.8B - 5.3B	2.7B - 6.2B
Arsenic	3/6	5.1 - 7.6	4.5 - 11.2
Barium	6/6	31.3B - 227	23.2B - 239
Cadmium	6/6	0.45B - 0.81B	0.32B - 0.78B
Chromium	6/6	14.9 - 21.5	13.7 - 54.8
Copper	6/6	8.6 - 37.4	11.6 - 23.6
Lead	6/6	5.2 - 8.8	4.8 - 37.1
Nickel	6/6	14.2 - 25.1	1.9B - 20.4
Selenium	4/6	0.4B - 3	0.22 - 0.65B
Thallium	2/6	0.23B - 0.28B	0.23B
Zinc	6/6	35.4 - 65.6	16.6B - 64.4

Note: A "B" flag beside concentrations for organics is for blank contamination, but denotes concentrations below the contract detection limits for inorganic parameters

"*" beside the concentrations for TPH indicates that the values are given in units of mg/kg.

Table 4.8
NONCARCINOGENIC HEALTH RISK EVALUATION—SOIL INGESTION (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Organic Chemicals						
Acetone	0.1	IRIS	13000	6.36E-06	6.36E-05	NO
Anthracene	0.3	IRIS	120	5.87E-08	1.96E-07	NO
Benzoic acid	4	IRIS	780	3.82E-07	9.54E-08	NO
bis(2-Ethylhexyl)phthalate	0.02	IRIS	6100	2.98E-06	1.49E-04	NO
Di-n-butylphthalate	0.1[b]	IRIS	50	2.45E-08	2.45E-07	NO
1,1-Dichloroethane	0.1[b]	HEAST	1	4.89E-10	4.89E-09	NO
1,1-Dichloroethene	0.009[b]	IRIS	24	1.17E-08	1.30E-06	NO
1,2-Dichloroethene (total)	0.01[e]	HEAST	28000	1.37E-05	1.37E-03	NO
Ethylbenzene	0.1	IRIS	11000	5.38E-06	5.38E-05	NO
Fluoranthene	0.04	IRIS	1600	7.83E-07	1.96E-05	NO
Fluorene	0.04	IRIS	100	4.89E-08	1.22E-06	NO
Indeno(1,2,3-cd)pyrene	0.2	IRIS	400	1.96E-07	9.78E-07	NO
Methylene chloride	0.06	IRIS	9500	4.65E-06	7.75E-05	NO
Naphthalene	0.004[b]	HEAST	13000	6.36E-06	1.59E-03	NO
Nitrobenzene	0.0005[f]	IRIS	270	1.32E-07	2.64E-04	NO

Table 4.8
NONCARCINOGENIC HEALTH RISK EVALUATION—SOIL INGESTION (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Pyrene	0.03	IRIS	1200	5.87E-07	1.96E-05	NO
Tetrachloroethene	0.01	IRIS	1100	5.38E-07	5.38E-05	NO
Toluene	0.2	IRIS	21000	1.03E-05	5.14E-05	NO
Xylenes	2	IRIS	89000	4.35E-05	2.18E-05	NO
Inorganic Chemicals[e]						
Antimony	0.0004	IRIS	5300	2.59E-06	6.48E-03	NO
Arsenic	0.001	HEAST[k]	7600	3.72E-06	3.72E-03	NO
Barium	0.05	HEAST[c]	227000	1.11E-04	2.22E-03	NO
Cadmium	0.0005	IRIS[g]	810	3.96E-07	7.93E-04	NO
Chromium	0.005	IRIS	21500	1.05E-05	2.10E-03	NO
Copper	0.037	HEAST[d]	37400	1.83E-05	4.95E-04	NO
Nickel	0.02	IRIS[f]	25100	1.23E-05	6.14E-04	NO
Selenium	0.003	IRIS[j]	3000	1.47E-06	4.89E-04	NO
Thallium	0.00007	HEAST	280	1.37E-07	1.96E-03	NO
Zinc	0.2	HEAST[b]	49000	2.40E-05	1.20E-04	NO
Hazard Index (Sum of DI/RfD)					2.27E-02	

Table 4.8
NONCARCINOGENIC HEALTH RISK EVALUATION—SOIL INGESTION (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Exposure Assumptions						
Exposure Setting		**Occupational**				
Exposed individual		Adult				
Soil intake (grams/day)		0.05				
Body weight (kilograms)		70				
Number of days/year exposed		250				
Number of years exposed		25				

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables - Quarterly Summary. USEPA
Sources of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"
[b]Under review by EPA workgroup.
[c]Verified by workgroup, IRIS input pending.
[d]The RfD was calculated from proposed drinking water standard of 1.3 mg/L assuming 2 liters of water consumed per day for 70 years.
[e]The EPA work group considers it inappropriate to develop a RfD for lead, thus it is not included in this table. Also, silver was not detected in any samples and is not included in this table.
[f]The oral RfD is being reconsidered by the RfD Workgroup.
[g]0.0005 mg/kg/day cadmium for water; 0.001 mg/kg/day for food (HEAST).
[j]Modifying Factor=1.5, as selenium seems to be absorbed more efficiently in water than in food.
[k]Will be reviewed by EPA work group.

Table 4.9
NONCARCINOGENIC HEALTH RISK EVALUATION—DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Organic Chemicals						
Acetone	0.1	IRIS	13000	5.4E-05	5.4E-04	NO
Anthracene	0.3	IRIS	120	5.0E-07	1.7E-06	NO
Benzoic acid	4	IRIS	780	3.2E-06	8.1E-07	NO
bis(2-Ethylhexyl)phthalate	0.02	IRIS	6100	2.5E-05	1.3E-03	NO
Di-n-butylphthalate	0.1[b]	IRIS	50	2.0E-07	2.0E-06	NO
1,1-Dichloroethane	0.1[b]	HEAST	1	4.2E-09	4.2E-08	NO
1,1-Dichloroethene	0.009[b]	IRIS	24	9.6E-08	1.1E-05	NO
1,2-Dichloroethene (total)	0.01[e]	HEAST	28000	1.2E-04	1.2E-02	NO
Ethylbenzene	0.1	IRIS	11000	4.6E-05	4.6E-04	NO
Fluoranthene	0.04	IRIS	1600	6.6E-05	1.7E-04	NO
Fluorene	0.04	IRIS	100	4.2E-07	1.0E-05	NO
Indeno(1,2,3-cd)pyrene	0.2	IRIS	400	1.7E-06	8.3E-06	NO
Methylene chloride	0.06	IRIS	9500	4.0E-05	6.6E-04	NO
Naphthalene	0.004[b]	HEAST	13000	5.4E-05	1.4E-02	NO
Nitrobenzene	0.0005[f]	IRIS	270	1.1E-06	2.2E-03	NO
Pyrene	0.03	IRIS	1200	5.0E-06	1.7E-04	NO

Table 4.9
NONCARCINOGENIC HEALTH RISK EVALUATION—DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Tetrachloroethene	0.01	IRIS	1100	4.6E-06	4.6E-04	NO
Toluene	0.2	IRIS	21000	8.7E-05	4.4E-04	NO
Xylenes	2	IRIS	89000	3.7E-04	1.8E-05	NO
Inors						
Antimony	0.0004	IRIS	5300	2.2E-06	5.5E-03	NO
Arsenic	0.001[k]	HEAST	7600	3.1E-06	3.1E-03	NO
Barium	0.05[e]	HEAST	227000	9.4E-05	1.9E-03	NO
Cadmium	0.0005[g]	IRIS	810	3.4E-07	6.7E-04	NO
Chromium	0.005	IRIS	21500	8.6E-06	1.8E-03	NO
Copper	0.037[d]	HEAST	37400	1.6E-05	4.2E-06	NO
Nickel	0.02[f]	IRIS	25100	1.0E-05	5.2E-04	NO
Selenium	0.003[j]	IRIS	3000	1.2E-06	4.2E-04	NO
Thallium	0.00007	HEAST	280	1.2E-07	1.7E-03	NO
Zinc	0.2[b]	HEAST	49000	2.0E-07	1.0E-04	NO
Hazard Index (Sum of DI/RfD)					4.8E-02	

Table 4.9
NONCARCINOGENIC HEALTH RISK EVALUATION—DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Exposure Assumptions						
Exposure Setting		Occupational				
Exposed individual		Adult				
Surface Area Exposed (cm2/event)		2940				
Soil to skin Adherence Factor (mg/cm2)		1.45				
Absorption Factor - Organics		0.1				
- Metals		0.01				
Exposure Frequency (events/year)		250				
Exposure Duration (years)		25				
Body weight (kilograms)		70				
Averaging time (ED x 365 days)		9125				

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables - Quarterly Summary. USEPA
Sources of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"
[b]Under review by EPA workgroup.
[c]Verified by workgroup, IRIS input pending.
[d]The RfD was calculated from proposed drinking water standard of 1.3 mg/L assuming 2 liters of water consumed per day for 70 years.
[f]The oral RfD is being reconsidered by the RfD Workgroup.
[g]0.0005 mg/kg/day cadmium for water; 0.001 mg/kg/day for food (HEAST).
[j]Modifying Factor=1.5, as selenium seems to be absorbed more efficiently in water than in food.
[k]Will be reviewed by EPA work group.

Table 4.10
EXCESS LIFETIME CANCER RISK—SOIL INGESTION (ADULT)
SITE 2—, OIL/WATER SEPARATOR
187th Tactical Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	U.S. EPA Carcinogen Classification	Slope Factor (kg-day/mg)	Source[a]	Concentration µg/kg	Lifetime Average Chemical Intake mg/kg-day	Excess Lifetime Cancer Risk
Arsenic	A	1.5	EPA 1988	780	1.4E-07	2E-07
Benzene	A	0.029	IRIS	1000	1.7E-07	5E-09
Benzo[a]anthracene	B2	11.53	[c]	770	1.3E-07	2E-06
Benzo[b]fluoranthene	B2	11.53	[c]	96	1.7E-08	2E-07
Benzo[k]fluoranthene	B2	11.53	[c]	760	1.3E-07	2E-06
Benzo[a]pyrene	B2	11.53	EPA 1980	660	1.2E-07	1E-06
Benzo[g,h,i]perlyene	B2	11.53	[c]	440	7.7E-08	9E-07
bis(2-Ethylhexyl)phthalate	B2	0.014	IRIS	6100	1.1E-06	1E-08
Chyrsene	B2	11.53	[c]	780	1.4E-07	2E-06
Dibenz[a,h]anthracene	B2	11.53	[c]	120	2.1E-08	2E-07
1,1-Dichloroethene	C	0.6	IRIS	24	4.2E-09	3E-09
Indeno[1,2,3-cd]pyrene	B2	11.53	[c]	400	7.0E-08	8E-07
Methylene chloride	B2	0.0075	IRIS	9500	1.7E-06	1E-08
N-Nitrosodiphenylamine	B2	0.0049	IRIS	94	1.6E-08	8E-11
Tetrachloroethene	B2	0.051[d]	HEAST	1100	1.9E-07	1E-08
Trichloroethene	B2	0.011[e]	HEAST	240000	4.2E-05	5E-07

Table 4.10
EXCESS LIFETIME CANCER RISK—SOIL INGESTION (ADULT)
SITE 2—, OIL/WATER SEPARATOR
187th Tactical Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	U.S. EPA Carcinogen Classification	Slope Factor (kg-day/mg)	Source[a]	Concentration µg/kg	Lifetime Average Chemical Intake mg/kg-day	Excess Lifetime Cancer Risk
Vinyl chloride	A	1.9[f]	HEAST	1300	2.3E-07	4E-07
SUM OF RISKS						9E-06

Exposure Assumptions	
Exposure Setting	Occupational
Exposed Individual	Adult
Soil ingestion rate (g/day)	0.05
Body weight (kg)	70
Number of days/years exposed	250
Number of years exposed	25
Years in lifetime	70
Lifetime average soil intake (g/kg body weight per day)	0.0002

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables - Quarterly Summary. USEPA
EPA 1980--Ambient Water Quality Criteria for PAHs risk estimates
EPA 1988--Special Report on Ingested Inorganic Arsenic
Source of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"
[c]Based on Benzo[a]pyrene.
[d]Under review by CRAVE Workgroup.
[f]Verified by workgroup, IRIS input pending.
[g]Based on metabolized dose.

Table 4.11
EXCESS LIFETIME CANCER RISK--DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Chemical	U.S.EPA Carcinogen Classification	Slope Factor (kg-day/mg)	Source[a]	Concentration µg/kg	Lifetime Average Chemical Intake mg/kg-day	Excess Lifetime Cancer Risk
Exposure Assumptions						
Exposure Setting		**Occupational**				
Exposed Individual		Adult				
Surface Area Exposed (cm2/event)		2940				
Soil to skin Adherence Factor (mg/cm2)		1.45				
Absorption Factor - Organics		0.1				
Absorption Factor - Metals		0.01				
Exposure Frequency (events/year)		250				
Exposure Duration (years)		25				
Body weight (kg)		70				
Averaging time (70 x 365 days)		25550				

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables - Quarterly Summary. USEPA
EPA 1980--Ambient Water Quality Criteria for PAHs risk estimates
EPA 1988--Special Report on Ingested Inorganic Arsenic
Source of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"
[c]Based on Benzo[a]pyrene.
[d]Under review by CRAVE Workgroup.
[f]Verified by workgroup, IRIS input pending.
[g]Based on metabolized dose.

Table 4.8 gives the noncarcinogenic health risk evaluation for the potential soil ingestion pathway while Table 4.9 presents hazard quotients for the dermal absorption pathway. None of the individual organic or inorganic chemicals detected at the site has a hazard quotient greater than one, and the sum of all hazard quotients (hazard index) for both pathways is less than 1.

Tables 4.10 and 4.11 show the cancer risk evaluations for the same potential pathways. The sum of the risks for each pathway is below $1x10^{-5}$.

4.3.4 Summary and Conclusions for Site 2

The only potential exposure pathways for this site are ingestion of soil and direct dermal contact with soil. The noncarcinogen and carcinogen health risk evaluations show that even under the conservative assumptions used in the calculation of chronic intakes, the potential risk from the contaminants at this site is very low.

4.4 SITE 4--EDGE OF AIRCRAFT PARKING APRON

4.4.1 Identification of Potential Contaminants of Concern

This section identifies chemicals that are potentially site-related and for which data are of sufficient quality for use in the risk evaluation. The risk evaluation is based on the data collected during the SI and presented in Section 3.

Table 4.12 summarizes the chemicals that were positively detected in at least one soil sample at Site 4 and were detected at levels significantly above the same chemicals detected in sample blanks. As discussed in Section 3 and in Section 4.1, there is insufficient underground water at this site to take water samples.

A preliminary analysis of the chemicals in Table 4.13 indicates the presence of PAHs similar to what would be expected to be in asphalt. Since shallow soil samples were taken at Site 4, the presence of these PAHs in the soil could be from the extraction of the nearby asphalt runway, by the spilled JP-4 fuel, or from weathering by rainwater. It is not unusual to detect these PAHs near an asphalt source. Also, the exhaust from airplanes and subsequent deposition on soil could be another source of these PAHs.

4.4.2 Exposure Assessment

Sitewide exposure considerations were presented in Section 4.1 and are as follows for Site 4:

- Current land use is light industrial.
- Site access is restricted.
- There is insufficient water in the Mooreville chalk layer beneath the site for a water supply and no connection of water in this layer with deeper aquifers.

Table 4.12
PARAMETERS DETECTED IN SOIL
SITE 4, EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Parameters	Frequency of Detections	Range of Detected Concentrations µg/kg	Background Concentrations
Anthracene	2/29	920 - 1,000	
Benzo(a)anthracene	12/29	110 - 6,000	
Benzo(a)pyrene	13/29	220 - 12,000	
Benzo(b)fluoranthene	13/29	240 - 9,500	
Benzo(g,h,i)perylene	14/29	45JX - 8,800	
Benzo(k)fluoranthene	13/29	120 - 5,000	
Chrysene	13/29	230 - 7,900	
Dibenzo(a,h)anthracene	11/29	39JX - 950	
Fluoranthene	16/29	37JX - 10,000	79J
Fluorene	1/29	300JX	
Indeno(1,2,3-cd)pyrene	14/29	68 - 10,000	
Phenanthrene	12/29	79 - 4,000	52J
Pyrene	15/29	38JX - 8,600	56J

Table 4.13
NONCARCINOGENIC HEALTH RISK EVALUATION—SOIL INGESTION (ADULT)
SITE 4, EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Anthracene	0.3	IRIS	1000	0.0000005	0.00000	NO
Fluoranthene	0.04	IRIS	10000	0.0000049	0.00012	NO
Fluorene	0.04	IRIS	300	0.0000001	0.00000	NO
Indeno(1,2,3-cd)pyrene	0.2	IRIS	10000	0.0000049	0.00002	NO
Hazard Index (Sum of DI/RfD)					0.00015	

Exposure Assumptions

Exposure Setting	Occupational
Exposed individual	Adult
Soil intake (grams/day)	0.05
Body weight (kilograms)	70
Number of days/year exposed	250
Number of years exposed	25

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
Sources of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"

Elevated concentrations of contaminants were measured in both surface and subsurface soil samples. Under current land use conditions there is the possibility of soil ingestion and dermal exposure to surface soils. For future land use the same two pathways could be completed for exposure to subsurface soils following construction or excavation.

The proximity of this site to the runway indicates that the standard exposure assumptions such as ingestion of a certain amount of soil 250 times per year will result in a very conservative intake calculation.

4.4.3 Toxicity/Risk Characterization

Potential human health risks resulting from the previously discussed exposure routes are quantitatively evaluated in this section. Direct contact with chemicals of potential concern in surficial soils may occur during onsite activities, although the proximity of this site to the runway should restrict the frequency of contact.

Both carcinogens and noncarcinogens were detected in the surface and subsurface soils at this site. The chronic daily intakes for ingestion of soil and dermal contact with soil are given in Tables 4.13 through 4.16. The assumptions used for calculating these intakes are discussed in Section 4.1 and follow the recent supplemental guidance to HHEM on the standard default exposure factors to use in the equations in HHEM.

Table 4.13 shows the noncarcinogenic health risk evaluation for the potential soil ingestion pathway, while Table 4.14 presents hazard quotients for the dermal absorption pathway. The individual hazard quotients are very low, and the sum of all hazard quotients (hazard index) is also very low, indicating a low health risk from these chemicals by these pathways.

Tables 4.15 and 4.16 give the cancer risk evaluations for the same potential pathways. The risk for dermal absorption from soil is very low at $5x10^{-7}$, but the excess lifetime cancer risk for soil ingestion is calculated to be $1x10^{-4}$. The soil ingestion risk calculation is conservative for several reasons: (1) when a slope factor is not available for an individual carcinogen, it is then based on benzo(a)pyrene, a potent carcinogen; (2) the proximity of the site to the runway should restrict access to the site to much less than 250 times per year.

4.4.4 Summary and Conclusions for Site 4

The only potential exposure pathways for this site are ingestion of soil and direct dermal contact with soil. Noncancer and cancer risks from dermal contact are insignificant, as is the ingestion risk for noncarcinogens. The cancer risk for ingestion of soil is above $1x10^{-6}$, but the calculations are conservative, and the calculated risk is no doubt much higher than the real risk.

Table 4.14
NONCARCINOGENIC HEALTH RISK EVALUATION—DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 4, EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemical	Reference Dose (RfD) mg/kg-day	Source[a]	Concentration µg/kg	Daily Intake (DI) mg/kg-day	Hazard Quotient DI/RfD	Does Intake Exceed RfD?
Anthracene	0.3	IRIS	120	5.0E-07	1.7E-06	NO
Fluoranthene	0.04	IRIS	1600	6.6E-06	1.4E-04	NO
Fluorene	0.04	IRIS	100	4.2E-07	1.0E-05	NO
Indeno(1,2,3-cd)pyrene	0.2	IRIS	400	1.7E-06	8.3E-06	NO
Hazard Index (Sum of DI/RfD)					1.9E-04	

Exposure Assumptions

Exposure Assumptions	Occupational
Exposed individual	Adult
Surface Area Exposed (cm2/event)	2940
Soil to skin Adherence Factor (mg/cm2)	1.45
Absorption Factor--Organics	0.1
Exposure Frequency (events/year)	250
Exposure Duration (years)	25
Body weight (kilograms)	70
Averaging time (ED x 365 days)	9125

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables, Quarterly Summary. USEPA
Sources of Exposure Assumptions:
HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"

Table 4.15
EXCESS LIFETIME CANCER RISK—SOIL INGESTION (ADULT)
SITE 4, EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemical	U.S. EPA Carcinogen Classification	Slope Factor (kg-day/mg)	Source[a]	Concentration µg/kg	Lifetime Average Chemical Intake mg/kg-day	Excess Lifetime Cancer Risk
Benzo[a]anthracene	B2	11.53	c	6000	1.048E-06	1E-05
Benzo[b]fluoranthene	B2	11.53	c	9500	1.660E-06	2E-05
Benzo[k]fluoranthene	B2	11.53	c	5000	8.736E-07	1E-05
Benzo[a]pyrene	B2	11.53	EPA 1980	12000	2.097E-06	2E-05
Benzo[g,h,i]perlyene	B2	11.53	c	8800	1.538E-06	2E-05
Chrysene	B2	11.53	c	7900	1.380E-06	2E-05
Dibenz[a,h]anthracene	B2	11.53	c	950	1.660E-07	2E-06
Indeno[1,2,3-cd]pyrene	B2	11.53	c	10000	1.747E-06	2E-05
Sum of Risks						1E-04
Exposure Assumptions						
Exposure Setting		Occupational				
Soil ingestion rate (g/day)		0.05				
Body weight (kg)		70				
Number of days/years exposed		250				
Number of years exposed		25				
Years in lifetime		70				
Lifetime average soil intake (g/kg body weight per day)		0.0002				

[a]Sources of Toxicity Values:
HEAST--Health Effects Assessment Summary Tables--Quarterly Summary. USEPA.
IRIS--Integrated Risk Information System. U.S. EPA
EPA 1980--Ambient Water Quality Criteria for PAHs risk estimates
Source of Exposure Assumptions: HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"
[c]Based on Benzo[a]pyrene.

Table 4.16
EXCESS LIFETIME CANCER RISK—DERMAL ABSORPTION FROM SOIL (ADULT)
SITE 4, EDGE OF AIRCRAFT PARKING APRON
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemical	U.S. EPA Carcinogen Classification	Slope Factor (kg-day/mg)	Source[a]	Concentration µg/kg	Lifetime Average Chemical Intake mg/kg-day	Excess Lifetime Cancer Risk
Benzo[a]anthracene	B2	11.53	c	770	7.9E-09	9.1E-08
Benzo[b]fluoranthene	B2	11.53	c	96	9.8E-10	1.1E-08
Benzo[k]fluoranthene	B2	11.53	c	760	7.8E-09	9.0E-08
Benzo[a]pyrene	B2	11.53	EPA 1980	660	6.8E-09	7.8E-08
Benzo[g,h,i]perlyene	B2	11.53	c	440	4.5E-09	5.2E-08
Chrysene	B2	11.53	c	780	8.0E-09	9.2E-08
Dibenz[a,h]anthracene	B2	11.53	c	120	1.2E-09	1.4E-08
Indeno[1,2,3-cd]pyrene	B2	11.53	c	400	4.1E-09	4.7E-08
Sum of Risks						**5E-07**
Exposure Assumptions						
Exposure Setting-Exposed Individual		**Occupational Adult**				
Surface Area Exposed (cm2/event)		2940				
Soil to Skin Adherence Factor (mg/cm2)		1.45				
Absorption Factor--Organics		0.1				
Exposure Frequency (events/year)		250				
Exposure Duration (years)		25				
Body Weight (kg)		70				
Average Time (70 x 365 days)		25550				

[a]Sources of Toxicity Values:
IRIS--Integrated Risk Information System. U.S. EPA
HEAST--Health Effects Assessment Summary Tables--Quarterly Summary. USEPA.
EPA 1980--Ambient Water Quality Criteria for PAHs risk estimates
EPA 1988--Special Report on Ingested Inorganic Arsenic
Source of Exposure Assumptions: HHEM 1989, Supplemental Guidance "Standard Default Exposure Factors"
[c]Based on Benzo[a]pyrene.
[d]Under review by CRAVE Workgroup.
[f]Verified by workgroup, IRIS input pending.
[g]Based on metabolized dose.

4.5 LIMITATIONS AND UNCERTAINTIES

This section discusses the key assumptions and uncertainties that affect the level of confidence placed on risk estimates for this site. Since uncertainties are inherent to any risk assessment, a qualitative discussion of these uncertainties helps put into perspective the risks calculated for a site. These uncertainties are generally associated with:

- Selection of chemicals
- Likelihood of exposure pathways and land uses actually occurring
- Methods to calculated exposure concentrations
- Uncertainty associated with the parameters and assumptions used to estimate exposures
- Selection of cancer slope factors and references doses
- Significant data gaps

Currently, there is much debate concerning the most appropriate methods to determine "average exposure conditions" and "worst-case exposure conditions." According to the guidelines, the 95 percent upper confidence limit on the arithmetic average should be used for calculating exposure. However, environmental data are not frequently normally distributed, and samples are not randomly collected. Infrequently reported constituents preclude the ability to use these statistical methods.

There is uncertainty associated with the use of the method to determine carcinogenic risks in humans. In discussing uncertainty, the EPA expressed the following:

> It should be emphasized that the linearized multistage procedure leads to a plausible upper limit to the risk that is consistent with some proposed mechanism of carcinogenesis. Such an estimate, however, does not necessarily give a realistic prediction of the risk. The true value of risk is unknown, and may be as low as zero. The range of risks, defined by the upper limit given by the chosen model and the lower limit which may be stated as low as zero, should be explicitly stated (51 Federal Register 33998).

The toxicological data base is also a source of uncertainty. The EPA indicates some of the sources of uncertainty include extrapolation from high to low doses and from animals to humans; species differences in uptake, metabolism, and organ distribution; species differences in target site susceptibility; and human population variability with respect to diet, environment, activity patterns, and cultural factors.

The use of standard exposure assumptions may lead to a conservative estimate of the chronic daily intake, particularly the worker frequency of ingestion of soil. Calculations of risk from these standard factors will lead to upper-bound valves. It would be more appropriate to study onsite activity patterns such as the number of trips by workers to each site and do the exposure calculations based on these activity patterns.

There are no data for surface water runoff during storm events. Although the sampling done for the Alabama Highway Department indicates little surface water runoff, data was not collected during the SI to support the sampling because of the destruction and reconstruction of Sites 3 and 5.

4.6 REFERENCES

U.S. EPA, 1989. Risk Assessment Guidance for Superfund Volume 1--Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002. Also, Supplemental Guidance: "Standard Default Exposure Factors," March, 1991.

Schaum, J. 1984. *Risk Analysis of TCDD Contaminated Soil.* U.S. EPA, Office of Health and Environmental Assessments.

5. INVESTIGATION-DERIVED WASTE

During the SI, no information was collected that indicated contaminants from the sites pose an imminent threat to human health or the environment. Therefore, immediate remedial activities have not been undertaken at the base.

During the SI, drill cuttings, water from well development, and decontamination fluids were placed in 55-gallon drums that were labelled, dated, and placed in a designated storage area on base. The SI data were reviewed to evaluate the appropriate disposition of investigation-derived wastes according the ADEM Division 13 and/or Division 14 regulations. The results of this evaluation are presented in Appendix J.

6. CONCLUSIONS

6.1 SUMMARY

As a result of the SI, the following conclusions are presented. Based on these conclusions, recommendations for further activity at Sites 1, 2, and 4 are also made.

6.2 SITE 1 (POL FACILITY)

6.2.1 Conclusions

The results of the soil analyses indicated the presence of petroleum fuel contaminants. Samples from four borings (P1BS, P2BS, P3BS and P4BS) contained TPH concentrations that exceeded the ADEM CAL of 100 mg/kg. Most of the TPH soil contamination appears to be present in the top 4 feet of soil. Elevated concentrations of ethylbenzene and total xylene were detected in samples collected from POL backfill boring P5BS at both the 4- to 6-foot and 8- to 10-foot sampling intervals. The highest ethylbenzene (3,200 μg/kg) and total xylene (3,000 μg/kg) concentrations were detected at the 12- to 14-foot sampling interval. These compounds were detected in other borings, but at much lower concentrations (9-34 μg/kg). These contaminants indicate fuel components.

Water samples were collected from two of the borings (P5BW and P7BW) within the saturated backfill material. VOC compounds were detected in both water samples but were not detected in the background groundwater sample. The highest concentrations were found in boring P5BW. Benzene was detected in this sample at a concentration of 400 μg/L, which is above the public water supply MCL of 5 μg/L. Toluene, ethylbenzene and xylene (total) also were present in this sample.

No groundwater was encountered in soil borings placed in the native soil outside the POL backfill. The low permeability (1.2E-03 cm/sec) of the natural soil surrounding the backfill appears to be restricting the migration of contaminants outside the backfill. The low vertical and horizontal permeability of the natural soil surrounding the backfill material appears to have restricted any migration of the contaminated water beyond the backfill area.

6.2.2 Data Limitations

Data collected during the SI field effort at Site 1 was found to generally meet the SI objectives. As described in Appendix I, the analytical data from the SI can be used in the IRP decision-making process.

6.3 SITE 2 (OIL/WATER SEPARATOR)

6.3.1 Conclusions

As stated previously, Site 2 consists of the area surrounding an OWS and a related holding tank. The OWS receives aircraft wash rack and floor drain wastewater containing solvents, paint strippers, and lacquer thinners. Historically, numerous spills have been associated with this unit during base operations. Analytical results of samples collected from this site exhibited several organic and inorganic compounds.

The results of inorganic analysis of soils in this area indicated that metals concentrations are not significantly higher than basewide levels except for selenium, which was more than twice the background concentration. Although selenium levels were measurably higher than those found in background samples, they do not exceed the chronic RfD, and the potential human health risk is very low.

Concentrations of organic contaminants were measured in both surface and subsurface soil samples collected around the OWS. These contaminants either were not present in background samples or exceeded background concentrations as shown in Table 6.1. No water was encountered in borings installed at Site 2, so the only potential exposure pathways that exist are through ingestion of soil and direct dermal contact with soil. Even using the conservative assumptions applied in the risk evaluation, the potential human health risk from Site 2 contaminants is very low.

The results of TPH analysis of soil samples taken from the OWS area revealed elevated concentrations at one of the five sampling locations (O4BS). TPH was measured at 2,120 mg/kg at a sample interval of 0 to 2 feet, which exceeded the ADEM CAL of 100 mg/kg. The remaining sample locations exhibited low concentrations in comparison (5.5-37.8 mg/kg), with two locations (O1BS and O3BS) having concentrations below the method detection limit.

6.3.2 Data Limitations

Data collected at Site 2 indicates that the vertical and lateral extent of contamination from organic compounds is undefined. Appendix F describes the appropriate data use in the IRP decision-making process.

6.4 SITE 4 (EDGE OF AIRCRAFT PARKING APRON)

6.4.1 Conclusions

Composite surface soil samples collected along the perimeter and low area at this site indicated the presence of 13 organic compounds in the surface soils (0 to 2 feet). However, no organic compounds were detected above method detection limits in the subsurface samples collected from the three boreholes drilled at the site. Organic compound contamination appears to be present only in the upper 2 feet of soils with the highest concentrations typically found in the top 6 inches of soil.

Table 6.1
ORGANIC CHEMICALS DETECTED IN SOIL
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemicals	Frequency of Detections	Range of Detected Concentrations µg/kg	Range of Background Concentrations µg/kg
Acetone	15/17	17B - 13,000B	13B - 110B
Anthracene	1/17	120J	--
Benzene	3/17	3J - 1000J	--
Benzo(a)anthracene	3/17	52J - 770	--
Benzo(a)pyrene	3/17	57J - 660	--
Benzo(b)fluoranthene	3/17	83J - 690	--
Benzo(g,h,i)perylene	3/17	50J - 440	--
Benzo(k)fluoranthene	3/17	64J - 760	--
Benzoic Acid	1/17	780J	--
bis(2-Ethylhexyl)phthalate	17/17	270BJ - 6100B	730 - 3700
Chrysene	3/17	84J - 780	--
Dibenz(a,h)anthracene	1/17	120J	--
Di-n-butyl phthalate	3/17	42J - 50J	--
1,1-Dichloroethane	2/17	1J - 790	--
1,1-Dichloroethene	1/17	24J	--
1,2-Dichloroethene (total)	12/17	150 - 28,000	--
Ethyl benzene	5/17	15 - 11,000	6J
Fluoranthene	3/17	92J - 1,600	79J
Fluorene	1/17	100J	--
Indeno(1,2,3-cd)pyrene	3/17	56J - 400J	--
Methylene chloride	15/17	11B - 9,500B	7B - 35B
2-Methyl naphthalene	6/17	43J - 4,100	--
Naphthalene	8/17	48J - 8,800E	--
1,1,2,2-Tetrachloroethane	1/17	1,600	--
Nitrobenzene	1/17	270J	--
n-Nitrosodiphenylamine	4/17	43J - 94J	--
Phenanthrene	3/17	49J - 510	52J
Pyrene	4/17	44J - 1,200	56J

Table 6.1
ORGANIC CHEMICALS DETECTED IN SOIL
SITE 2, OIL/WATER SEPARATOR
187th Fighter Group
DANNELLY ANG - Montgomery, Alabama

Organic Chemicals	Frequency of Detections	Range of Detected Concentrations µg/kg	Range of Background Concentrations µg/kg
Tetrachloroethene	3/17	400J - 1,100	--
Toluene	10/17	7 - 21,000	1J - 3J
Trichloroethene	13/17	2BJ - 160,000E	--
Vinyl chloride	3/17	7J - 1,300J	--
Xylenes (total)	7/17	4J - 89,000	4J
Note: A "B" flag beside concentrations is for blank contamination.			

It appears the contamination found in surface samples is the result of contaminant runoff from the edge of aircraft parking apron. Site soils in this area restrict the vertical migration of these contaminants. All borings installed at Site 4 were drilled to a depth (18 to 20 feet) that penetrated the Mooreville chalk. No groundwater was encountered within this subsurface zone.

6.4.2 Data Limitations

Data collected during the SI field effort at Site 4 was found to generally meet the SI objectives. Appendix F describes the appropriate use of these data in the IRP decision-making process.

7. RECOMMENDATIONS

This section presents the recommendations resulting from the SI fieldwork conducted at the base in Montgomery, Alabama.

7.1 SITES 1 AND 2

The base planned to decommission Sites 1 and 2 under an ongoing construction project. Although these sites may pose no risk to human health or environment in their current state, decommissioning of these sites may have triggered state and federal ARARs for soil contamination that may need to be addressed. Although soil contamination is present at Sites 1 and 2, the PRE indicates that the potential health risk from contaminants at these sites is very low. DDs for no further action are recommended for these sites.

7.2 SITES 3 AND 5

Two of the sites (Sites 3 and 5) have been destroyed during roadway construction activities by the Alabama Highway Department. Sampling conducted by the Highway Department before road construction activities showed that low levels of compounds were detected in various samples, but no major environmental problems existed in these area. DDs for no further action are recommended for these sites based on the results of the Alabama Highway Department investigation and subsequent construction activities.

7.3 SITE 4

Contamination was found only in the surface soils (0 to 2 feet) next to the aircraft parking apron. This contamination is indicative of compounds associated with runoff from asphalt paved areas. A DD for no further action is recommended for this site.