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REMEDIAL INVESTIGATION FEASIBILITY STUDY WORK PLAN FOR OUTLYING LANDING FIELD BARIN VOLUME 1 OF 2 NAS WHITING FIELD FL

4/1/1993

ABB ENVIRONMENTAL

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN

OUTLYING LANDING FIELD (OLF) BARIN
FOLEY, ALABAMA

VOLUME I: WORKPLAN

CTO: 031

Navy CLEAN - District I

Contract No. N62467-89-D-0317

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April 1993

EXECUTIVE SUMMARY

This Remedial Investigation and Feasibility Study (RI/FS) Workplan was developed to identify a range of remedial alternatives to address any identified risk to public health and the environment by contaminants present due to past waste disposal activities or spill sites at Outlying Landing Field (OLF) Barin, Foley, Alabama.

The objectives of the RI are to collect sufficient data to: characterize and quantify the extent of contamination, to assess potential risks to human health and the environment posed by contaminants of concern, to support an FS at sources of contamination where remedial action is warranted, and to support a Record of Decision (ROD) at all Potential Sources of Contamination (PSCs).

The FS is designed to evaluate remedial alternatives, conduct treatability studies, and design remedial actions. Remedial actions are performed to mitigate threats to human health and the environment by removing, containing, or treating contaminated media to established target levels.

As a result of the Site Inspection (SI) conducted by ABB Environmental Services, Inc. (ABB-ES), in 1990, the five identified sites at OLF Barin are as follows:

Site 19B, Former Hangar Maintenance Area;
Site 20B, Abandoned Underground Storage Tanks and Fuel Pit Area;
Site 21B, Rubble Landfill;
Site 22B, Old Firefighting Demonstration Area; and
Site 23B, Drainage Ditch Leading to Sandy Creek.

These sites were recommended for further investigation to assess the nature and distribution of contaminants associated with each site. In addition to these sites, five other sites the Firefighting Training Area (Site 24B), the Machine Gun Butt (Site 25B), the Abandoned Wastewater Treatment Plant (26B), the Uncontrolled Dumpsite (Site 27B) and the Fuel Pit Drainage Ditch (Site 28B) identified during the SI field program were recommended for contaminant investigation.

Recommendations for the 10 sites will be implemented in the next step, an RI/FS, of the Navy's Installation Restoration (IR) Program. ABB-ES was contracted under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) contract (Contract Number N62467-89-D-0317, Contract Task Order [CTO] Number 031) to prepare an RI/FS Workplan for the 10 sites at OLF Barin.

The planning documents to support the RI/FS program consist of four volumes:

Volume I, RI/FS Workplan;
Volume II, Sampling and Analysis Plan (incorporates both the Field Sampling Plan and Quality Assurance Project Plan);
Volume III, Health and Safety Plan; and
Volume IV, Community Relations Plan.

Together the four volumes present the scope of the RI/FS program. The Workplan (Volume I) provides a record of site history, describes regional environmental factors, details previous investigative results, describes data quality objectives (DQOs) and RI/FS tasks, and describes site-specific investigative methodology and project organization and schedule.

The Sampling and Analysis Plan (SAP) (Volume II) focuses on the field investigation, analytical methods, and quality assurance/quality control (QA/QC) procedures. The SAP provides a project description, describes site management and field methods, details the technical approach and sampling plans for each site, and describes QA/QC requirements for sample collection, sample analysis, data assessment, corrective action, and reporting.

Volume III, the Health and Safety Plan (HASP), outlines health and safety procedures for field tasks. The HASP includes material safety data sheets for chemicals that may be encountered at the site and provides emergency information and telephone numbers. The Community Relations Plan (CRP) (Volume IV), to be completed at a later date, describes procedures and schedules for public meetings, public comment, and methods of keeping the community informed.

Volumes I through III of the RI/FS planning documents have been prepared by ABB-ES under the CLEAN contract (CTO-031). The format and scope of these documents are in compliance with the 1988 *RI/FS Guidance under Superfund Interim Guidance on Preparing Community Relation Plans*, the Navy IR Program Manual of 1988, and the Navy IR QA Manual of 1988.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
ADEM	Alabama Department of Environmental Management
AFFF	Aqueous Film Forming Foam
ARAR	Applicable or Relevant and Appropriate Requirements
ASCII	American Standard Code for Information Interchange
AVGAS	aviation gasoline
AWQC	Ambient Water Quality Criteria
AWTP	abandoned wastewater treatment plant
BCF	Bioconcentration Factor
bls	below land surface
BW	body weight
CAS	Chemical Abstract Service
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
cm/sec	centimeters per second
CPCs	contaminants of potential concern
COC	contaminants of concern
CRP	Community Relations Plan
CTO	Contract Task Order
CWA	Clean Water Act
DERA	Department of Defense Environmental Restoration Account
DERP	Department of Defense Environmental Restoration Program
DOD	Department of Defense
DQOs	data quality objectives
EIC	Engineer-in-Charge
F&W	fish & wildlife
FCAG	Federal Criteria, Advisors, and Guidance
FDER	Florida Department of Environmental Regulation
FFS	focused feasibility study
FICCDC	Federal Interagency Coordinating Committee for Digital Cartography
FID	Flame Ionization Detector
FR	Federal Register
FSP	Field Sampling Plan
FSS	Focused Feasibility Study
ft/ft	foot per feet
ft/day	foot per day
ft^3/s	cubic feet per second
$ft^3/s/mi^2$	cubic feet per second per square mile

GLOSSARY (Continued)

GAC	granular activated carbon
GC/MS	gas chromatograph/mass spectrometry
GPR	ground-penetrating radar
gpm	gallons per minute
gpm/ft	grams per minute per feet
HASP	Health and Safety Plan
HEAST	Health Effects Assessment Summary Tables
HI	hazard indices
HQ	hazard quotient
HRS	Hazard Ranking System
IR	Installation Restoration
IRIS	Integrated Risk Information System
Jordan	E.C. Jordan Company
LOEL	lowest observed effect level
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MEK	methyl ethyl ketone
mg/ℓ	milligrams per liter
mg/kg	milligrams per kilogram
μg/ℓ	micrograms per liter
μg/kg	micrograms per kilogram
NAAS	Naval Auxiliary Air Station
NACIP	Naval Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NCP	National Contingency Plan
ND	non detects
NDI	Nondestructive Inspection
NEESA	Naval Energy and Environmental Support Activity
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
O&M	operating and maintenance
OLF	Outlying Landing Field
OPNAVINST	Operations Naval Instruction
OVA	organic vapor analyzer
PA	Preliminary Assessment
PAHs	polynuclear aromatic hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability

GLOSSARY (Continued)

PCBs	Polychlorinated Biphenyls
PDE	potential dietary exposure
POL	petroleum, oils, and lubricants
PSC	Potential Source of Contamination
QA/QC	quality assurance/quality control
QSAR	Quantitative Structure Activity Relationship
RAGS	Risk Assessment Guidance for Superfund
RfD	reference doses
ROD	Record of Decision
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
RTVs	Reference Toxicity Values
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDN	Site Discovery Notification
SF	slope factors
SFF	Site Foraging Frequency
SOPs	Standard Operating Procedures
SOUTHNAVFAC-ENGCOM	Southern Division Naval Facilities Engineering Command
SI	Site Inspection
SQC	Sediment Quality Criteria
SVOCs	semivolatile organic compounds
SWDA	Solid Waste Disposal Act
TAL	target analyte list
TBC	to be considered
TBD	total body dose
TCL	target compound list
TOC	total organic carbon
TRC	Technical Review Committee
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USTs	underground storage tanks
VOCs	volatile organic compounds
WWTP	Wastewater Treatment Plant
WWII	World War II

1.0 INTRODUCTION

1.1 PURPOSE AND REGULATORY SETTING. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), and as directed in Executive Order 12580 of January 1987, the Department of Defense (DOD) conducts an Installation Restoration (IR) Program for evaluating and remediating problems related to releases and disposal of toxic and hazardous materials at DOD facilities. The Naval Assessment and Control of Installation Pollutants (NACIP) program was developed by the Navy to implement the IR Program for all Naval and Marine Corps facilities. The NACIP program was originally conducted in three phases: (1) Phase I, Initial Assessment Study, (2) Phase II, Confirmation Study (including a Verification Step and a Characterization Step), and (3) Phase III, Planning and Implementation of Remedial Measures. The three-phase IR Program was modified in 1987-88 to be congruent with CERCLA and SARA. The updated nomenclature for the Remedial Investigation/Feasibility Study (RI/FS) process is as follows:

- Site Discovery Notification,
- Preliminary Assessment and Site Inspection,
- Remedial Investigation,
- Feasibility Study, and
- Planning and Implementation of Remedial Design.

As a component of the IR Program a Preliminary Assessment (PA) was conducted at Outlying Landing Field (OLF) Barin subsequent to the Site Discovery Notification (SDN) by the Naval Energy and Environmental Support Activity (NEESA) in December 1988. Five potential contaminant sources (sites) were identified and recommended for additional study. As a result, ABB Environmental Services, Inc. (ABB-ES), was contracted by Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) in Amendment 2 of Contract No. N62467-88-C-0382, to implement the next step of the IR program, a Site Inspection (SI) of the five identified sites. The overall purpose of the SI was to characterize the five identified sites with potential for contamination and/or contaminant migration, and either eliminate sites from further consideration within the IR Program (i.e., due to the nature and extent of contamination) or plan future response actions including an RI/FS.

Section 105(a)(8)(A) of SARA required the U.S. Environmental Protection Agency (USEPA) to develop criteria to set priorities for remedial action based on relative risk to public health and the environment. To meet this requirement, USEPA has established the Hazard Ranking System (HRS) as Appendix A to the National Contingency Plan (NCP). The HRS is a scoring system designed to assess relative threat due to documented or potential releases at a site. First promulgated in 1982, the HRS was amended in December 1990, effective March 14, 1991 (55 Federal Register FR No. 241:51532-51667), to comply with requirements of Section 105(c)(1) of SARA to increase the accuracy of the assessment of relative risk. The newly promulgated HRS II has been substantially revised and is designed to prioritize sites after the SI phase of the CERCLA process. The SI or extended SI is used to present the required data to expeditiously perform

an HRS II ranking. At present (April 1992) the HRS II score for OLF Barin is being generated and should be submitted to USEPA for review in May 1992.

Based on the results of the SI, a Phase I Remedial Investigation was recommended to more completely describe the nature and extent of contamination at the five identified sites and to verify the contamination status of five additional sites identified during and after the SI. ABB-ES was contracted under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) contract (contract number N62467-89-D-0317, Contract Task Order Number [CTO] No. 31) to prepare an RI/FS Workplan for all 10 sites.

The purpose of the OLF Barin RI/FS is to identify a range of remedial alternatives to address any identified risk to public health and the environment posed by contaminants present due to past waste disposal activities or spill sites. To achieve this objective the RI must collect data sufficient to assess the nature and distribution of contaminants associated with each site and identify unacceptable human health and/or environmental risks. The FS will use the data collected in the RI to screen, evaluate, and select remedial alternatives to provide permanent, feasible solutions to environmental contamination problems at OLF Barin.

1.2 SCOPE. As a result of previous investigations at OLF Barin, five sites were identified and recommended for further investigation. An additional five sites were later identified during and after the SI. The sites are identified as follows.

Previously Identified Sites

Site 19B, Former Hangar Maintenance Area
Site 20B, Abandoned Underground Storage Tanks and Fuel Pit Area,
Site 21B, Rubble Landfill
Site 22B, Old Firefighting Demonstration Area
Site 23B, Drainage Ditch Leading to Sandy Creek

Sites Identified during or after the SI

Site 24B, Abandoned Firefighting Training Area
Site 25B, Machine Gun Butt
Site 26B, Abandoned Wastewater Treatment Plant
Site 27B, Uncontrolled Dump Site
Site 28B, Fuel Pit Drainage Ditch

Site histories, descriptions, and results of previous investigations are presented in Section 4.0. To adequately characterize and quantify the extent of contamination an extensive RI field investigation was developed. The scope of activities to be conducted during the RI field investigation include:

- background sampling and reconnaissance,
- surface water and sediment sampling,
- soil gas survey,
- geophysical investigations,

- test pitting and soil sampling,
- monitoring well installation and groundwater sampling, and
- aquifer characterization.

Sampling and exploration objectives, rationale, locations, methods, and techniques for the above activities are detailed in Sections 5 and 6 of this Workplan and in the Sampling and Analysis Plan (SAP).

1.3 OVERVIEW OF PLANNING DOCUMENTS (VOLUMES I THROUGH IV). The planning documents to support the RI/FS program consist of four volumes:

Volume I, RI/FS Workplan;
Volume II, SAP (incorporates both the Field Sampling Plan [FSP] and Quality Assurance Project Plan [QAPP]);
Volume III, Health and Safety Plan (HASP); and
Volume IV, Community Relations Plan (CRP).

Together the four volumes present the scope of the RI/FS program. The Workplan (Volume I): provides a record of site history, describes regional environmental factors, details previous investigative results, describes data quality objectives (DQOs), RI/FS tasks, site-specific investigative methodology, and project organization and schedule.

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Volumes I through III of the RI/FS planning documents have been prepared by ABB-ES under the CLEAN contract (CTO-031). The format and scope of these documents are in compliance with the 1988 RI/FS Guidance under Superfund, Interim Guidance for preparing Community Relations Plans, the Navy IR Program Manual of 1988, and the Navy IR QA Manual of 1988.

2.0 ACTIVITY DESCRIPTION

2.1 LOCATION OF INSTALLATION. OLF Barin is located in Baldwin County, Alabama, 40 miles southeast of Mobile, Alabama. It is approximately 10 miles north-northeast of Gulf Shores, Alabama, and 35 miles west of Pensacola, Florida, near the Gulf of Mexico coast (Figure 2-1). Presently, OLF Barin consists of approximately 490 acres, considerably less than the nearly 1,000 acres that comprised the station during World War II (WWII) and the Korean Conflict. A major part of the land within the activity boundaries is used for three active airstrips.

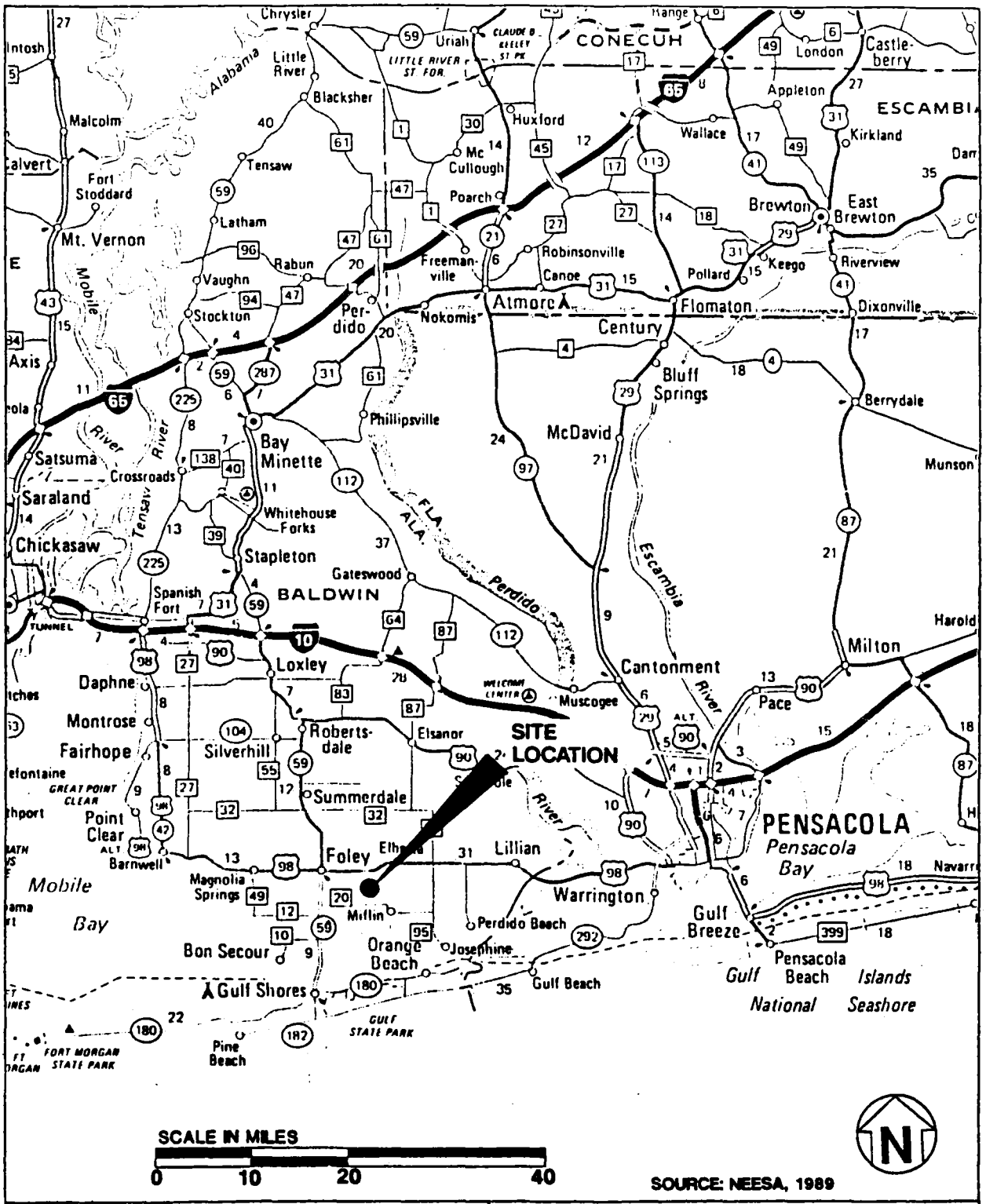
2.2 INSTALLATION LAYOUT. The Foley, Alabama, municipal airport was leased from the city of Foley and commissioned by the U.S. Navy as the Naval Auxiliary Air Station (NAAS) Barin on December 5, 1942. The airport consisted of three airstrips covering 310 acres that became the OLF Barin West Field. The Navy acquired another 655 acres east of the original airport to build another three airstrips (East Field) and an administrative and housing area. Figure 2-2, taken from the PA (NEESA, 1989) depicts the layout of NAAS Barin during WWII.

2.3 INSTALLATION OWNERSHIP AND MISSION. After commissioning, NAAS Barin was used for basic and advanced flight training and as an indoctrination center for enlisted personnel. During WWII, NAAS Barin grew to include 4 large aircraft hangars, an underground refueling system with 8 tanks (25,000-gallon capacity) connected to about 2 miles of fuel lines, and 60 fuel pits (paved areas of the aircraft parking apron used to refuel) planes, as well as approximately 65 structures used to support station personnel, and 6 active airstrips.

NAAS Barin was deactivated on January 5, 1947, and remained closed until the Korean Conflict. Reopened in 1952, the airfield again functioned as a training facility until 1959. Upon closing in 1959, the original airstrip area west of the facility was transferred back to the City of Foley. The majority of the installation buildings were either sold or dismantled at this time. The east field remained unoccupied until 1985. At that time, pilots from Naval Air Station (NAS) Whiting Field, Milton, Florida, began using the field for "touch-and-go" practice. NAS Whiting Field began construction of a crash crew building in 1985 and the field was officially reopened in May 1988 and renamed OLF Barin.

Under the command of NAS Whiting Field, OLF Barin functions as a practice landing strip for pilots training at NAS Whiting Field. A major part of the land within the activity boundaries is used for three active airstrips. A small part of the field is occupied by station personnel as operational buildings and equipment storage. A small contingent of firefighters (63 personnel) is assigned to the station to be on hand in case of an aircraft accident. This is the only currently ongoing activity at OLF Barin. The remaining acreage consists primarily of mowed and open grasslands and pine plantations. Figure 2-3, adapted from NEESA (1989), shows the current layout of OLF Barin as well as the identified sites of potential contamination.

2.4 REGULATORY HISTORY. SARA, Section 211 (1986), provides continued authority for the DOD Environmental Restoration Program (DERP) and the DOD Environmental Restoration Account (DERA). The Navy IR Program is authorized by Operations



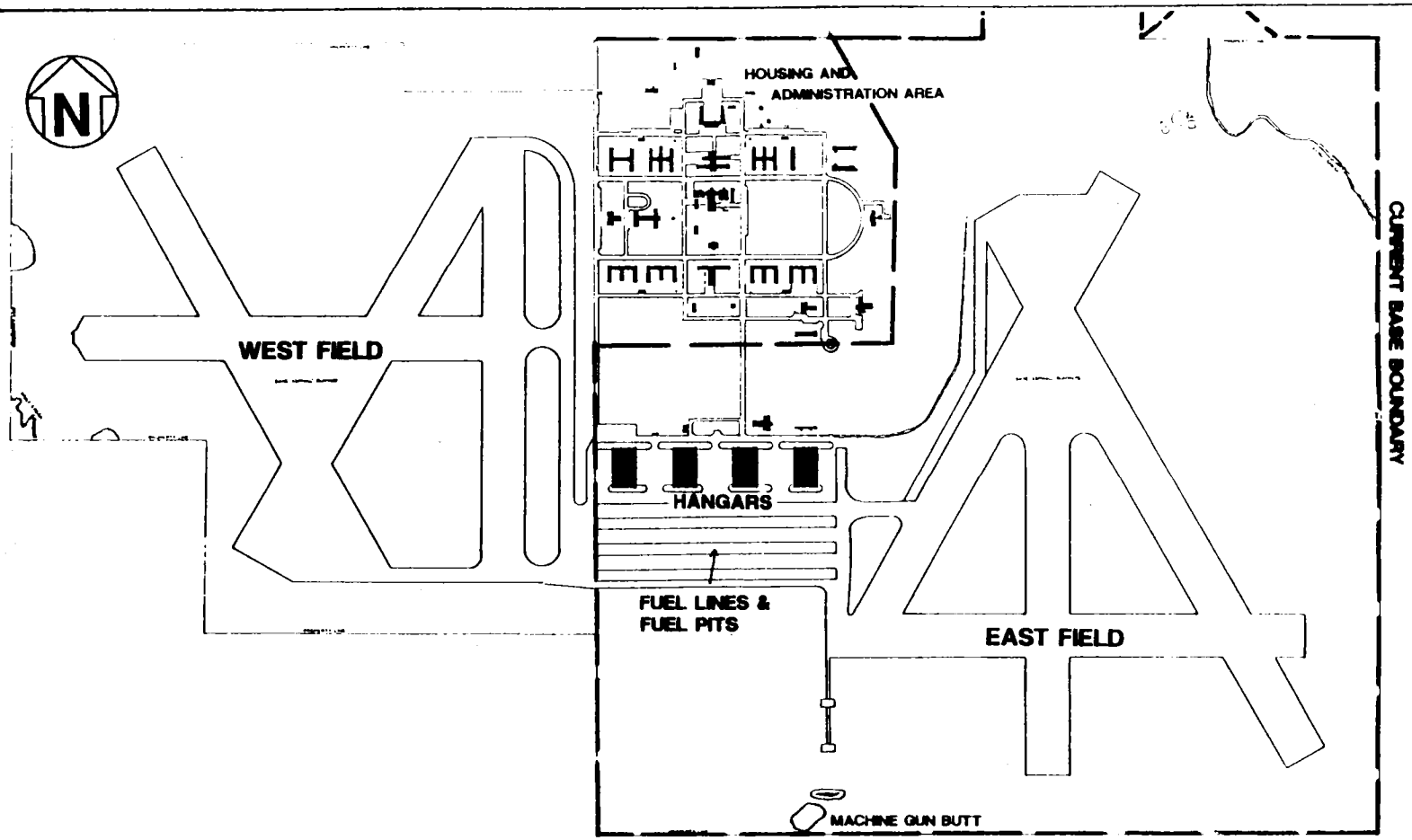
SOURCE: NEESA, 1989

FIGURE 2-1

LOCATION OF OLF BARIN

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA



APPROX. SCALE

0 600 1,200

SOURCE: NEESA, 1989

FIGURE 2-2

HISTORICAL SITE SKETCH

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

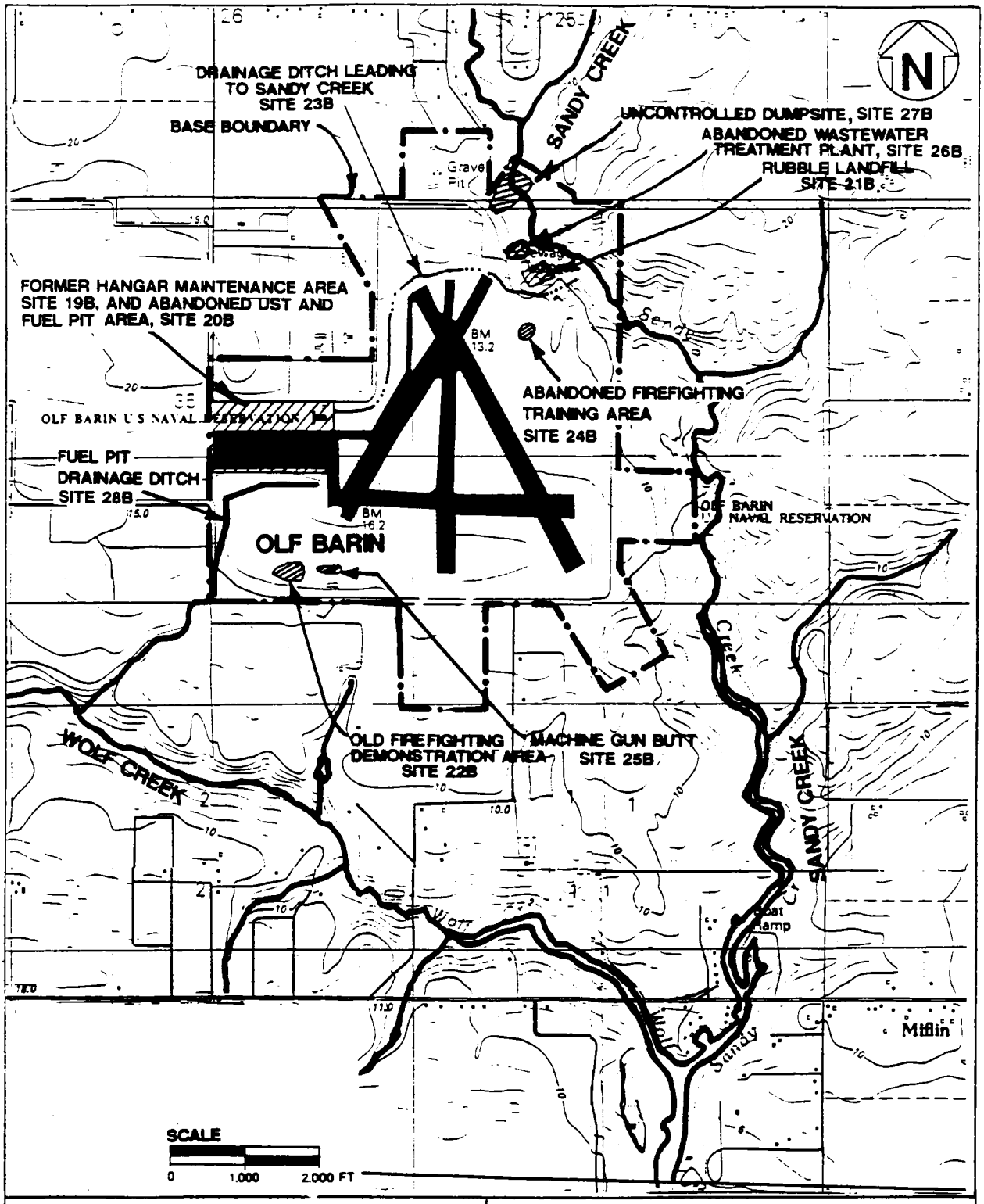


FIGURE 2-3
LOCATION OF REMEDIAL INVESTIGATION STUDY AREAS

SOURCE: MODIFIED FROM USGS 7.5' QUADRANGLE MAP, FOLEY AL, (1980 a)

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

Naval Instruction (OPNAVINST) 5090.1 of May 26, 1983. SOUTHNAVFACENGCOM manages the Navy program.

SOUTHNAVFACENGCOM tasked NEESA to conduct a PA for each Navy and Marine Corps facility listed on the Federal Agency Hazardous Waste Compliance Docket as required by SARA Section 120.

The PA for OLF Barin began with investigation and review of available records at NEESA and SOUTHNAVFACENGCOM. After the record search the PA team, composed of NEESA personnel, visited OLF Barin in December 1988 to complete documentation of past and present operations and disposal practices. The PA completed in February 1989 identified and recommended five potential contaminant sources for additional study (NEESA, 1989).

An SI of the five identified potential sources was the next step prescribed by the Navy's IR Program. A final workplan for the OLF Barin SI was developed in March 1990 by E.C. Jordan Company (Jordan) under contract to SOUTHNAVFACENGCOM. The SI field program was conducted during the period April through June 1990 and the SI report completed in October 1991.

2.5 REMEDIAL ACTIONS TO DATE. During WWII and again during the Korean Conflict, NAAS Barin was used for training and aircraft maintenance. Numerous types of aircraft fuel, solvents, petroleum, oils, and lubricants (POL) were used by maintenance personnel in these operations.

In August 1988, a drinking water supply well located at OLF Barin was discovered to be contaminated with trans-1,2-dichloroethylene, tetrachloroethylene, and trichloroethylene. Granular activated carbon (GAC) filters were installed to remove the above-mentioned organic contaminants detected in the groundwater from the water supply well. The State of Alabama permitted the use of the well by the OLF Barin personnel after the GAC filtering system and monitoring program were put in place. The installation of the GAC treatment system does not constitute a permanent remedial measure.

As a result of past flight and aircraft maintenance operations, 19 abandoned POL underground storage tanks (USTs) existed at OLF Barin. Remedial action plans and specifications for removal and closure of these tanks were prepared by ERC Environmental and Energy Services Company from Nashville, Tennessee, in July 1990. Removal of the tanks was completed in January 1992 by Barnes Electric from Pensacola, Florida.

3.0 ENVIRONMENTAL SETTING

This section presents a description of the environmental and demographic setting at OLF Barin and adjacent southern Baldwin County, Alabama. This section represents a synthesis of general background information provided mainly by the U.S. Geological Survey (USGS) and the Alabama Geological Society, as well as the U.S. Soil Conservation Service and Baldwin County Chamber of Commerce. Site-specific hydrogeologic information collected during the SI field program is also presented, as applicable, to characterize the environmental setting at OLF Barin.

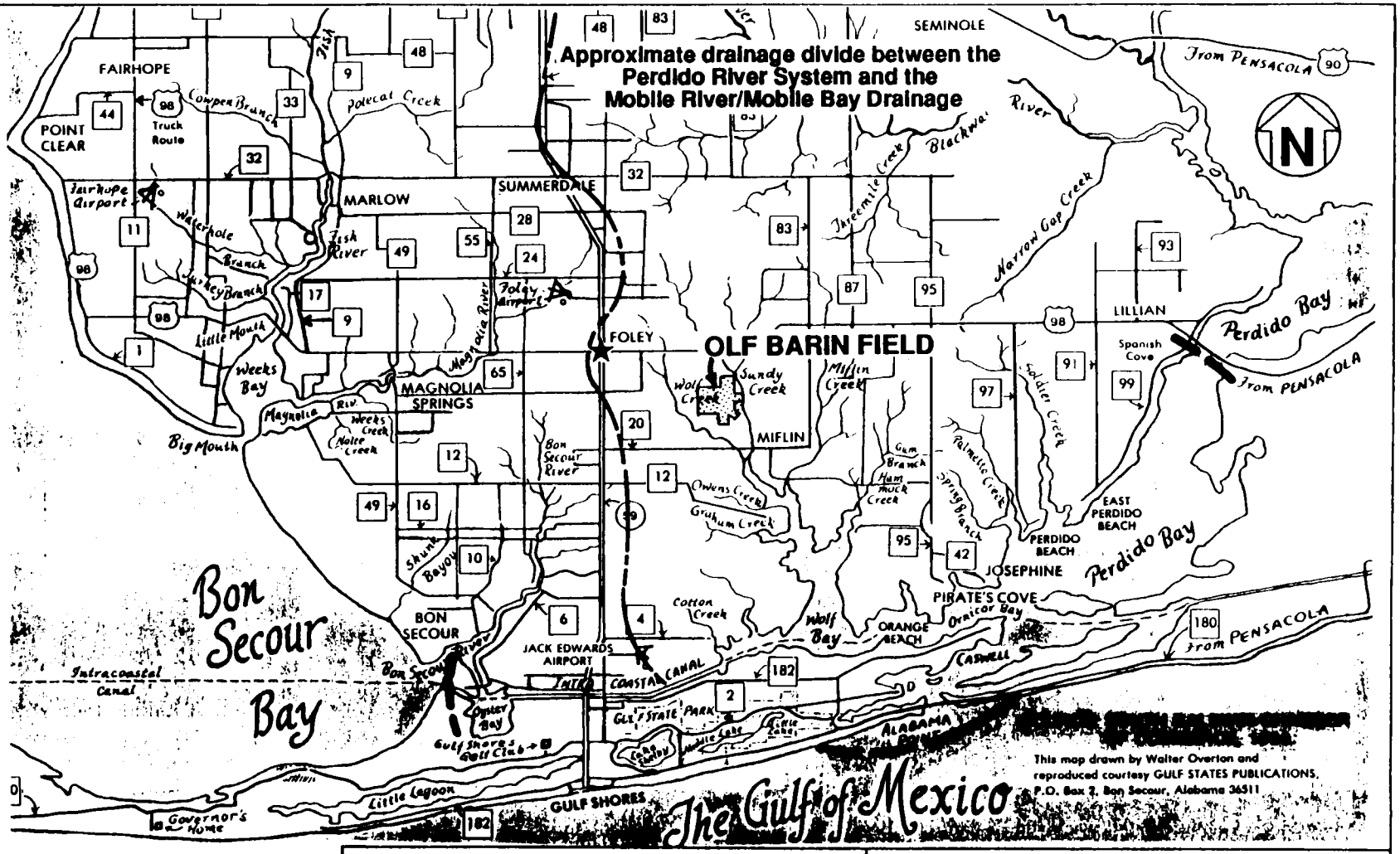
3.1 TOPOGRAPHY. OLF Barin is located in the Southern Pine Hills/Coastal Lowlands District Region, which is part of the East Gulf Coastal Plain part of the Coastal Plain Physiographic Province. Elevations at OLF Barin, taken from the Foley and Elberta, Alabama, USGS quadrangle maps (7.5 minute) (USGS, 1980a; 1980b), range from 10 feet (3.1 meters) to 53 feet (16.2 meters) above the National Geodetic Vertical Datum (NGVD) of 1929. The station is characterized by a relatively flat topographic surface, except in the extreme eastern part where topography slopes steeply down to the narrow floodplain of Sandy Creek. The land surrounding OLF Barin slopes slightly upward to the north with the highest elevations at approximately 100 feet (31 meters) above NGVD to the north of the towns of Foley and Elberta, Alabama. In general, the major relief features are the floodplains of Sandy Creek and Wolf Creek. The land surface reaches mean sea level in the salt marshes and coastal swamp forests adjacent to Wolf Bay.

3.2 SURFACE HYDROLOGY. OLF Barin is located in USGS Hydrologic Unit 03140107, an Eastern Coastal Unit adjacent to the Perdido River Drainage Basin (O'Neil and Mettee, 1982). The Perdido River flows south from Alabama and forms the border between Baldwin County, Alabama, and Escambia County, Florida. Figure 3-1 is a map of the southern part of Baldwin County. As shown, the Perdido River System becomes a long southwesterly trending estuarine system that opens to the Gulf of Mexico among a series of barrier islands. As shown in Figure 3-1, the southeastern part of Baldwin County, which makes up the Eastern Coastal Unit, drains to the Perdido Bay estuarine system via a series of creeks and bayous.

The western part of Baldwin County drains westerly into Mobile Bay. Wolf Creek and Sandy Creek have drainage areas upstream of OLF Barin estimated as 10.91 and 13.54 square miles, respectively. No USGS streamflow gauging stations exist on either Wolf Creek or Sandy Creek.

O'Neil and Mettee (1982), in their assessment of coastal hydrology of the Mobile Bay area, estimated unit runoff in the Perdido River Basin and the Fish River at an average annual flow of approximately 2.0 cubic feet per second per square mile ($ft^3/s/mi^2$) based on the following gauging locations.

- Perdido River at Barrineau Park, Florida (1942-1967), 1.96 $ft^3/s/mi^2$;
- Styx River at Loxby, Alabama (1952-1962), 1.94 $ft^3/s/mi^2$; and
- Fish River near Silverhill, Alabama (1954-1962), 2.16 $ft^3/s/mi^2$.



15 RIVER MILES FROM OLF BARIN

APPROXIMATE SCALE IN MILES

0 1.5 3 6

FIGURE 3-1

OVERALL SURFACE HYDROLOGIC FEATURES OF SOUTHERN BALDWIN COUNTY, ALABAMA

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN FOLEY, ALABAMA

Overall land use, topography, and, therefore, runoff relationships would be expected to be similar for the non-tidal reaches of Wolf Creek and Sandy Creek.

Using these assumptions, the average annual discharge of Wolf Creek and Sandy Creek can be estimated as 22 cubic feet per second (ft^3/s) and 27 ft^3/s, respectively.

The installation is drained by Wolf Creek to the west and Sandy Creek to the east (Figure 3-1). Both streams flow to the south-southeast into Wolf Bay. No other naturally occurring bodies of surface water that can receive flow from the station appear to be located within the immediate vicinity of OLF Barin. Several man-made ditches are located throughout the former aircraft maintenance and runway areas that convey drainage to the east into Sandy Creek. Runoff from a part of the southern half of the runways flows overland into Wolf Creek. Overland flow distances from the former operational areas of OLF Barin to the streams are relatively great. Runoff from the former fuel storage system, the north side of the former hangar areas, and the administrative area was collected in drainage ditches that flowed for approximately 5,500 feet before discharging to Sandy Creek. Runoff from the former aircraft parking areas and the southern part of the former hangar areas flows for 4,000 to 4,500 feet overland before discharging into Wolf Creek. Runoff from the area of the Machine Gun Butt and Old Firefighting Demonstration Area travels 4,000 feet overland before discharging to Wolf Creek. The Abandoned Wastewater Treatment Plan (WWTP) and Rubble Landfill are located within 200 feet of Sandy Creek. An unrestricted dumping area (Uncontrolled Dumpsite) located just north of the WWTP is just above and possibly on the banks of Sandy Creek.

Because of the relatively small drainage basins of Wolf and Sandy Creeks above OLF Barin, and the steep slopes from the installation to the thalweg of the streams, only a small part of the northeastern part of OLF Barin is within the 500-year or 100-year floodplain. The 100-year and 500-year floodplains are delineated in Figure 3-2. The Abandoned WWTP and the toe of the Rubble Landfill are near the edge of the 100-year floodplain. An Uncontrolled Dumpsite lies partially within the 100-year floodplain.

According to *Alabama Waste Quality Criteria Use Classification Regulations* (Alabama Water Improvement Commission Regulations, Policies and Procedures Title II, 1982), the waters of Sandy Creek and the estuarine systems are all classified "S", suitable for human body contact recreation as well as "F&W" and/or "SH." "F&W" and "SH" classes are suitable for propagation of fish and wildlife and suitable for taking of shellfish, respectively.

Wolf Creek downstream of the Foley, Alabama, sewage treatment discharge and upstream of Wolf Bay is classified "F&W" only.

3.3 GEOLOGY AND SOILS.

3.3.1 Regional Geologic Setting The geologic setting of Baldwin County, Alabama is characterized by the outcrop of Tertiary and Quaternary sediments. The sedimentary deposits in descending order are: alluvium and low terrace deposits in the Pleistocene and Holocene Series, high terrace deposits in the Pleistocene

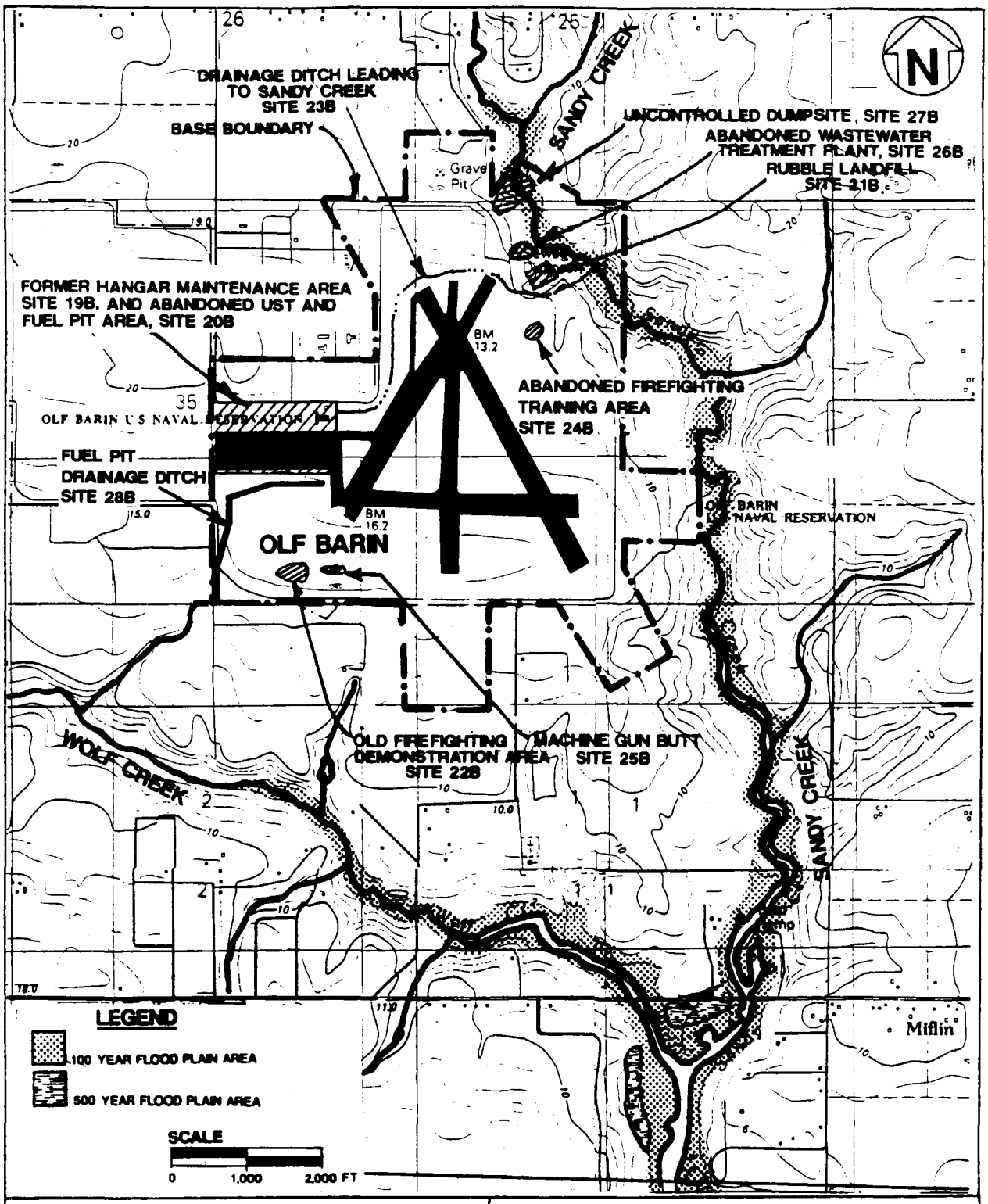


FIGURE 3-2

DELINEATION OF FLOOD PRONE AREAS ADJACENT TO OLF BARIN

SOURCE: MODIFIED FROM USGS 7.5' QUADRANGLE MAP, FOLEY AL. (USGS 1980 a) AND FEMA, 1985

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

Series, the Citronelle Formation in the Pliocene Series and the Miocene Series undifferentiated. A general geologic map of shallow sediments in southeastern Baldwin County is presented in Figure 3-3. Figure 3-4 shows the stratigraphic sequence, extending before and including Miocene age, in southern Baldwin County. The sequence was developed from the log of a boring approximately 10 miles northeast of OLF Barin by O'Neil and Mettee (1982).

Pleistocene and Holocene Series Alluvial Deposits. In lowland areas of Baldwin County low terrace deposits, alluvium, beach and deltaic deposits of Pleistocene and Holocene age can be found. These deposits generally consist of white, gray, orange, and brown locally fossiliferous, very fine to coarse-grained sand that may contain gravel (Reed, 1971). These alluvial deposits are typically less than 50 feet thick.

Pleistocene Series High Terrace Deposits. The high terrace deposits of the Pleistocene Series have been separated by Carlston (1950) into the Coharie and Penholoway terraces. These terraces are generally 5 to 30 feet thick but can be as thick as 50 feet. The terrace deposits consist of white, gray, brownish-red, and orange fine- to coarse-grained sand that may be gravelly (Reed, 1971).

Citronelle Formation. The Citronelle Formation of Pliocene age unconformably overlies the Miocene Series and primarily outcrops in the central and southern parts of Baldwin County. OLF Barin is primarily situated on the outcrop of the Citronelle Formation. Holocene and Pleistocene alluvial deposits are found only in the floodplain of Sandy and Wolf Creeks.

The Citronelle Formation generally consists of dark reddish-brown gravelly sand which locally contains light-gray clay balls and partings, and light gray, orange, and brown sandy clay (Reed, 1971). The thickness of the Citronelle can be as much as 130 feet (Carlston, 1950). In Alabama Geological Map 94 (1971) Philip Reed reported that the base of the Citronelle Formation is marked in many exposures by a dark yellowish-brown limonite-cemented sandstone bed that locally contains gravel.

Miocene Series Undifferentiated. The Miocene Series overlies the Oligocene Series and ranges in thickness from 100 feet in the northern part of Baldwin County (where the series outcrops) to about 3,000 feet in the subsurface in the southernmost part of the county.

The Miocene primarily is composed of light-gray, yellowish-gray, yellow, and white laminated to thin-bedded and massive clay, sand and sandy clay (Reed, 1971). The sands range from fine to very coarse grained, and the upper part of this series (just below the Citronelle) is listed as the major producing formation for public water supplies within Southern Baldwin County, including OLF Barin.

3.3.2 Soils and Drainage Figures 3-5 and 3-6 show the general soil associations for southeastern Baldwin County and the specific soil series on and adjacent to OLF Barin, respectively. Table 3-1 summarizes the drainage and slope characteristics of the soils delineated in Figure 3-5. In general, soils belong to the Lakeland-Plummer or Norfolk-Klej-Goldsboro associations. These are deep soils

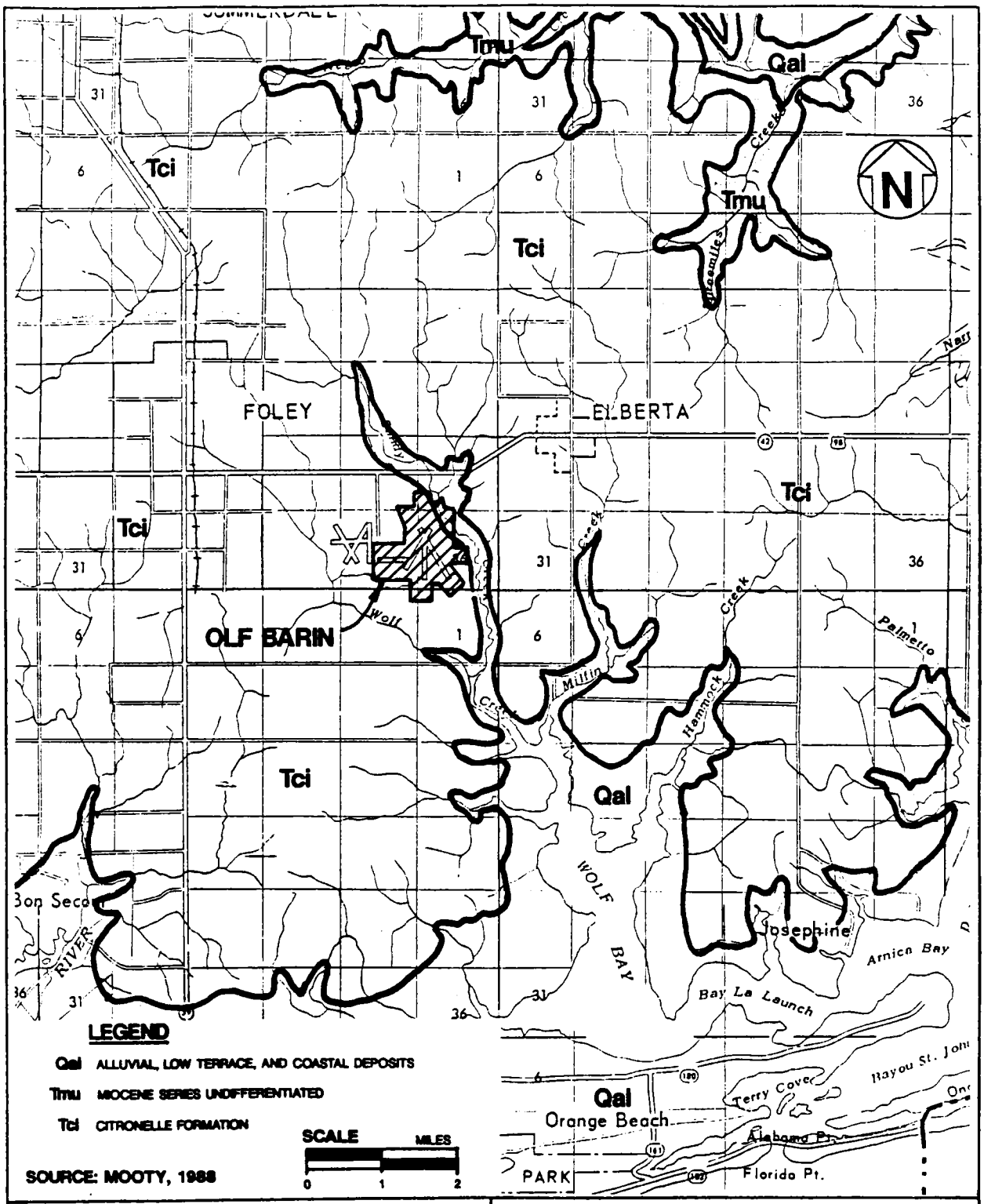


FIGURE 3-3
GENERAL SURFICIAL GEOLOGIC MAP

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

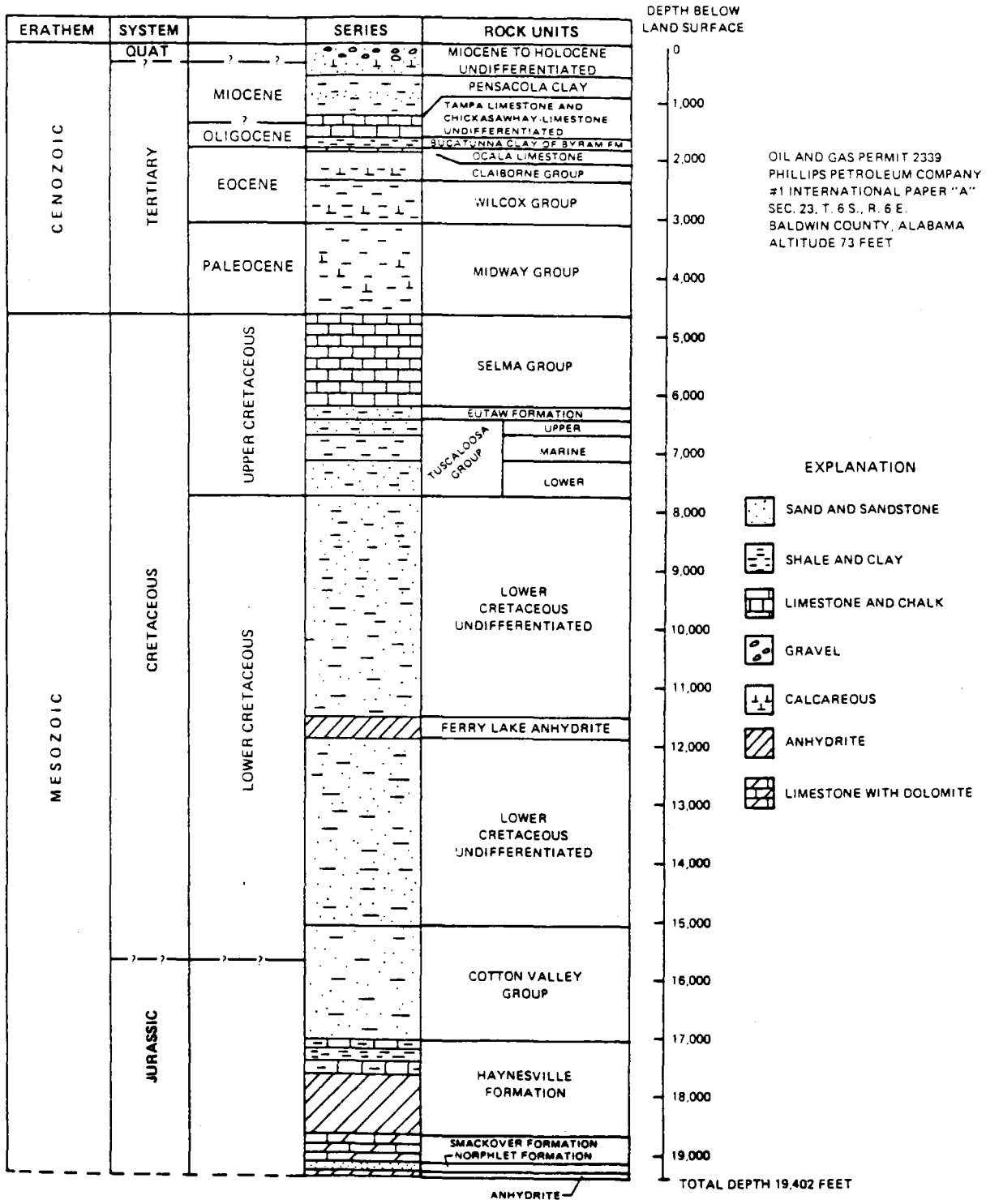
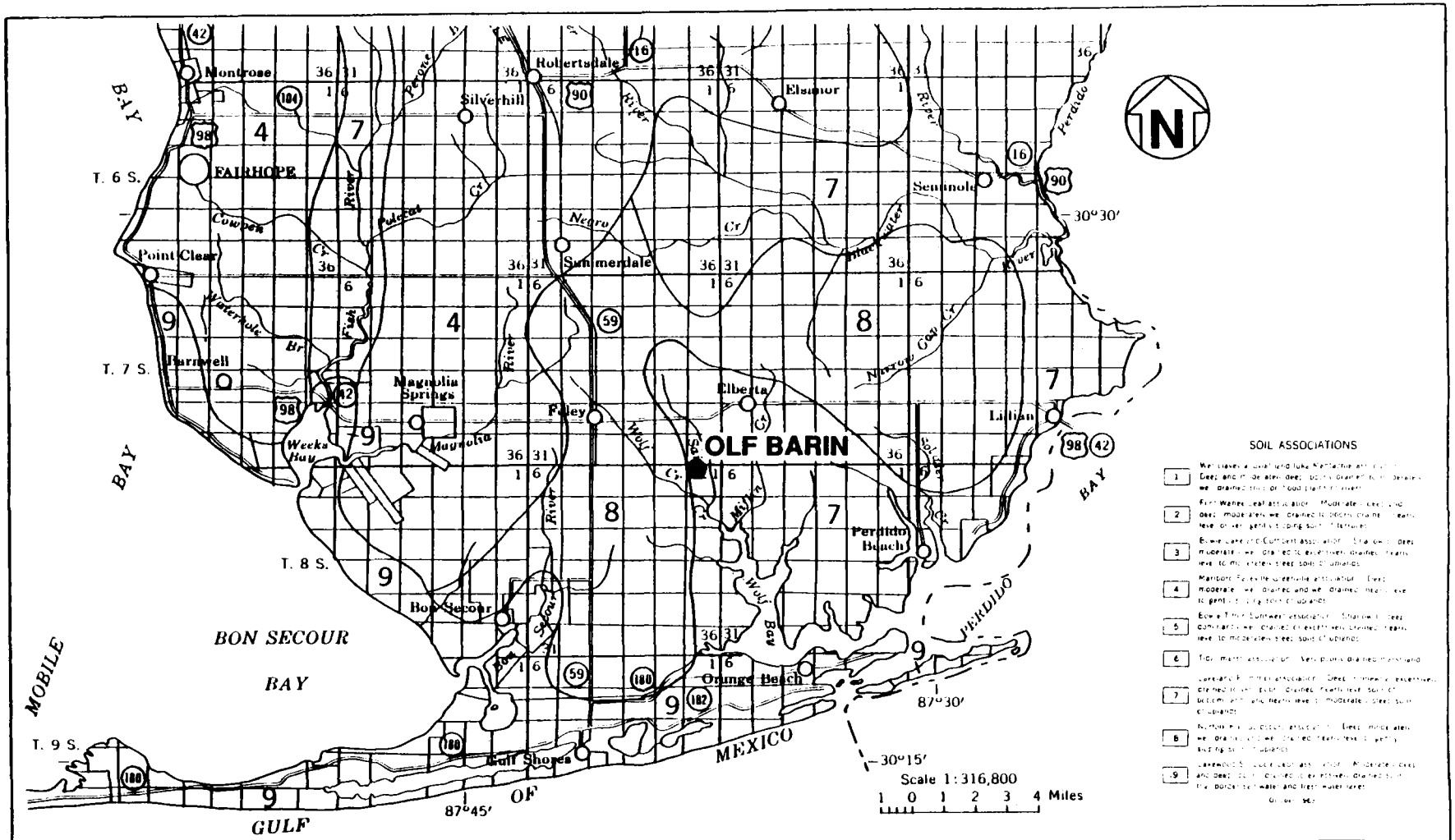


FIGURE 3-4

TYPICAL STRATIGRAPHIC SEQUENCE IN SOUTHERN BALDWIN COUNTY
SOURCE: O'NEILL AND METTEE, 1982

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA



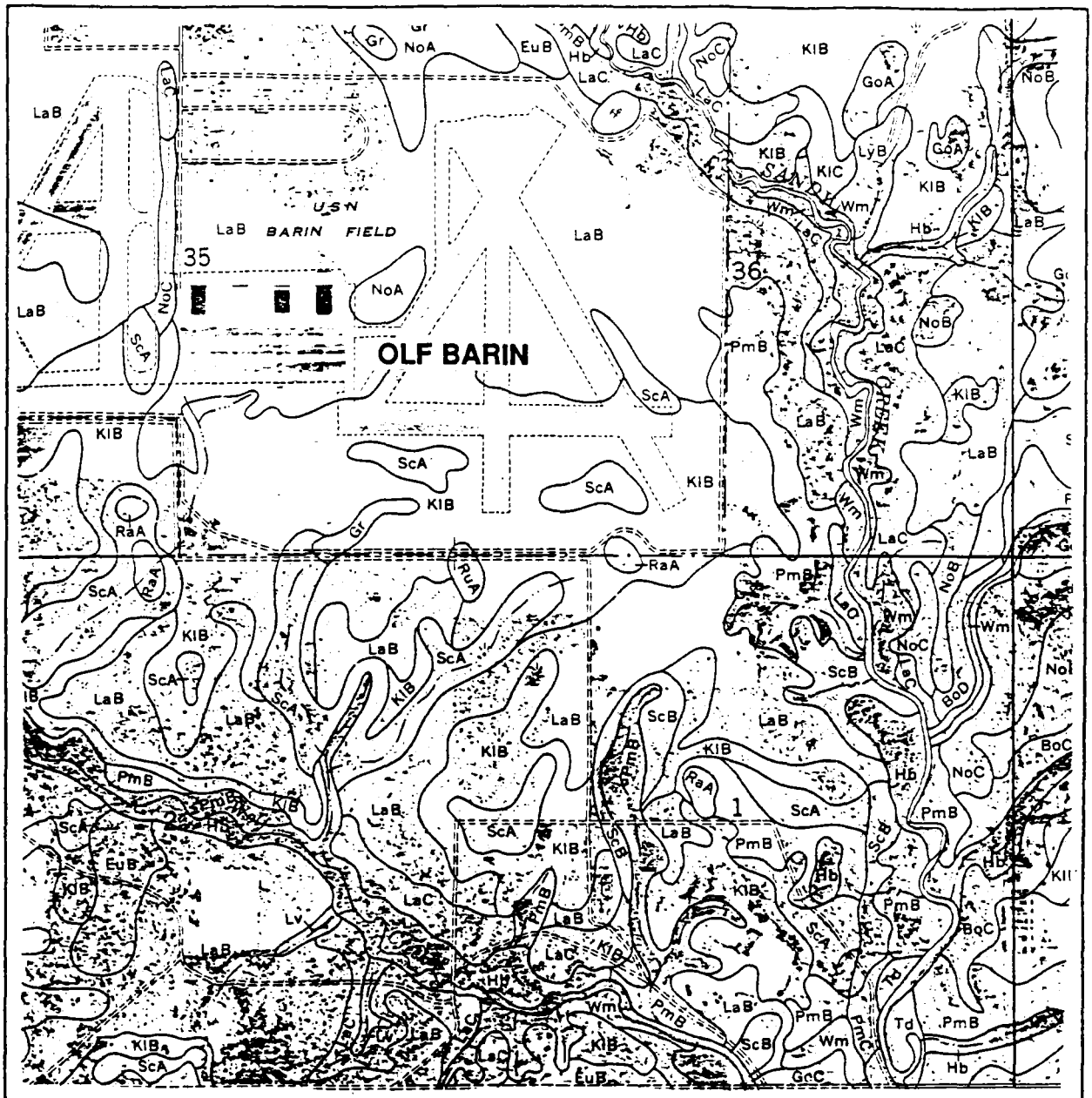
SOURCE:
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ALABAMA DEPARTMENT OF AGRICULTURE AND INDUSTRIES
AND ALABAMA AGRICULTURAL EXPERIMENT STATION

FIGURE 3-5

GENERALIZED SOILS MAP OF SOUTHERN BALDWIN COUNTY

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA



N

APPROXIMATE SCALE IN FEET

0 800 1600 3200

SEE TABLE 3-1 FOR SOIL CLASS KEY
SOURCE: U.S. Dept of Agriculture, Soil Conservation Service General Soils Map, Baldwin County, Alabama.1963

FIGURE 3-6

SOIL TYPES ON AND ADJACENT TO OLF BARIN

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

Table 3-1
Soil Classes On and Adjacent to Outlying Landing Field (OLF) Barin

RI/FS Workplan
OLF Barin, Foley, Alabama

Symbol	Description
BoC	Bowie fine sandy loam, 5 to 8 percent slopes
EuB	Eustis loamy fine sand, 0 to 5 percent slopes
GoA	Goldsboro fine sandy loam, 0 to 2 percent slopes
Gr	Grady soils
Hb	Hyde and Bayboro soils and muck
KlB	Klej loamy fine sand, 0 to 5 percent slopes
KlC	Klej loamy fine sand, 5 to 8 percent slopes
LaB	Lakeland loamy fine sand, 0 to 5 percent slopes
LaC	Lakeland loamy fine sand, 5 to 8 percent slopes
Lv	Local alluvial land
LyB	Lynchburg fine sandy loam, 2 to 5 percent slopes
NoA	Norfolk fine sandy loam, 0 to 2 percent slopes
NoC	Norfolk fine sandy loam, 5 to 8 percent slopes
PmB	Plummer loamy sand, 0 to 5 percent slopes
RaA	Rains fine sandy loam, 0 to 2 percent slopes
RuA	Ruston fine sandy loam, 0 to 2 percent slopes
ScA	Scranton loamy fine sand, 0 to 2 percent slopes
ScB	Scranton loamy fine sand, 2 to 5 percent slopes
Td	Tidal marsh
Wm	Wet loamy alluvial land

Source: U.S. Department of Agriculture, Soil Conservation Service, General Soils Survey, Baldwin County, Alabama, 1963.

that occur on the nearly level to gently sloping surfaces of uplands. Lakeland-Plummer association soils are characterized as soils occurring on poorly drained, level bottom lands extending, however, to excessively drained uplands and slopes.

The Norfolk-Klej-Goldsboro Association consists of deep, moderately well-drained soils to well-drained soils that occur in uplands. Figure 3-6, which shows the detailed soil classes, indicates a predominance of Lakeland loamy fine sand comprising the soil making up most of OLF Barin. South and southeast of the runways are areas of Scranton loamy fine sand.

Lakeland soils have a permeability of 6.0 to 20 inches per hour (U.S. Department of Agriculture, Soil Conservation Service, 1962). Clay content increases as a function of depth in typical Lakeland soils from 10 percent or less at the surface to up to 35 percent at depths greater than 4 feet. This lowers permeability below the surface by up to an order of magnitude. As discussed in Section 3.3.3, the surface stratigraphic sequence shows some silt and clay content in the upper 5 feet of the onsite soil borings.

Alluvial, fine-grained, poorly drained soils are found in the floodplains of both Sandy Creek and Wolf Creek. These are areas with low infiltration rates. The upland soils on and adjacent to OLF Barin are sandy loams to loamy, fine sands and are characterized as medium- or coarse-textured soils with moderate to high infiltration rates. No silty loams, silts, or sandy clays appear to be present.

The surface drainage patterns at OLF Barin are modified due to the presence of storm drainage ditches, mainly for the runways. The ditches, interpreted flow directions, and drainage basin delineations are shown in Figure 3-7 in relation to the identified sites.

3.3.3 Site-Specific Geologic Setting Based on regional geological information presented in Section 3.3.1, the upper 100 feet of the geological matrix at OLF Barin is expected to consist of the Pleistocene and Holocene alluvium near the creek systems and the Pliocene age Citronelle Formation on the upland terraces. The stratigraphy to a depth of 100 feet bls was explored during the 1990 SI field program by means of three borings (WHF-19B-1D through WHF-19B-3D). Five other borings (WHF-20B-1 through WHF-20B-5) were installed to depths of 18 to 22 feet bls. These borings were installed in the western half of OLF Barin (Figure 3-8) to evaluate the stratigraphy, soil, and groundwater contamination status.

Figure 3-9 shows the interpreted north to south and east to west stratigraphy at OLF Barin for the two cross sections located as shown in Figure 3-8. Boring logs for the SI soil explorations are contained in Appendix A of the SI report. These logs show a thin series of deposits generally ranging from silts and silty sand with some clay to coarse sand interspersed with a few gravel lenses. The matrix typically consists of fine- to medium-grained sands. The only significant clay was found at boring WHF-19B-2D at the southern boundary of OLF Barin. This consisted of a set of sandy clay layers lying from approximately 30 to 41.4 feet bls. These layers consisted of red, orange, tan, and brown to tan clay mixed with medium to fine sand and small amounts of gravel at approximately 35 feet. At 56 feet, boring WHF-19B-2D encountered a 0.2-foot thick hardpan layer which may be the base of the Citronelle Formation. As discussed in Section 3.3.1

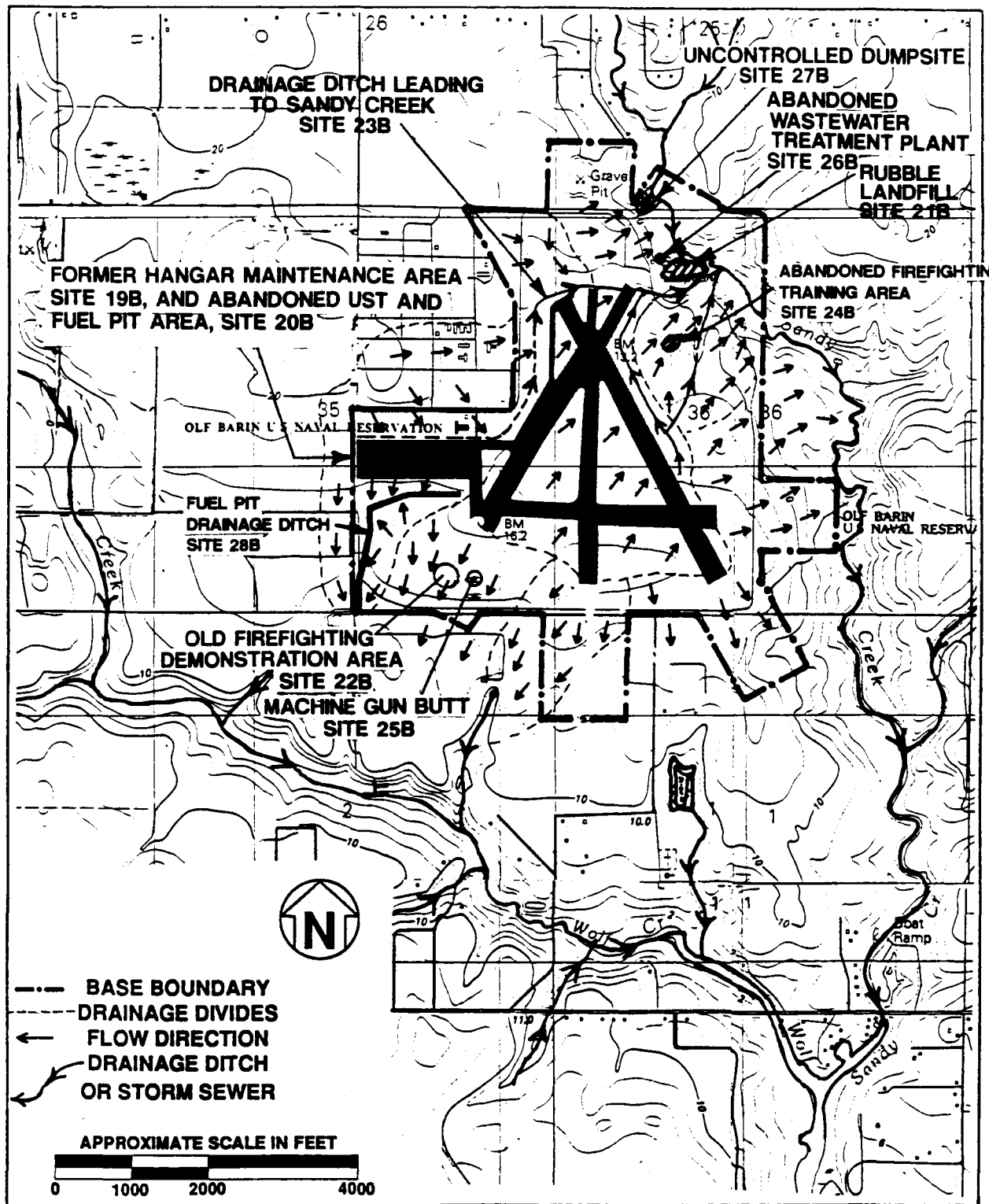


FIGURE 3-7

STORMWATER DRAINAGE AREAS AT OLF BARIN

SOURCE: ADAPTED FROM USGS 7.5' QUADRANGLE MAP FOLEY, AL (1980 a)

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

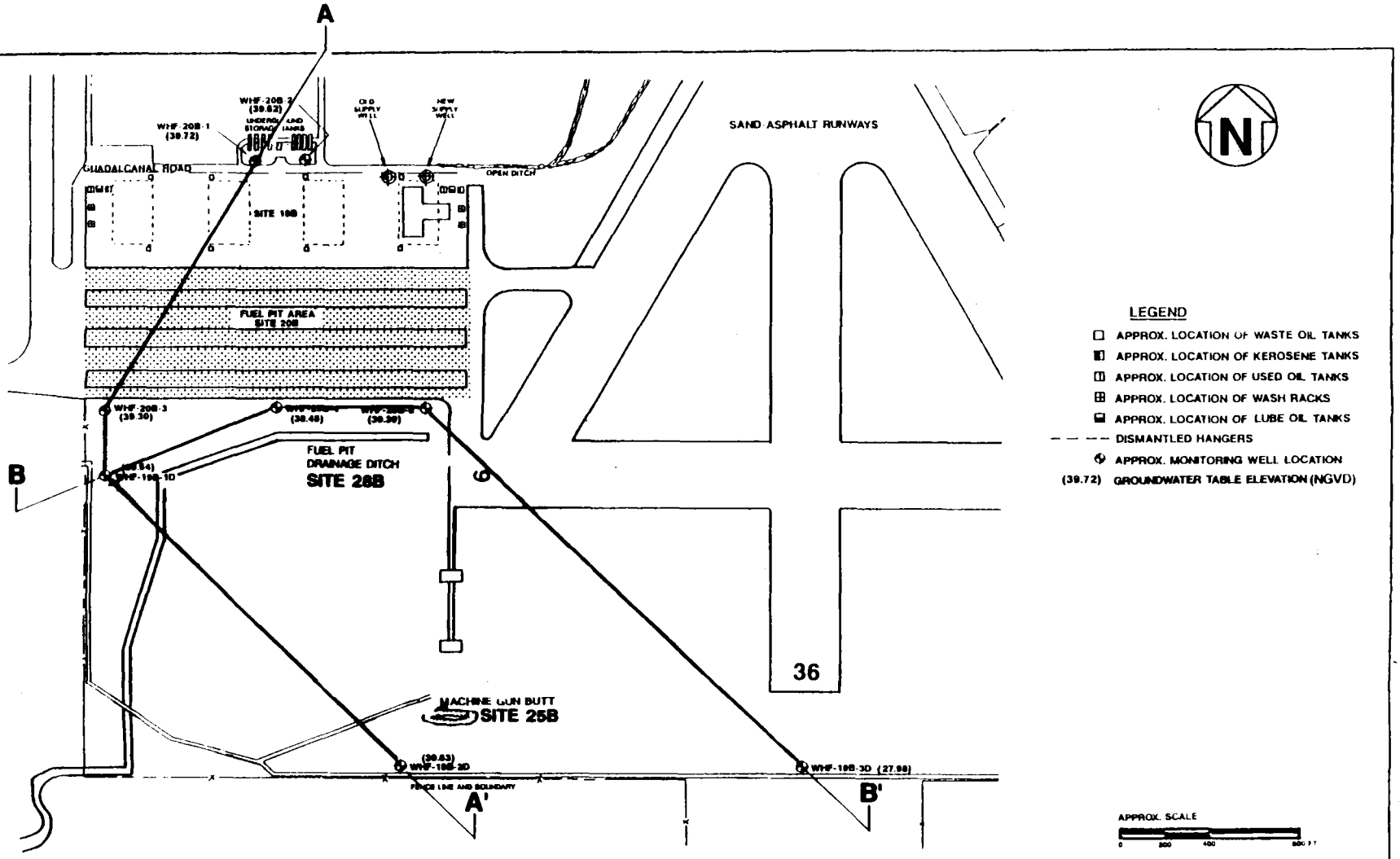


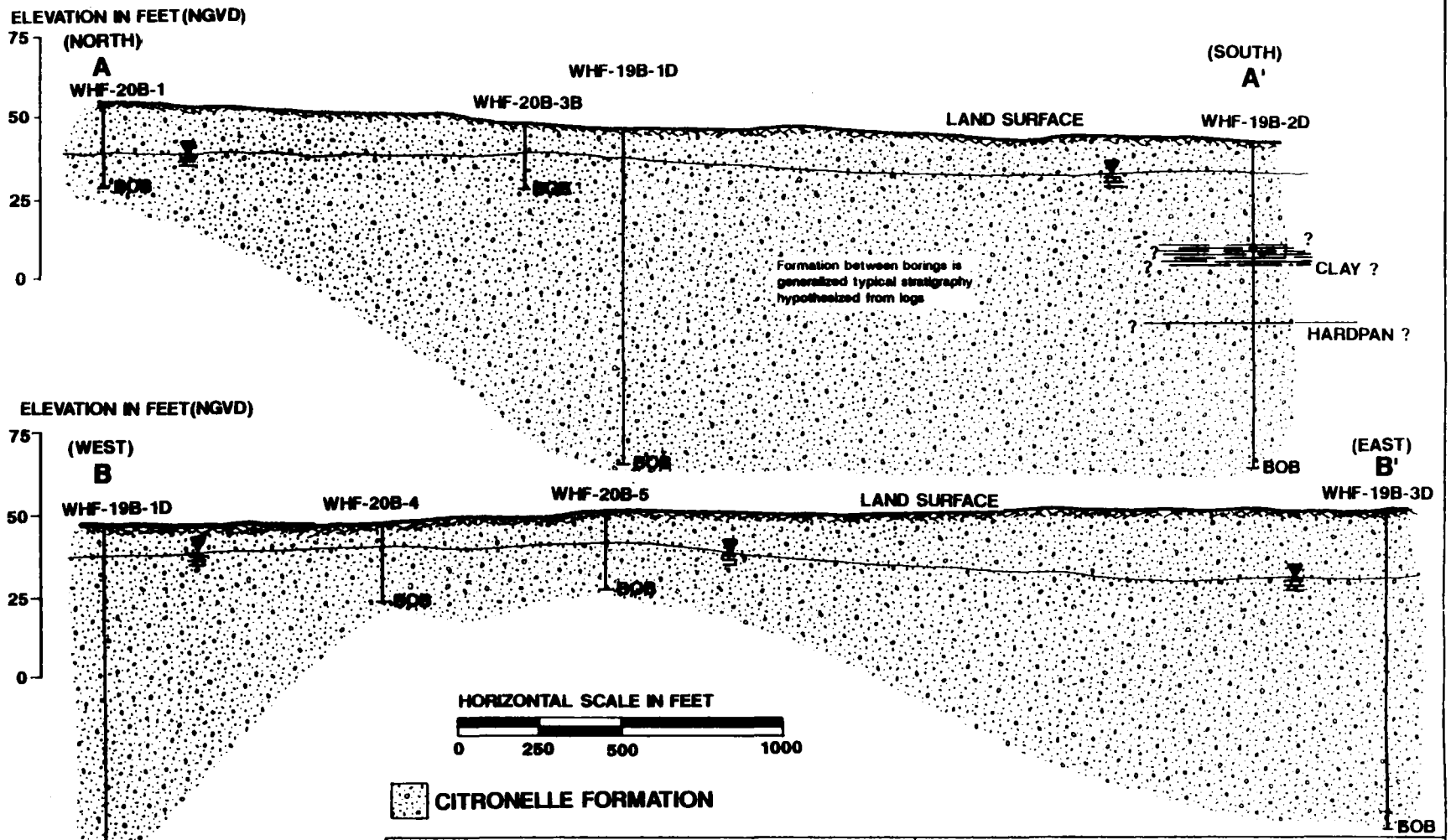
FIGURE 3-8
PLAN VIEW
GEOLOGIC CROSS SECTIONS

SOURCE: ADAPTED FROM NEESA, 1989

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA



NOTE:
BOB - BASE OF BORING

FIGURE 3-9

NORTH-SOUTH AND EAST-WEST CROSS SECTIONS AT OLF BARIN

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

(Regional Geologic Setting), the base of the Citronelle has been reported to be marked by a dark yellowish-brown limonite-cemented sandstone bed that locally contains gravel.

The stratigraphy is typical of undifferentiated depositional sediments of either Pliocene (Citronelle) or more recent age. No explorations have been performed along the creek slopes or eastern half of the installation. Based on the existing site-specific data and regional/area geologic data, the entire installation is likely to be similar to the western half consisting of a set of thinly bedded sands with minor amounts or stringers of silts, clays, and gravels. No contiguous confining layers or aquitards appear to be present. Wood fragments were observed in a sample from 70.0 to 71.2 feet bls in boring WHF-19B-3D.

3.4 GROUNDWATER.

3.4.1 Hydrogeology OLF Barin lies within the recharge area of the Pliocene-Miocene aquifer that supplies most, if not all, of the potable groundwater in the general region. This aquifer is within the undifferentiated sediments of the lower Citronelle Formation and the upper Miocene Series. This aquifer is highly transmissive, producing water in Baldwin, Washington, Clarke, and Mobile Counties of Alabama (Hinkle, 1984). This formation is the primary source of water for the monitoring wells that were installed at OLF Barin. Most wells completed in the above mentioned aquifer range from 40 to 1,100 feet deep and can yield up to 700 gallons per minute (gpm). Aquifer testing has shown that specific capacities of more than 10 gallons per minute per foot (gpm/ft) in wells drilled in the area are not uncommon (Hinkle, 1984). Water supply wells within the vicinity of OLF Barin are described in Section 3.8. The Pliocene-Miocene aquifer is also connected hydraulically to the Alluvial Coastal Plain aquifer, but because of their relatively thin and discontinuous nature they are not a source of abundant supplies of groundwater. Although the formations comprising these aquifers differ somewhat in their origin, age, and lithology, both the systems are typically unconfined at depths less than 100 feet bls and are under water table conditions throughout the southern part of Baldwin County. However, Walter and Kidd (1979) identified clayey sediments (approximately 6 miles south of OLF Barin) in the Miocene series between 300 and 500 feet bls that create locally semi-confining conditions at these depths in the Pliocene-Miocene aquifer. Figure 3-10, adapted from Mooty (1984) and Riccio and others (1973), shows the regional hydrogeological systems and potentiometric surface (i.e., water table) in southern Baldwin County. This shows that OLF Barin lies in the Pliocene-Miocene system with the exception of the eastern and northeastern corners in which the Alluvial-Coastal system is expressed along Sandy Creek.

Within the boundaries of OLF Barin, groundwater lies approximately 10 to 20 feet bls. Depth to groundwater and groundwater elevations in the monitoring wells installed and sampled during June 1990 are summarized in Table 3-2. As described in Section 4.0, these wells were installed in the western part of OLF Barin to verify contaminants in groundwater. The groundwater contour map of the groundwater table in the southwestern part of OLF Barin is presented in Figure 3-11. Groundwater in the western part of the installation flows south-southeasterly at a gradient of approximately 1:200 south of the fuel pit area (Site 20B). However, the gradient becomes very flat directly beneath sites 19B

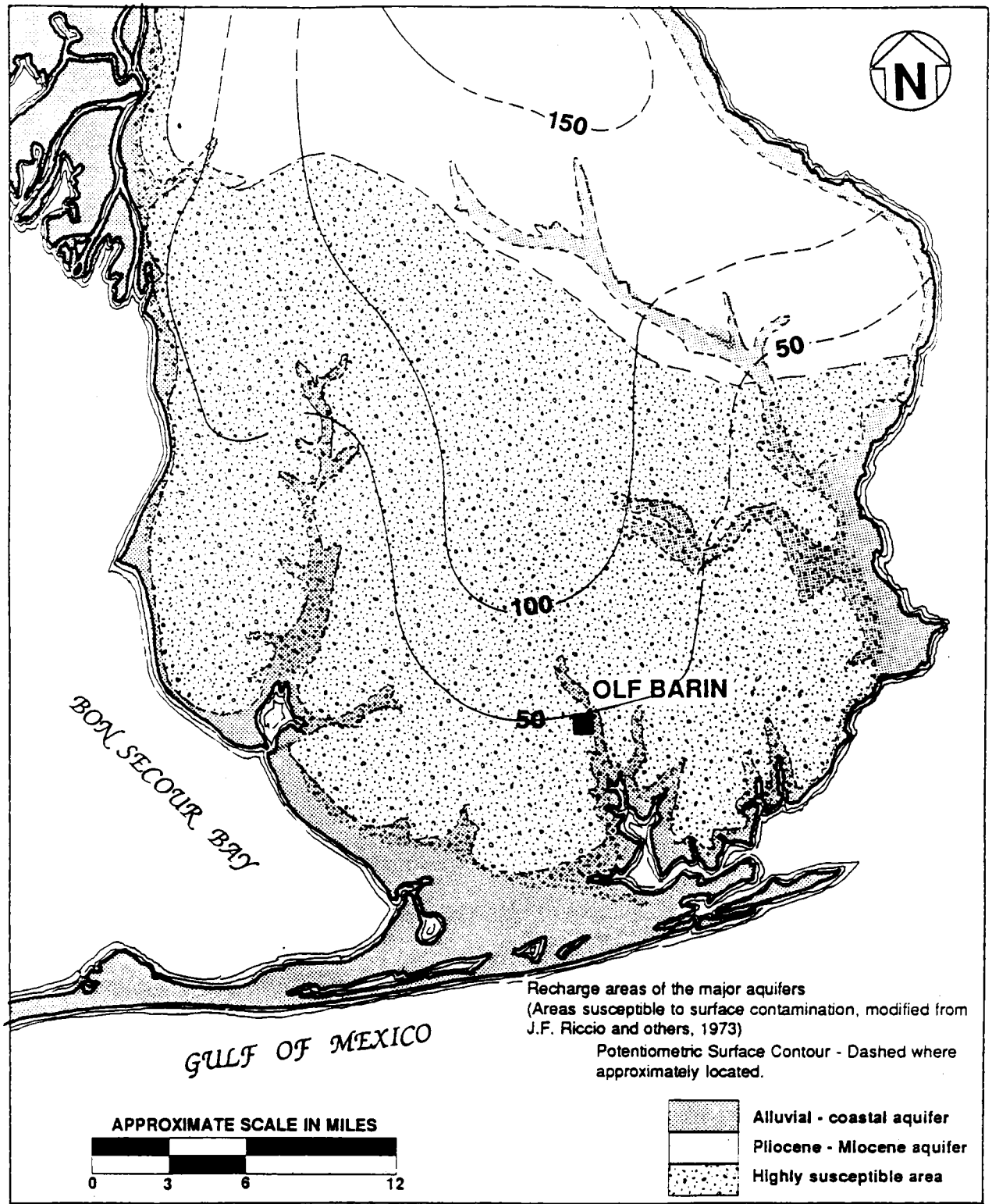


FIGURE 3-10

REGIONAL HYDROGEOLOGY

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

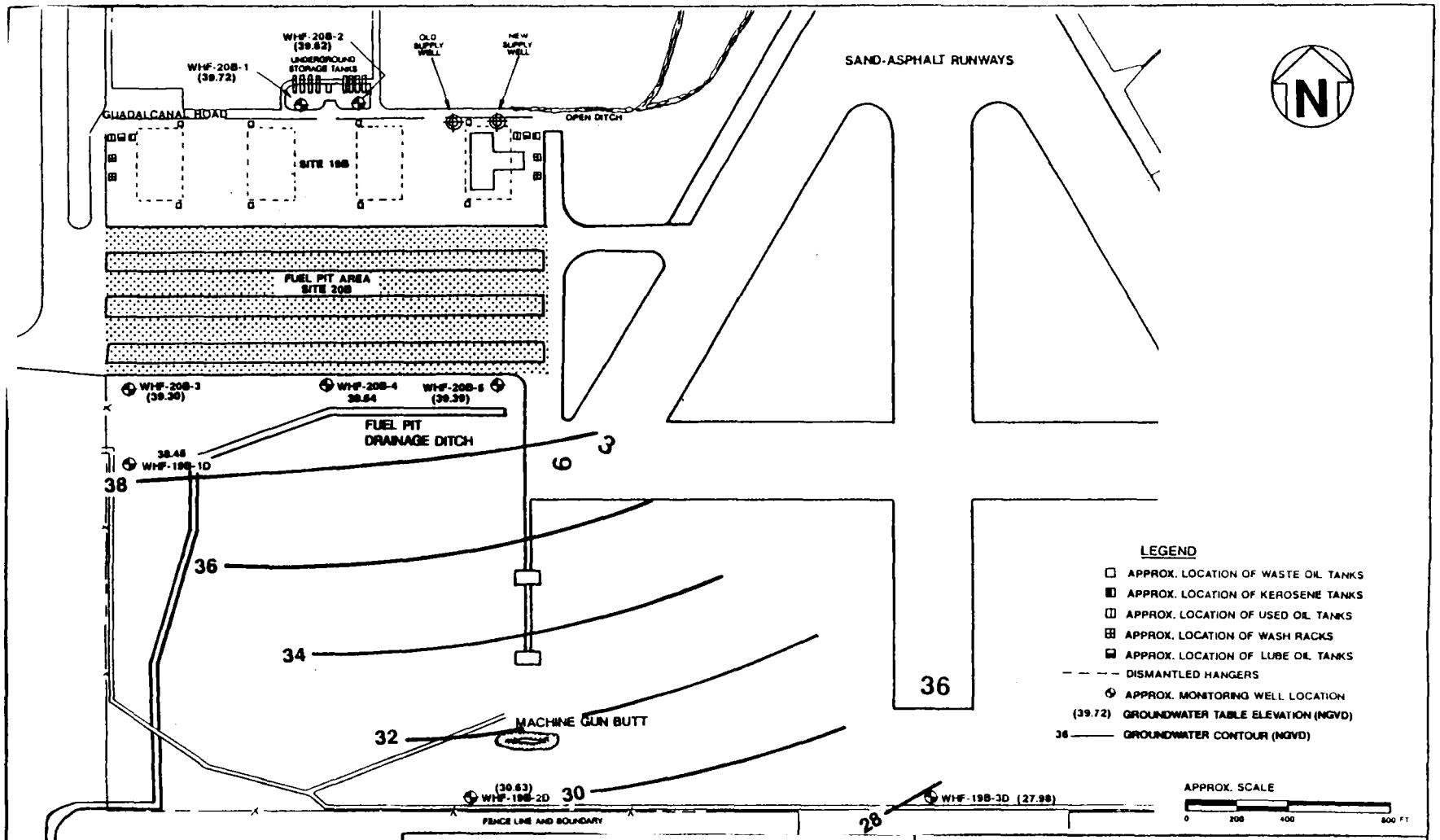


FIGURE 3-11
SITE-SPECIFIC
GROUNDWATER CONTOUR MAP

SOURCE: ADAPTED FROM NEESA, 1989

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

and 20B (see Figure 3-11). The gradient across this part of OLF Barin is estimated as 2.26×10^{-4} foot per foot (ft/ft) based on averaged water levels in wells WHF-20B-1 and WHF-20B-2 compared to Wells WHF-20B-3, WHF-20B-4, and WHF-20B-5.

Table 3-2
Groundwater Elevation Summary
June 12, 1990

RI/FS Workplan
OLF Barin, Foley, Alabama

Monitoring Well No.	Total Depth (feet bls)	Screen Interval (feet bls)	Riser Elevation (feet above NGVD)	Depth to Water (feet)	Water Table Elevation (feet above NGVD)
WHF-19B-1D	100	90-100	48.65	10.20	38.45
WHF-19B-2D	100	90-100	43.78	13.15	30.63
WHF-19B-3D	100	90-100	50.28	22.30	27.98
WHF-20B-1	22	12-22	57.60	17.88	39.72
WHF-20B-2	22	12-22	56.99	17.37	39.62
WHF-20B-3	18	8-18	49.00	9.70	39.30
WHF-20B-4	18	8-18	49.31	9.77	39.54
WHF-20B-5	18	8-18	51.29	11.90	39.39

Notes: bls = below land surface
NGVD = National Geodetic Vertical Datum of 1929.

Because of this, it is likely that pumping of the installation supply wells has a significant effect on flow direction in the highly permeable substrate of Sites 19B and 20B.

3.4.2 **Aquifer Characteristics** The results of hydraulic conductivity analyses of all monitoring wells at OLF Barin as estimated from *in-situ* rising head "slug" permeability tests during the SI are presented in Table 3-3. Slug test data was analyzed using a method developed by Bouwer and Rice (1976) for calculating the hydraulic conductivity of an aquifer from partially penetrating wells in an unconfined aquifer. The geometric mean hydraulic conductivity of all eight monitoring wells was 3.89×10^{-3} centimeters per second (cm/sec). Even though the shallow and deep wells are both part of the same aquifer, considerable variability in the calculated hydraulic conductivities exists as shown. The conductivity of the deeper zone (90 to 100 feet bls) was approximately 6 times lower than the conductivity at the water table. At the water table wells (WHF-20B-1 through WHF-20B-5), the geometric mean hydraulic conductivity was 7.93×0^{-3} centimeter per second (cm/sec). This variability may be a result of the different lithologies present over the screened interval of the monitoring wells. Because the sediments encountered below the site are not homogeneous and exhibit a wide range of grain sizes and degrees of sorting, greater deviations from the mean hydraulic conductivity can be expected.

Table 3-3
Hydraulic Conductivity Estimates

RI/FS Workplan
OLF Barin, Foley, Alabama

Well No.	Hydraulic Conductivity Rising Head (cm/sec)	Geometric Mean Hydraulic Conductivity (cm/sec)
WHF-19B-1D	3.34×10^{-3}	Deep wells
WHF-19B-2D	3.34×10^{-4}	
WHF-19B-3D	1.50×10^{-3}	1.19×10^{-3}
WHF-20B-1	1.84×10^{-3}	Water table wells
WHF-20B-2	7.08×10^{-3}	
WHF-20B-3	1.53×10^{-2}	7.93×10^{-3}
WHF-20B-4	7.90×10^{-3}	
WHF-20B-5	1.99×10^{-2}	

Notes: Overall geometric mean = 3.89×10^{-3} cm/sec.
cm/sec = centimeters per second.

The average groundwater seepage velocities across the site can be estimated using the following equation:

$$v = \frac{KI}{n}$$

where
v = seepage velocity (cm/sec),
K = hydraulic conductivity (cm/sec),
I = hydraulic gradient, and
n = effective porosity.

The average hydraulic conductivity (7.93×10^{-3} cm/sec) and the hydraulic gradient (2.26×10^{-4}) for the area under the former hangar maintenance and fuel pit areas were calculated previously from data collected during the SI. From the fuel pit area to the southern installation boundary the average hydraulic conductivity and the hydraulic gradient was calculated to be 1.19×10^{-3} cm/sec and 2.50×10^{-3}, respectively. The effective porosity is estimated to be 0.25, which is a typical value for fine- to coarse-grained sands. Seepage velocity calculated between the area of WHF-20B-1 and WHF-20B-2 and the area of WHF-20B-3, WHF-20B-4, and WHF-20B-5 is as follows:

$$v = \frac{(7.93 \times 10^{-3})(2.26 \times 10^{-4})}{0.25} = 7.2 \times 10^{-6}\ cm/sec\ or\ 0.020\ ft/day$$

Seepage velocity calculated between the fuel pit are (Sites 19 and 20) and monitoring wells WHF-19B-2D and WHF-19B-3D is as follows:

$$v = \frac{(1.19 \times 10^{-3})(2.50 \times 10^{-3})}{0.25} = 1.19 \times 10^{-5}\ cm/sec\ or\ 0.034\ ft/day$$

Seepage velocity increases south of this area by approximately 2 times due to an 11 fold increase in hydraulic gradient value and a 6 fold decrease in the hydraulic conductivity value.

This seepage velocity is a representative rate at which groundwater is moving horizontally through the pore spaces in the upper part of the aquifer at OLF Barin.

3.5 CLIMATE AND METEOROLOGY. OLF Barin is located in a region of humid, near-subtropical climate with an average annual temperature of 68 degrees Fahrenheit (Moore, 1987). The region can be characterized as having a long spring and fall, extremely hot summers, and short, mild winters. Average yearly precipitation is approximately 64.6 inches (Moore, 1987). The wettest month is July, and the driest month is October. Heavy rains can occur in the mid-summer to early fall months when tropical storms enter the Gulf of Mexico.

Rainfall intensity is a factor that strongly influences the potential for surface water migration of contaminants via overland flow or runoff. National Oceanic and Atmospheric Administration (NOAA) publishes rainfall intensity-duration-frequency curves for various locations in the United States (U.S. Department of Commerce, 1955). For Mobile, Alabama, the 2 year, 24-hour maximum rainfall event is 5.28 inches (0.22 inch per hour). The 100 year, 24-hour rain event is estimated as 12.0 inches.

3.6 LAND USE. Three airstrips with associated flat grassland and pine plantations cover the major part of the 490-acre area of OLF Barin. On-site activity at the facility occurs on approximately 4 acres. This area comprises the firefighting operations and storage buildings, parking lot, and recreational area. The northeastern and eastern edge of the installation, consisting of the slope to and the floodplain of Sandy Creek, are forested. This forested area represents approximately 70 acres. Approximately 6 acres at the southern boundary are also forested.

In general, land surrounding OLF Barin is sparsely populated including a few residential and mobile homes, agricultural lands, commercial lands, pasture lands, timberland and fallow land, but also includes the suburban residential areas of Foley and Elberta, and institutional (churches and schools) and urban commercial areas in the centers of Elberta and Foley.

3.7 WATER SUPPLIES. The OLF Barin facility receives its water from a water supply well located north of the station headquarters adjacent to Guadalcanal Road (see Figure 3-11). The water is used for firefighting activities, cleaning, and personal consumption by the station personnel. The water is obtained from the Pliocene-Miocene aquifer from a depth of approximately 100 feet bls. No drilling or well construction logs are available for this well.

Analyses of the water from this well in July and September of 1988 revealed the presence of trans-1,2-dichloroethylene, tetrachloroethylene, and trichloroethylene. Prior to the use of this well, the station water supply was from an old supply well about 200 feet due west of the new well. Water from the old well analyzed in September of 1988 also contained tetrachloroethylene and trichloro

ethylene. The old supply well subsequently has been abandoned and grouted. Table 3-4 shows the results of analysis of the water from the OLF Barin supply wells. The OLF Barin supply wells are located adjacent to the Former Hangar Maintenance Area and within 400 feet of the abandoned UST. Presently, water from the installation supply well is treated with granular activated carbon prior to use to remove volatile organic compounds (VOCs). Table 3-4 shows results of analysis on April 30, 1990, for the water supply after carbon treatment.

Table 3-4
Analytical Data for OLF Barin Water Supply Wells

RI/FS Workplan
OLF Barin, Foley, Alabama

Parameters	Well and Sample Data			
	Raw Water			Treated Water Supply 4/30/90
	New Well 07/29/88	New Well 09/07/88	Old Well 09/07/88	
Physical Characteristics				
Specific conductance (μmhos/cm)	32.0	48.0	40.0	34.0
pH (standard units)	5.7	5.2	3.3	5.6
Organic Chemicals				
trans-1,2-Dichloroethylene (μg/ℓ)	13.2	< 5.0	< 5.0	< 0.5
Tetrachloroethylene (μg/ℓ)	6.0	6.0	7.0	< 0.5
Trichloroethylene (μg/ℓ)	4.0	8.0	7.0	< 0.5
Inorganic Analytes				
Alkalinity (mg/ℓ as $CaCO_3$)	5.0	Not analyzed	Not analyzed	10.0
Chloride (mg/ℓ)	4.0	Not analyzed	Not analyzed	8.0
Total hardness (mg/ℓ as $CaCO_3$)	3.0	Not analyzed	Not analyzed	5.0
Calcium (mg/ℓ)	< 0.01	Not analyzed	Not analyzed	1.4
Magnesium (mg/ℓ)	0.88	Not analyzed	Not analyzed	0.74
Lead (mg/ℓ)	0.004	Not analyzed	Not analyzed	0.004
Total dissolved solids (mg/ℓ)	5.7	Not analyzed	Not analyzed	3.0

Source: Personal Communication, Department of Public Works, NAS Whiting Field, 1990.

Notes: No extractable organic chemicals, pesticides, or herbicides were detected.

μmho/cm = micromhos per centimeter.
μg/ℓ = micrograms per liter.
mg/ℓ = milligrams per liter.
$CaCO_3$ = calcium carbonate.

Public water supply wells near OLF Barin and Foley draw water from depths of 80 to 157 feet bls and can yield up to 700 gpm. Foley is listed as having three high capacity wells ranging in depth from 138 to 157 feet. The locations of the Foley wells are indicated on Figure 3-12. Records indicate these wells are drilled to the Miocene, although the screened interval most likely overlaps the Miocene/Citronelle contact. Capacity of these wells was reported by the Town of Foley to be 400, 550, and 550 gpm respectively (Foley, Alabama, Department of Public Works, 1991). The Town of Elberta, Alabama, is served by a single well with a capacity of 45,000 gallons per day (Scott, 1991). The location of this well is also shown on Figure 3-12.

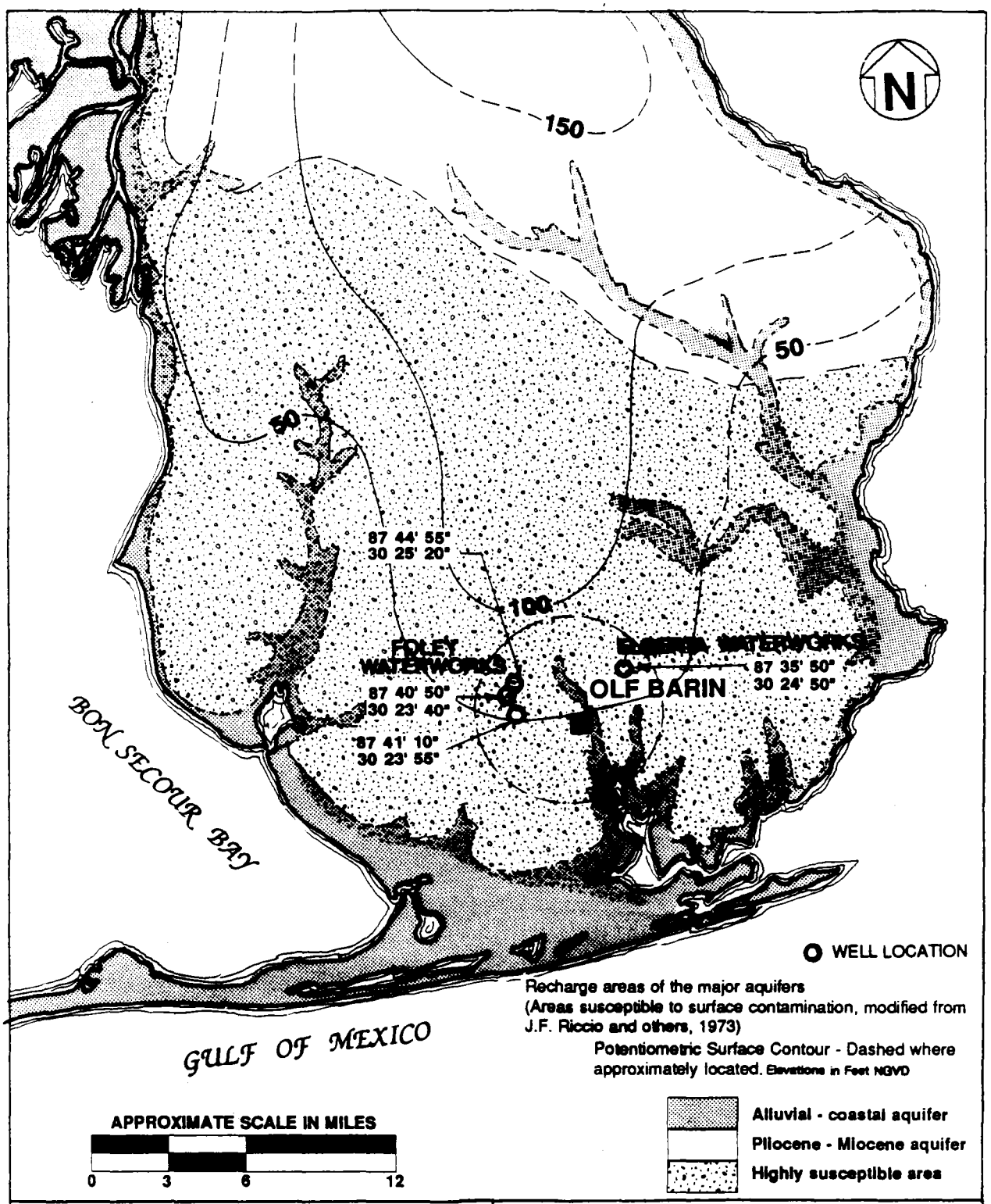


FIGURE 3-12
LOCATION OF PUBLIC WATER SUPPLY WELLS NEAR OLF BARIN (Mooty, 1988)

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

4.0 SITE-SPECIFIC DESCRIPTION, HISTORY, AND PREVIOUS INVESTIGATIONS

4.1 SITE 19B, FORMER HANGAR MAINTENANCE AREA

4.1.1 Site Description and History Site 19B consists of four former large aircraft maintenance hangars (Figure 4-1) having dimensions of approximately 350 feet by 1,460 feet (11.8 acres). As described in Section 2.0, these hangars (former building numbers 1221, 1222, 1223, and 1235) were built during WWII for the purpose of aircraft maintenance. These hangars were used as described below during periods of active flying operations until 1959 when the installation was deactivated and the aboveground structures demolished. Currently, buildings 2768 and 3029 occupy the site of former hangar 1223. The existing buildings were built in 1985 to house the emergency equipment and crash crew operations and storage areas. According to the OLF Barin fire chief, a total of 63 full-time personnel provide 24-hour emergency services for NAS Whiting field flight operations involving OLF Barin.

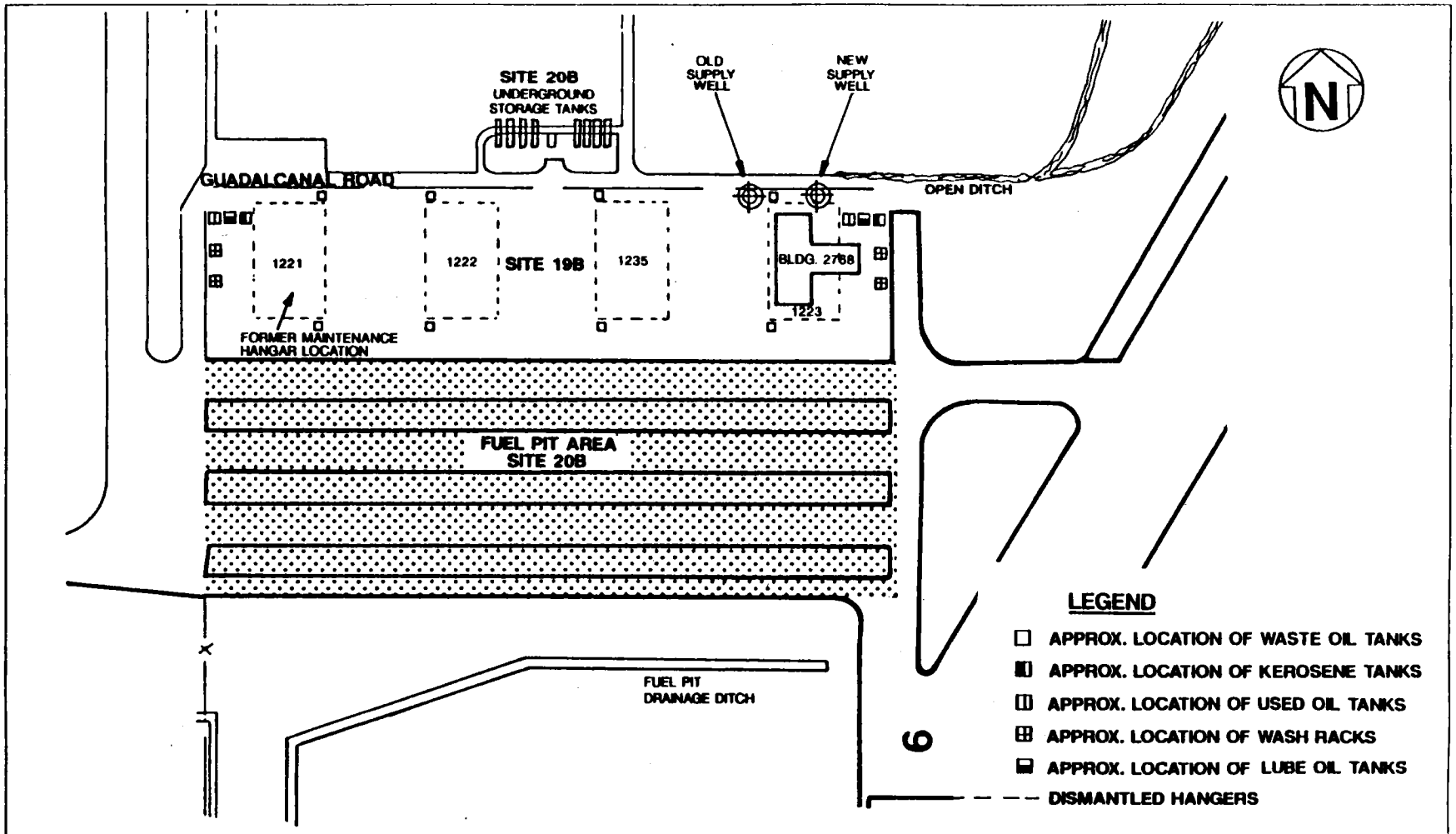
As reported in the PA, maintenance shops were located at the northern end of each hangar area. Maintenance operations likely included cleaning and degreasing of aircraft and aircraft parts, corrosion control, inspection, and testing.

Between 1942 and 1959, the Site 19B hangars were periodically used for aircraft maintenance. The periods of activity mainly occurred during WWII and the Korean Conflict. Numerous types of solvents, oils, and fuels were reportedly used by maintenance personnel in these operations. Toluene, carbon tetrachloride, trichloroethylene, tetrachloroethylene, and trichloroethane as well as petroleum distillates were among the solvents likely used by maintenance personnel. The solvents used have not been documented, however, the above solvents are those used for aircraft maintenance during the time period. In addition, it is unknown whether corrosion control (painting) operations, Nondestructive Inspection (NDI) operations, or storage battery service occurred in the hangars. If so, wastes containing metals could have been used at the site. NDI operations involved the use of degreasers and X-ray-opaque salts such as barium. Battery rework may have involved electrolytes containing lead or dry cells containing nickel, cadmium, or mercury. The use rate of these materials is unknown.

The aircraft required oil changes every 40 hours of flying time. The waste oils were put into underground waste oil tanks at the north and south ends of each hangar. When the tanks were full, the wastes were reportedly pumped out by local contractors and transported off station (NEESA, 1989).

Typically, until the mid-1970's or later, halogenated and non-halogenated solvents and other flammable materials were routinely commingled with waste oils for disposal.

In the PA, inferred tanks locations were shown. Subsequent to the PA (NEESA, 1984), SOUTHNAVFACENGCOM has located and evaluated the UST's associated with the Former Hangars and with the aviation fuels storage and dispensing system identified as Site 20B. Site 20B is discussed in Section 4.2.



SCALE

0 400 800

FIGURE 4-1
LOCATION OF SITES 19B, FORMER HANGAR MAINTENANCE AREA, & 20B, ABANDONED UNDERGROUND STORAGE TANK & FUEL PIT AREA

HRS II SCORING DOCUMENTATION

OLF BARIN
FOLEY, ALABAMA

The UST program updated the PA by means of a field inspection. Remedial action plans and specifications for removal and closure of these tanks were prepared by ERC Environmental and Energy Services Company from Nashville, Tennessee, in July 1990. Removal of the tanks was completed in January 1992 by Barnes Electric from Pensacola, Florida. Table 4-1 shows the status of the contents of each tank (SOUTHNAVFACENGCOM, 1991 Personnel Communication).

Aircraft formerly were washed with kerosene at wash racks located at the east and west end of the hangars. The wash racks were reportedly connected to an oil/water separator designed to collect the kerosene and water run-off. The recovered kerosene was stored in three tanks located at each wash rack. The size of the tanks connected to the wash racks is unknown. The hangars were reportedly flanked on the east and west by used oil and lube oil, as well as kerosene tanks. The specific use of each tank does not appear in the SOUTHNAVFACENGCOM 1991 inventory. Local residents interviewed during the PA site visit reported that fishing in Sandy Creek had to be stopped while the field was active because of kerosene contamination. Kerosene use for washing airplanes was discontinued in the early 1950's because it left a slippery residue on the wings and fuselage.

The Former Hangar Maintenance Area is adjacent to grassy, non-paved areas to the east, west, and north along Guadalcanal Road. Any solvents, oils, or fuels spilled onto the concrete in these areas would be washed into the soil by either stormwater runoff or rinsing of the hardstand (airplane parking area).

The total waste oil storage capacity at Site 19B was 6,310 gallons, based on the volumes of tanks 1221A through 1235B tabulated in Table 4-1. This amount of material would have been handled many times during the operation history. Currently no oily product exists in any of the tanks. Materials likely handled include: halogenated and nonhalogenated solvents, aliphatic and aromatic hydrocarbons, aviation gasoline (AVGAS) (containing tetraethyl lead), kerosene, lubrication oils, and hydraulic fluids. Potentially, paint (containing solvents and metals in pigments), corrosion products from airframes and internal aircraft parts, and possibly X-ray-opaque material from NDI may have been disposed. The quantities released through spills or leaks are unknown. Migration pathways available to any waste residuals are infiltration to groundwater, migration toward surface water via overland flow of contaminated soil particles, or migration as dissolved materials in runoff.

4.1.2 Previous Investigations and History The scope of the SI field investigation at site 19B consisted of a hydrogeologic assessment based on installation of eight soil boring and monitoring wells, estimation of aquifer properties by means of *in-situ* aquifer testing, field screening of subsurface soils for the presence of volatile organic compounds (VOCs), field analysis of pH and specific conductance, and sampling of groundwater for laboratory analysis of the target compound list (TCL) and target analyte list (TAL) chemicals. No samples from USTs or from surface soil were collected.

Based on the discussion presented in Section 3.3, the unconsolidated sediments consisted of layers of silty sands with interspersed silts and clays. As shown in Table 3-2, the water table was encountered at depths ranging from 15 to 20 feet bls at Site 19B, due to topographic relief. As shown in Table 3-3, the hydraulic conductivity in the upper part of the aquifer was 7.93×10^{-3} cm/sec.

Table 4-1
Underground Storage Tank (UST) Removal Schedule

RI/FS Workplan
OLF Barin, Foley, Alabama

Navy Tank No.	Tank Capacity (gallons)	Material of Construction	Tank Diameter (inches)	Tank Length (feet)	Cover Over Tank	Depth of Cover (inches)	Tank Contents	Depth of Fluid (inches)		Volume of Contents in Tank (gallons)		Estimated Material to be Excavated (cy)
								Product	Water	Product	Water	
1226	25,000	Steel	126	39	Concrete vault and soil	54	Water with gasoline sheen	<1/8	126	N/A	25,000	[1]656
1227	25,000	Steel	126	39	Concrete vault and soil	54	Water with gasoline sheen	<1/8	126	N/A	25,000	
1228	25,000	Steel	126	39	Concrete vault and soil	54	Water with gasoline sheen	<1/8	126	N/A	25,000	[1]656
1229	25,000	Steel	126	39	Concrete vault and soil	54	Water with gasoline sheen	<1/8	126	N/A	25,000	
1230	15,000	Steel	120	39	Concrete vault and soil	52	Water with gasoline sheen	<1/8	3	N/A	120	183
1231	25,000	Steel	126	39	Concrete vault and soil	52	Water with gasoline sheen	<1/8	126	N/A	25,000	[1]656
1232	25,000	Steel	126	39	Concrete vault and soil	52	Water with gasoline sheen	<1/8	126	N/A	25,000	
1233	25,000	Steel	126	39	Concrete vault and soil	52	Water with gasoline sheen	<1/8	126	N/A	25,000	[1]656
1234	25,000	Concrete	[2]48 x 36	8.0	Concrete manway and soil	52	Water with gasoline sheen	<1/8	126	N/A	25,000	
1221-A	720	Concrete	[2]48 x 24	3.0	Concrete manway and soil	24	Water with fuel oil sheen	<1/8	[3]56	N/A	740	23
1221-B	175	Concrete	[2]48 x 36	8.0	Concrete manway and soil	19	Water with gasoline sheen	<1/8	10	N/A	40	11
1221-C	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Soil[4]	N/A	N/A	N/A	N/A	26
1222-A	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Water with fuel oil sheen	<1/8	[3]54	N/A	740	23
1222-B	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Soil[4]	N/A	N/A	N/A	N/A	26
1235-A	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Water with fuel oil sheen	<1/8	48	N/A	720	23
1235-B	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Water with fuel oil sheen	<1/8	[3]61	N/A	750	23
1223-A	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Water with fuel oil sheen	<1/8	47	N/A	700	23
1223-B	720	Concrete	[2]48 x 36	8.0	Concrete manway and soil	24	Soil[4]	N/A	N/A	N/A	N/A	26
1223-C	375	Concrete	[2]48 x 36	4.0	Concrete manway and soil	24	Soil[4]	N/A	N/A	N/A	N/A	17

[1] Two underground storage tanks are located within one tank pit.
[2] Tanks are rectangular concrete vaults (depth x width).
[3] Depth of each tanks is 48 inches. The water level extends up into the manway, thus giving a depth of water greater than 48 inches.
[4] Each of these tanks are filled, to the top of the manway, with soil.

Notes: Actual contents and the volume of the tanks contents are based on information obtained in the field. Actual contents and volume of contents may vary from those indicated above at the time of the tank removal project.

Groundwater flow direction is from the north-northwest to the south-southeast across the site at a gradient of 2.26×10^{-4} ft/ft. Monitoring wells WHF-20B-1 and WHF-20B-2 are upgradient of the Former Maintenance Hangar Area potential contamination sources. Wells WHF-20B-3 through WHF-20B-5 monitor the water table, whereas WHF-19B-1D through WHF-19B-3D monitor the production zone (90 to 100 feet bls), downgradient of sites 19B and 20B. The groundwater seepage velocity estimated under Site 19B was 0.020 foot per day (due to the low gradient). The high hydraulic conductivity at the water table suggests that the flow gradient and seepage velocity are easily influenced by local perturbations. For example, pumping in the production zone at 100 feet bls could create a cone of depression and change the flow direction to easterly. Also downgradient of the site at the installation boundary, seepage velocity might be expected to increase if gradient increased in the steeply sloping terrain to the south.

No evidence of subsurface VOC contamination was detected either by visual evidence of soil staining or the organic vapor analyzer (OVA) readings. Borings were not placed directly in former waste discharge areas, however. The flame ionization detector (FID) used by the OVA is highly sensitive to aromatic and aliphatic hydrocarbons such as predominate in fuels; however, the FID is essentially unable to detect halogenated solvents. At site 19B, it would be expected that fuel-related and solvent-related VOCs would be commingled.

Field Measurements. Field measurements of specific conductance and pH collected prior to sampling are presented as follows.

Well No.	pH Standard Units	Specific Conductance µmhos/cm at 25 °C
Production Zone		
WHF-19B-1D	6.0	175
WHF-19B-2D	7.8	200
WHF-19B-3D	7.8	92
Water Table		
WHF-20B-1	3.75	40
WHF-20B-2	3.8	20
WHF-20B-3	3.7	20
WHF-20B-4	4.3	70
WHF-20B-5	4.2	80

Notes: umhos/cm = microumhos per centimeter.
°C = degrees Celsius.

The pH of the groundwater in the water table monitoring wells is much lower than naturally occurring groundwater of the region. The lowest pH for groundwater in Baldwin County was reported by Reed (1971) to be 4.5. A review of the field records indicated the electronic pH meter was not agreeing with readings from pH paper (5.5). A pH of 5.5 is probably more representative of the water table zone than the measurements presented above.

Groundwater samples were collected from the eight SI monitoring wells for detection of contamination migrating from Sites 19B, 20B, and 22B. The samples were collected and analyzed as described in Section 4.0 of the SI. Complete analytical results for the groundwater samples are tabulated in Appendix B of the SI and summarized in Table 4-2.

Metals. Eleven metals were detected in the eight groundwater samples. These metals include aluminum, calcium, iron, potassium, magnesium, and sodium, which, although listed in the CERCLA TAL for inorganics, also are major-ion constituents of natural surface waters and groundwaters. Iron was detected in amounts in excess of the Alabama secondary drinking water maximum contaminant level (MCL) of 0.3 milligram per liter (mg/ℓ). None of these metals occur at levels suggesting a site-related release or exhibit an upgradient-downgradient pattern. The presence of iron at concentrations in excess of the secondary MCL is expected to occur naturally in shallow groundwater in silty or clayey sands of the type underlying OLF Barin. Further, the iron MCL is based on esthetics considerations (staining of clothes or fixtures), not health effects. Other metals detected were lead, arsenic, antimony, cadmium, and mercury. As shown in Table 4-3, soils naturally contain varying concentrations of the TAL metals. These metals are present in an aquifer partially as dissolved metals ions, as precipitates sorbed to the aquifer solids particles, or as components of the chemical structure of the aquifer solids. The fraction and total mass in each compartment is a function of soil type, redox conditions, pH, and other factors. Analysis of total metals, if any trace amounts of turbidity (aquifer solids) is present, produces an over estimate of the concentrations of any metal present in the dissolved state and capable of migrating with groundwater. Where turbidity is present, it is impossible to determine whether or if the metal is truly present in groundwater or bound to aquifer solids. The monitoring wells at OLF Barin contain some turbidity. Because of this factor, the presence of TAL metals must be interpreted carefully.

The Alabama and Federal primary drinking water MCL for arsenic is 0.05 mg/ℓ. Arsenic was detected in a sample from one monitoring well just at the limit of detection (0.001 mg/ℓ). Arsenic occurs naturally in soil (see Table 4-3) and occasionally at trace levels in groundwater. Arsenic at a concentration 0.001 mg/ℓ would not significantly affect aquatic life in Wolf Creek even if groundwater discharge made up the base flow of the stream. Appendix G shows the Ambient Water Quality Criteria (AWQC) for protection of fish and aquatic life is 0.190 mg/ℓ. Arsenic is not likely to have been used in aircraft maintenance operations; however, historically arsenicals have been used as pesticides or herbicides. It is unlikely that arsenic found in MW WHF-19B-1D is site related.

Antimony also was observed at the limit of detection (0.1 mg/ℓ) in samples from two production zone wells (WHF-19B-1D and in one replicate of WHF-19B-3D). Alabama does not regulate antimony. A Federal AWQC for protection of human health of 0.146 mgℓ has been set for this metal. Antimony is a naturally occurring metal in soils (see Table 4-3) and some groundwaters (Kabata-Pendias and Pendias, 1984). Because the element, when detected, was observed in two non-adjacent deep wells and in only one of the replicates from WHF-19B-3, its true presence at a detectable concentration is questionable. Antimony is used as a

Table 4-2
Summary of Groundwater Quality Data from Sampling of June 13 and 14, 1990

RI/FS Workplan
OLF Barin, Foley, Alabama

Compounds	Sample Numbers								
	WHF-19B-1D	WHF-19B-2D	WHF-19-3D	WHF-19B-3D	WHF-20B-1	WHF-20B-2	WHF-20B-3	WHF-20B-4	WHF-20B-5
Total Phenols (mg/ℓ)									
Total phenols	0.011	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005
Total Metals (mg/ℓ)									
Aluminum	<0.5<	<0.5	0.8	0.8	1.1	3.3	1.0	1.8	<0.5
Calcium	14	2.8	7.1	7.2	4	7.4	2.4	6.2	1.8
Iron	0.19	0.36	0.2	0.19	0.31	0.65	0.35	2	0.22
Mercury	0.0007	<0.0005	<0.0005	<0.0005	0.0058	0.0059	<0.005	<0.000	<0.0005
Potassium	7.1	4.1	17	18	0.8	0.7	1.5	<0.6	<0.6
Magnesium	0.38	0.18	0.22	0.23	0.45	0.77	0.49	0.91	0.5
Sodium	12	9	7.3	8.1	1.6	1.3	0.9	0.9	2.5
Antimony	0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	0.005	0.007	<0.004	<0.004	<0.004	0.007	<0.004	0.03	<0.004
Arsenic	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	<0.0002	0.0003	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	0.001	<0.0002
Volatile Organic Chemicals (ug/ℓ)									
Toluene	<1	<1	<1	<1	<2	<1	<1	<1	<1
Acetone	[1]30	[2]<130	[2]<130	[2]<130	[2]<130	[2]<130	[2]<130	[1]44	[2]<130
2-Butanone	[1]43	113	[1]<60	[2]60	[2]60	[2]60	[2]60	[1]5	[2]60
Vinyl acetate	<2	6	<2	<2	<2	<2	<2	<2	<2

[1] J = Concentration is estimated due to being <10 times the concentration in the method blanks (see Section 4.2).
[2] UJ = Analyte is undetected, however, due to contamination in the method blanks the reported detection limit is elevated to account for inability to discriminate positive results that are less than 10 times the detection limit from potential blank contamination (see Section 4.2).

Notes: All total cyanide, semivolatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs) samples were below detection limits.
mg/ℓ = milligram per liter.

Table 4-3
Background Concentration Range for Elements in Soils

RI/FS Workplan
OLF Barin, Foley, Alabama

Element	Eastern United States[1]		Gulf Coast[2] (FL and AL)	United States Clay and Clay Loam[3]		United States Alluvial Soils[3]		United States Sandy Soils[3]	
	Geometric Mean	Range	Range	Arithmetic Mean	Range	Arithmetic Mean	Range	Arithmetic Mean	Range
Aluminum	3.3%	0.7 - >10%	0.07 - 3%	No data		No data		No data	
Antimony	0.10	<0.08 - 0.31	<1 - 10	--	0.25 - 0.6	No data		No data	
Arsenic	4.8	<0.1 - 73	<0.1 - 100	7.7	1.7 - 27.0	8.2	21 - 22.0	5.1	<0.01 - 300
Barium	31	<20 - 150	10 - 200	535	150 - 1,500	660	200 - 1,500	400	20 - 1,500
Beryllium	0.55	<1 - 7	<1	1.9	<1 - 15	1.6	1 - 3	1.9	<1 - 3
Calcium	0.34%	0.01 - 28%	0.013 - 0.23%	No data		No data		No data	
Cadmium	No data		No data	--	0.4 - 0.57	No data		No data	
Chromium	33	1 - 1,000	1 - 2,000	55	20 - 100	55	15 - 100	40	3 - 200
Cobalt	5.9	<0.3 - 70	<3 - 7	8.0	3 - 30	9.0	3 - 20	3.5	0.4 - 20
Copper	13	<1 - 7,000	<10 - 700	29	7 - 70	27	5 - 50	14	1 - 70
Iron	2.87%	<0.01 - >10	0.01 - 1.5%	No data		No data		No data	
Lead	14	<10 - 300	<10 - 700	22	10 - 70	18	10 - 30	17	<10 - 70
Magnesium	0.21%	0.005 - 5%	0.005 - 0.15%	No data		No data		No data	
Manganese	260	<2 - 7,000	<2 - 7,000	580	50 - 2,000	405	150 - 1,500	345	7 - 2,000
Mercury	0.081	0.01 - 3.4	<0.01 - 5.1	0.13	0.01 - 0.90	0.05	0.02 - 0.15	0.08	<0.01 - 0.54
Nickel	11	<5 - 700	<5 - 15	20.5	5 - 50	19.0	7 - 50	13	<5 - 70
Potassium	1.2%	0.005 - 3.7%	0.22 - 0.88%	No data		No data		No data	

See notes at end of table.

Table 4-3 (Continued)
Background Concentration Range for Elements in Soils

RI/FS Workplan
OLF Barin, Foley, Alabama

Element	Eastern United States[1]		Gulf Coast[2] (FL and AL)	United States Clay and Clay Loam[3]		United States Alluvial Soils[3]		United States Sandy Soils[3]	
	Geometric Mean	Range	Range	Arithmetic Mean	Range	Arithmetic Mean	Range	Arithmetic Mean	Range
Selenium	0.30	<0.1 - 3.9	<0.01 - 5	0.5	<0.1 - 1.9	0.5	<0.1 - 2.0	0.5	<0.005 - 3.5
Sodium	0.25%	<0.05 - 5%	<0.05 - 0.2%	No data		No data		No data	
Vanadium	43	<7 - 300	<7 - 50	87	20 - 150	79	30 - 150	47	7 - 150
Zinc	40	<5 - 2,900	28 - 45	67	20 - 220	58.5	20 - 108	40	<5 - 164

[1] Shacklette and Boerngen (1984), Table 2, East of Longitude 96° West.
[2] Taken from Shacklette and Boerngen (1984) data display figures.
[3] Kabata-Pendias and Pendias (1984).

Note: Concentration in milligrams per kilogram unless otherwise noted.

pigment component in paint; therefore, it could occur as a result of improper disposal of paint wastes.

Cadmium was detected in three samples, WHF-19B-2D, WHF-20B-4, and one replicate of WHF-19B-3D. With the exception of the 0.001 mg/ℓ concentration observed at MW WHF-20B-4, the results are at the limit of detection. Federal and Alabama standards for cadmium are 0.010 mgℓ. Cadmium also may occur naturally at low concentrations in groundwater. Cadmium is a component of metal alloys, batteries, and pigments.

Lead is a constituent of motor fuels, batteries, and AVGAS. It is also commonly found at trace concentrations in groundwaters. As shown in Table 4-2, it was observed in samples from two of the production zone monitoring wells (WHF-19B-1D and WHF-19B-2D) at 0.005 and 0.007 mg/ℓ. It also was detected in samples from the station water supply well at 0.004 mg/ℓ in 1988 and at the time of the SI groundwater sampling event. The Alabama and Federal MCLs for lead are 0.02 mg/ℓ and 0.05 mg/ℓ respectively. Lead at 0.03 mg/ℓ in a sample from well WHF-20B-4, downgradient of Site 19B and the fuel pit area of Site 20B, violates the Alabama primary drinking water MCL. Lead was also detected at WHF-20B-2 at 0.007 mg/ℓ. Because of the presence of lead in the fuels handled at Sites 19B and 20B and the presence of lead in waste oils and in paints, it is possible that the lead observed in groundwater samples from downgradient well WHF-20B-4 is related to either Site 19B or Site 20B. However, no fuel related VOCs were detected in the wells.

Mercury was observed in samples from two water table depth monitoring wells upgradient of Site 19B (WHF-20B-1 and WHF-20B-2). The concentrations of 0.0058 and 0.0059 mg/ℓ exceed Alabama and Federal drinking water MCLs (0.002 mg/ℓ). Mercury is used in pressure measuring instruments, batteries, as a pigment, and as a fungicide. It could be expected to result from operations that occurred at Site 19B. It is not a component of AVGAS.

Because of the flat gradient and high hydraulic conductivity, groundwater flow at Site 19B may be highly sensitive to the pumping of the production well. The presence of mercury at Site 19B may have migrated from off-site. It was reported in the PA that a Baldwin County operated landfill existed to the west of the former OLF Barin west field (NEESA, 1989). Also, nonflightline maintenance activities of power and heat generation (using fossil fuels) occurred in the former "administrative area" upgradient of WHF-20B-01 and WHF-20B-02. The observed mercury may therefore result from a source further upgradient. Based on topographic considerations, any releases from the county landfill would be more likely to migrate toward Wolf Creek rather than toward the present OLF Barin property. Also, the distance to the other potential upgradient sources is probably beyond the distance that contaminants could migrate since OLF Barin was developed as discussed later in this section. Mercury occurs naturally at low concentrations in some soils (see Table 4-3). Because total rather than dissolved metals were analyzed the mercury reported may have come from aquifer solids present as turbidity and may not be present in the groundwater.

Extractable Organic Chemicals, Pesticides, and Polychlorinated Biphenyls (PCBs). With the exception of two samples in which total phenols were reported, no extractable TCL organic chemicals, pesticides, or PCBs were detected in groundwater samples at Site 19B. Total phenols were reported in samples from monitoring wells WHF-19B-1D (0.011 mg/ℓ) and WHF-20B-4 (0.006 mg/ℓ). Total phenols are analyzed colorimetrically using 4-aminoantipyrine and concentrations are measured against a pure phenol standard. The test is non-specific but highly sensitive. In addition to phenol, many naturally occurring hydroxylated aromatic compounds may be detected as positive inferences. The test is highly sensitive to ortho- and meta-substituted phenols and to many chlorophenols. Because of the lack of specificity of the total phenol test and its potential for positive interference due to non-TCL chemicals, the groundwater total phenol results probably do not relate to contamination due to hazardous materials. No detectable acid-extractable organics were detected. Many of the acid extractable compounds would be expected to be detected by the total phenol test. On the other hand, oxidation products in waste oils and weathered fuels may be phenolics. Concentrations of phenolics detected colorimetrically are at or slightly below the limit of detection of the gas chromatograph/mass spectrometry (GC/MS) extractable organic method.

Volatile Organic Chemicals. Based on the history of operations at the Former Hangar Maintenance Area, the close relationship of Site 20B (the UST Area and Fuel Pits), and the presence of halogenated VOCs in the installation potable supply, VOCs were expected to be the major contaminants observed in groundwater. VOC results are shown in Table 4-2. No halogenated solvents were detected during the SI sampling event.

Laboratory method blanks contained several VOCs. Method blanks analyzed with the groundwater sample delivery group were reported to contain the following VOC concentrations.

Acetone	<10 to 13 micrograms per liter (μg/ℓ)
2-Butanone	3 to 6 μg/ℓ
2-Hexanone	<3 to 5 μg/ℓ
Methylene chloride	<3 to 6 μg/ℓ
4-Methyl-2-pentanone	<3 to 7 μg/ℓ
1,1,2,2-Tetrachloroethane	<2 to 6 μg/ℓ
1,1,2-Trichloroethane	<2 to 3 μg/ℓ

As a result, each of the VOC results in Table 4-2, except for toluene and vinyl acetate, are flagged as estimated and the detection limits elevated. Toluene was detected in both the equipment and rinsate blanks and was frequently detected in method blanks for other VOC data sets. Because of these factors, with the exception of 2-butanone (also known as methyl ethyl ketone) at 113 μg/ℓ and vinyl acetate at 6 μg/ℓ in well WHF-19-2D, the VOC data can be interpreted as artifacts and are not site related. 2-Butanone is a major component of paint strippers and solvents. However, because of the age of the site and elapsed time since its use, it is highly unusual to find 2-butanone in the absence of other halogenated organic compounds. This is because 2-butanone is more water soluble and volatile than the halocarbons and is readily transformed to carbon dioxide and water by microbial action. Its persistence in soils would be many times shorter than

halocarbons. 2-Butanone was a frequent artifact of other VOC method blanks and it is unlikely that the 2-butanone detected is related to Site 19B or Site 20B.

Vinyl acetate also is not a chemical likely to be associated with aircraft maintenance. Vinyl acetate is an industrial chemical heavily used as an intermediate or reactant in the formation of polyvinyl plastic products such as vinyl gloves and as a vehicle in latex paints. Vinyl acetate also is water soluble and volatile and therefore non-persistent in the soil environment.

4.2 SITE 20B, ABANDONED UNDERGROUND STORAGE TANKS AND FUEL PIT AREA.

4.2.1 Site Description and History Site 20B consists of the abandoned aircraft fuel storage and dispensing facility at OLF Barin. Figures 4-1 and 4-2 show the relationship of the site and its layout on the north and south sides of the Former Hangar Maintenance Area. The fuels system consisted of an aquafarm-type system installed in the 1940's and operated during the WWII period until 1947 and again in the 1950's until the installation was placed on inactive status in 1959. Based on Figures 4-1 and 4-2, Site 20B comprises an area of 19.8 acres and includes the 1-acre fuel USTs (USTs removed in January 1992) and pumping system area and the 18.8-acre hardstand area where the fueling pits are located.

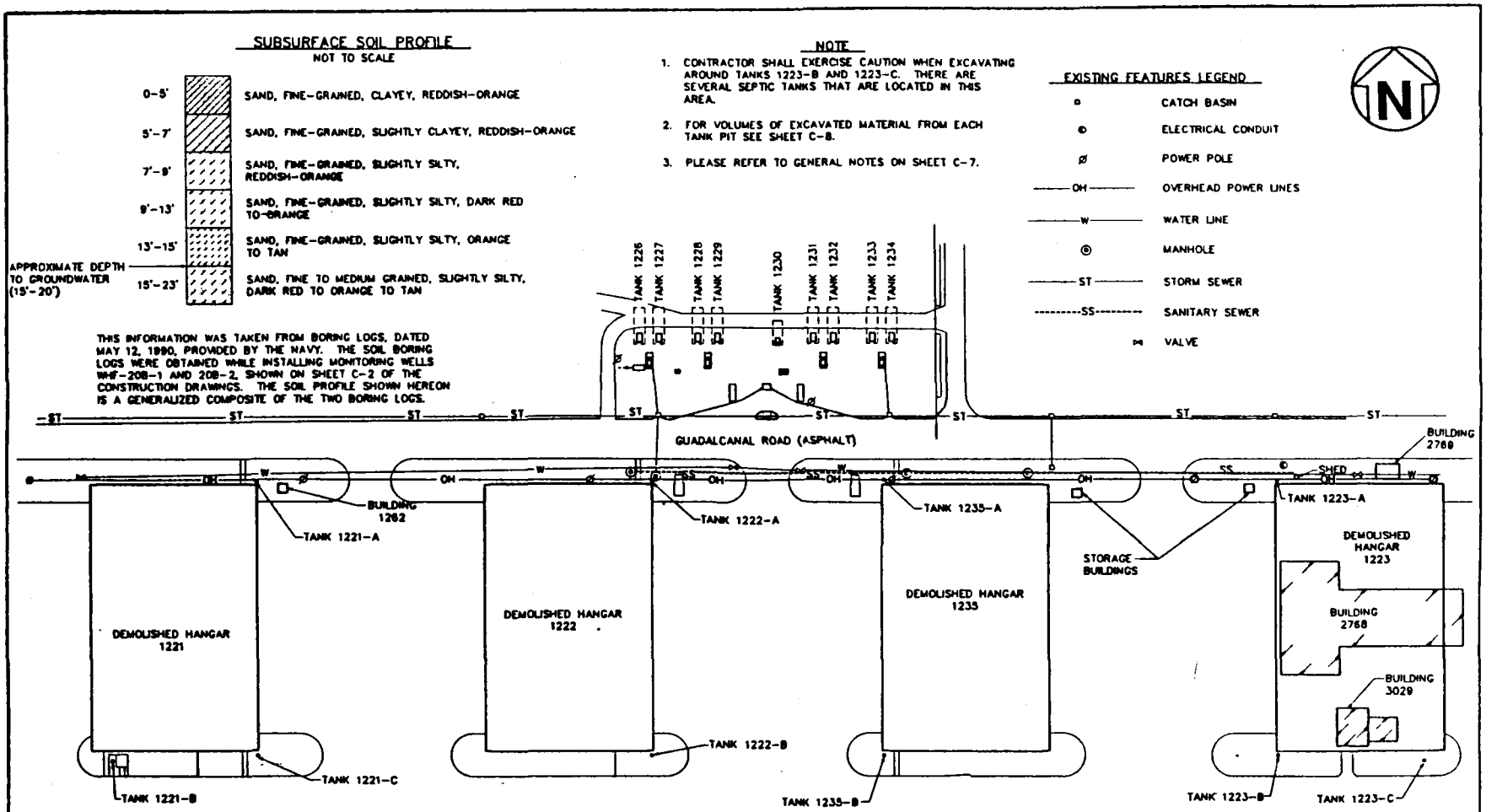
The former UST area, a reported 60 abandoned fuel pits, and 2.15 miles of underground fuel lines comprise Site 20B (Figure 4-3). All of the pits, and lines are reportedly still in place. The integrity of the fuel pits and lines is unknown. Table 4-1 tabulates the details of the fuel storage tanks construction and status prior to removal. The PA showed fuel lines running under Guadalcanal Road to dispense fuel via four rows of fuel pits. The lines from the aquafarm reportedly ran west of Hangar 1222 and east of Hangar 1235, respectively. Based on the tank diameters tabulated in Table 4-1 and depth of cover, the invert of the 25,000 gallon USTs can be estimated as 15 feet bls, which is near the water table.

Nine underground tanks were used during operation of NAAS Barin as storage for AVGAS during WWII, and AVGAS or jet fuel during the 1950's. Prior to removal, eight of the underground tanks (25,000-gallon capacity each) were being used as water storage reservoirs for fire protection. The remaining tank (15,000 gallons capacity) was empty. There is no information available on procedures followed to abandon these facilities when the field was deactivated in 1959. During the tank reactivation for water storage in the mid-1980's and during the PA visit, an oily sheen and residue were noted on the water in these tanks.

As discussed in Section 2.5, an UST removal action has been completed for the USTs at Site 20B. Table 4-1, taken from the remedial design report, indicates that no detectable fuel was present in the tanks.

During the dispensing of fuels, water for displacing the fuel was discharged to the storm sewer along Guadalcanal Road. Unknown quantities of water were discharged via this route.

According to the PA report, a 2,000-gallon aviation fuel spill occurred in 1954 when vandals opened a release valve on one of the 25,000-gallon fuel tanks. Most



SOURCE: ADAPTED FROM SOUTHNAVFACENGCOM, 1989

FIGURE 4-2

UST LOCATIONS AT THE FORMER HANGAR MAINTENANCE AND FUEL PIT AREA

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
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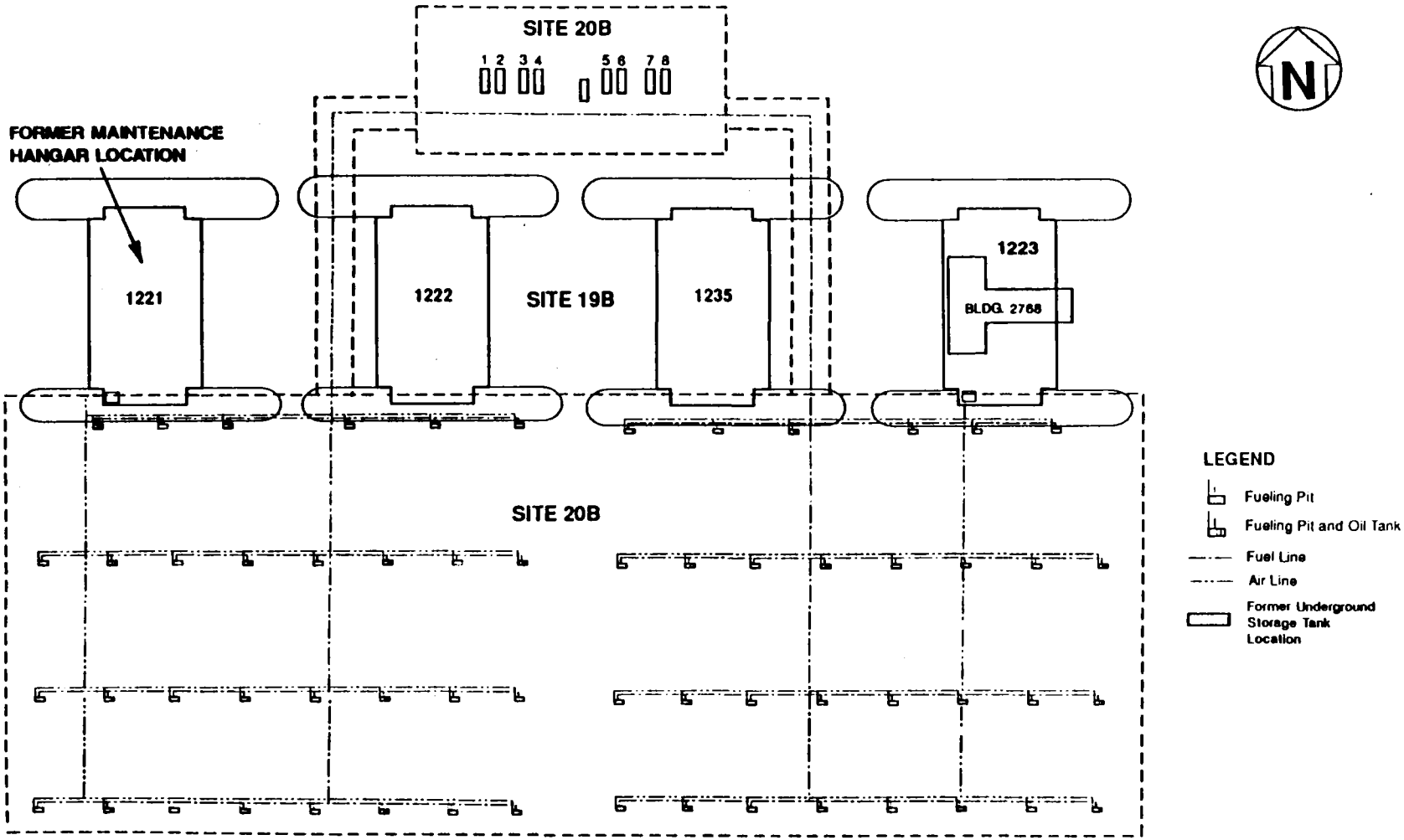


SCALE

0 225 450

FIGURE 4-3

LOCATIONS OF FUEL PITS AND LINES AT SITE 20B

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN FOLEY, ALABAMA

of the fuel reportedly migrated to an unlined drainage ditch along the north side of Guadalcanal Road. Due to the porous nature of the soils at OLF Barin, it is likely that some of the fuel migrated through the soil to the water table, which lies between 15 and 20 feet bls.

4.2.2 Previous Site Investigations The groundwater investigation SI program at OLF Barin focused on both Site 19B and Site 20B. Detailed assessments of the analytes detected and the hydrogeologic properties of the water table and production zone of the aquifer have been described in Section 3.4. Chemical water quality data were presented in Table 4-2. In contrast to their distance from Site 19B, the water table depth monitoring wells (WHF-20B-1 through WHF-20B-5) are located immediately downgradient of the former aviation fuel storage system or at the edge of the hardstand within 100 feet from the farthest south line of fuel pits. Each of these wells was screened at the water table to monitor for any undissolved petroleum hydrocarbons.

The chemical groundwater quality data show no evidence of significant fuel releases with the exception of the detection of lead at 0.03 mg/ℓ in WHF-20B-4 and 0.007 mg/ℓ at WHF-20B-2. A trace of toluene (2 μg/ℓ) was observed in well WHF-20B-1. This, however, may be a laboratory artifact. The mercury present in this well and in well WHF-20B-2 is not interpreted as eminating from site 20B. At the estimated rate of groundwater flow, contaminants from the lower 2/3 of the fuel pit area could be detected in wells WHF-20B-3, WHF-20B-4, and WHF-20B-5. The lead concentration observed in sample WHF-20B-4 is greater than the Alabama primary drinking water MCL. It could represent site-related contamination as residuals from AVGAS leaks in the 1940's or 1950's in the fuel pit area. Acetone and 2-butanone are not components of AVGAS or jet aircraft fuels. These chemicals have been interpreted as artifacts of VOC analysis.

4.3 SITE 21B, RUBBLE LANDFILL

4.3.1 Site Description and History The Rubble Landfill is located in the northeast section of OLF Barin as shown in Figure 4-4. This fill area reportedly received debris from dismantled buildings that were destroyed when the station was decommissioned and the north and west areas released in 1959. The landfill appears to be approximately 3.1 acres in area and lies immediately to the west of Sandy Creek. It borders a drainage pipe and ditch for approximately 350 feet. The fill appears to be free of surface debris except in the northeast edge bordering the drainage pipe. The remainder of the surface area is covered with vegetation, appears relatively smooth, and slopes slightly towards Sandy Creek providing a potential pathway for surface runoff from the landfill toward the creek. To the east of the drainage pipes, the fill slopes abruptly to the floodplain of Sandy Creek. The vertical distance from the top of the fill to the floodplain is approximately 15 feet.

According to the PA (NEESA, 1989), only waste debris from dismantled buildings was discarded on this site. No burial of the rubble was reported and all disposal was on the surface. During the PA site visit, no evidence of drums or other containers that might have contained hazardous waste was located. The site is overgrown with Kudzu vine so visibility was limited. The soils covering the landfill are porous and any leachate or runoff from the site would most likely

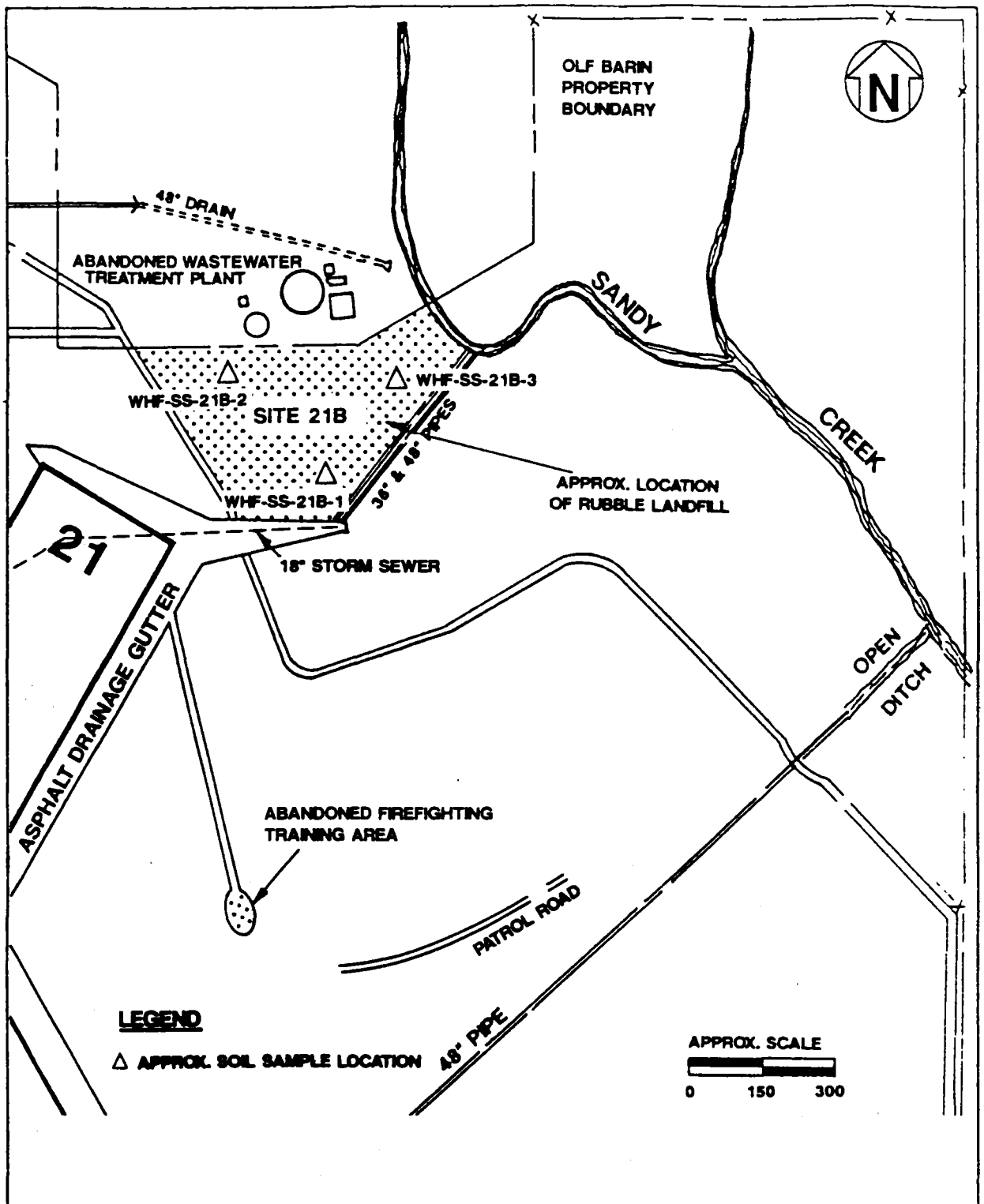


FIGURE 4-4
LOCATION OF SITE 21B,
RUBBLE LANDFILL, & SITE 26B,
ABANDONED WASTEWATER
TREATMENT PLANT

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

migrate to Sandy Creek approximately 50 to 100 feet northeast of the site. Leachate may discharge onto the floodplain immediately east of the storm drain, or may be collected in the storm drain depending on the integrity of the storm drain construction.

4.3.2 Previous Investigations The SI exploration program at the Rubble Landfill consisted of a thorough surface reconnaissance of the entire landfill area. Soil samples were taken at three locations on the fill as shown in Figure 4-4. No evidence of drums or containers was observed during the visual inspection that might indicate the disposal of hazardous waste.

Soil samples were collected at 1 to 2 feet depths at locations that had the best chance of being contaminated considering possible contaminant migration routes. A summary of the analytical results for the three soil samples collected from the Rubble Landfill is presented in Table 4-4.

Toluene was reported in the method blanks associated with this sample set at 180 micrograms per kilogram (μg/kg). Because of this factor, the detection limit for toluene has been elevated by a factor of 10 times. Concentrations below this level cannot be interpreted as distinguishable from laboratory contamination. The estimated value of 21 μg/kg in one replicate of sample WHF-SS-21B-3 is interpreted as such an artifact and not environmental contamination. Methylene chloride was found in the one field replicate at sample location WHF-SS-21B-3 at a reported concentration of 448 μg/kg, approximately 14 times the normal detection limit. Methylene chloride was not detected in the other replicate, field blanks, or method blanks for this sample set, but methylene chloride was reported in other method blanks in the analytical program. As with toluene, the methylene chloride present in a single replicate is suspected to be a laboratory artifact and not an environmental contaminant.

The metals detected in the soil samples from Site 21B have been tabulated in Table 4-4. These have been compared to the average and range of background soil concentrations tabulated in Table 4-3. No site-specific background soil samples were collected during the SI.

Table 4-3 presents mean concentrations of metals in uncontaminated surface soils in the Eastern United States as a whole and in clay or clay loam, sandy, and alluvial soils. These data were developed from a data set of more than 1,000 soil samples. None of the metals observed in surface soils at site 21B exceeds its respective tabulated mean concentration or is in the upper portion of any of the ranges in concentration for background. The soil from sample location WHF-SS-21B-3 is generally richer in metals that the other two sites. The differences probably reflect natural variability. Sample locations WHF-SS-21B-2 and WHF-SS-21B-3 are on the downslope side of the landfill surface.

4.4 SITE 22B, OLD FIREFIGHTING DEMONSTRATION AREA

4.4.1 Site Description and History The exact location of the Old Firefighting Demonstration Area is not known, but the PA (NEESA, 1989) locates it just west of the machine gun butt. The suspected location is shown in Figure 4-5. The suspected location is a level, poorly vegetated area with poor drainage. More

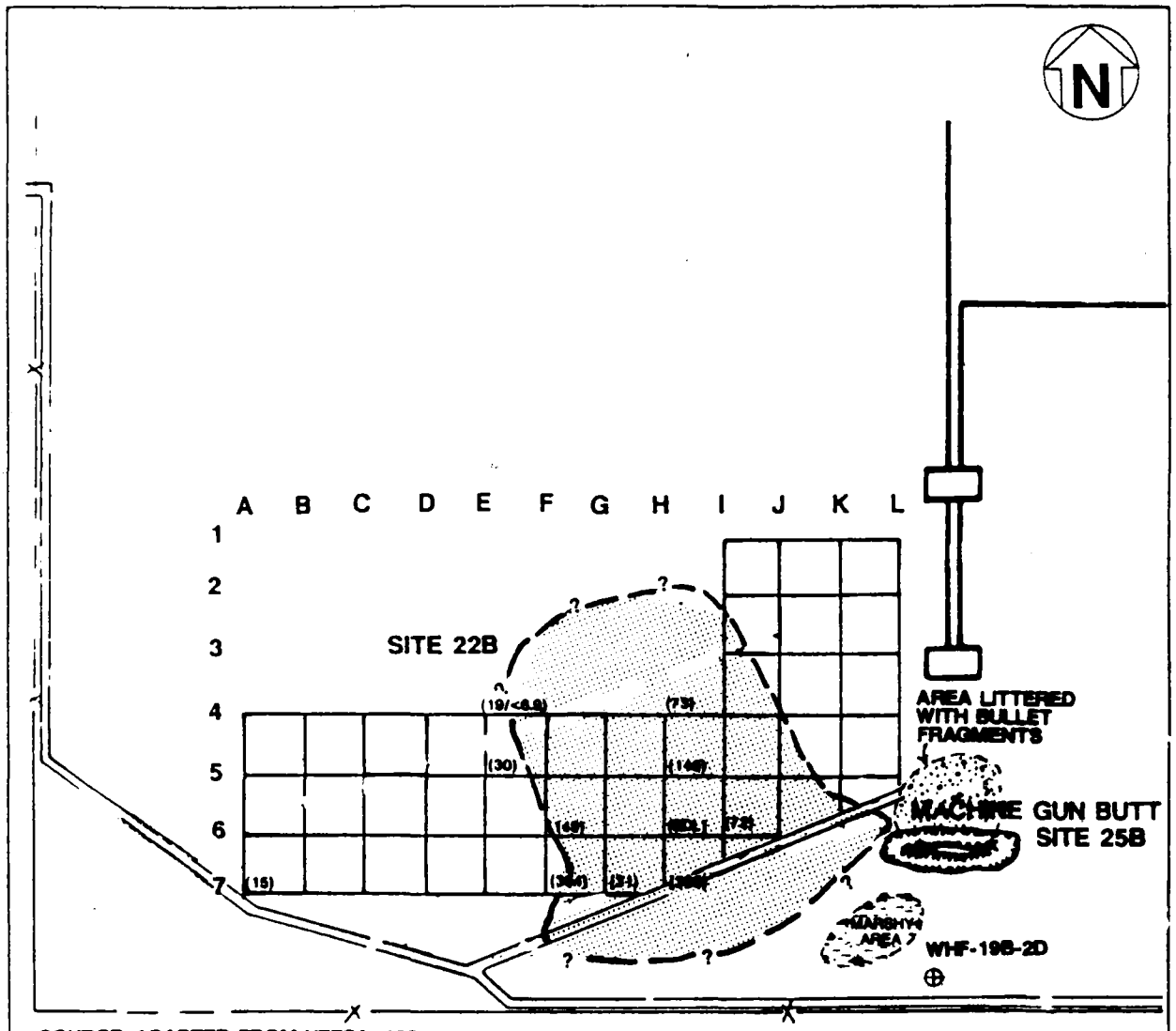
Table 4-4
Summary of Surface Soil Data, Rubble Landfill, Site 21B

RI/FS Workplan
OLF Barin, Foley, Alabama

Compound	Soil Sample Location			
	WHF-SS-21B-1	WHF-SS-21B-2	WHF-SS-21B-3	WHF-SS-21B-3-D
Inorganic Chemicals (mg/kg)				
Aluminum	1,711	4,842	24,167	13,187
Barium	7.4	8.4	24	18
Calcium	63	89	167	130
Chromium	1.1	1.1	24	12
Copper	<1.6	3.2	11	4.4
Iron	2,526	2,737	11,611	6,923
Potassium	49	36	117	60
Magnesium	79	95	167	66
Manganese	7.4	44	<0.56	<0.55
Arsenic	0.63	0.68	2.20	1.65
Vanadium	<11	11	40	24
Zinc	1.1	2.6	6.1	<1.1
Volatile Organic Chemicals (μg/kg)				
Toluene	180 UJ	<180 UJ	<180 UJ	21 J
Methylene chloride	<32	<32	448	<33

Notes: All analyses for total phenols, cyanide, semivolatile organic compounds (SVOC), pesticides, and polychlorinated biphenyls (PCBs) were below detection limits.

mg/kg = milligram per kilogram.
μg/kg = microgram per kilogram.
J = Concentration is estimated due to being <10 times the concentration in the method blanks (see Section 4.2).
UJ = Analyte is undetected; however, due to contamination in the method blanks the reported detection limit is elevated to account for inability to discriminate positive results that are less than 10 times the detection limit from potential blank contamination (see Section 4.2).



SOURCE: ADAPTED FROM NEESA, 1989

LEGEND

SOIL SAMPLING GRID

(364) LEAD CONCENTRATION (mg/kg)

⊕ MONITORING WELL

AREA OF ELEVATED LEAD CONCENTRATION

APPROX. SCALE

0 150 300

FIGURE 4-5

LOCATION OF SITE 22B, OLD FIREFIGHTING DEMONSTRATION AREA, AND SITE 25B, MACHINE GUN BUTT

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

than 45 years have elapsed since firefighting exercises were staged in this area. The last firefighting demonstrations to take place occurred during World War II and probably numbered fewer than 12 to 15 total demonstrations. The area does not show on any of the historical plans or aerial photographs.

Discussions with station firefighting personnel resulted in an estimate of 400 to 1,000 gallons of combustible liquids including contaminated fuel that could have been ignited on a wrecked aircraft for each demonstration. During WWII it is likely that oils and spent solvents were commingled with the fuel. No records exist describing the total amount of liquid flammables that were actually used during the WWII demonstrations.

Because of the age of the site, it is expected that any mobile and degradable constituents would likely have migrated or disappeared. Probable contaminants would have included tetraethyl lead from AVGAS, volatile and semivolatile fuel hydrocarbons, combustion products such as polynuclear aromatic hydrocarbons (PAHs), as well as any solvents, cleaners, or other materials that may have been commingled with the materials used in the practices and demonstrations. It would be expected that degradable or volatile materials such as hydrocarbons and solvents would have disappeared from the soil surface layers. Residual chemicals such as lead or PAHs might remain if sorbed to soils.

Migration pathways for existing residual contaminants would be overland transport in surface water runoff, vertical transport to the water table with infiltrating rainwater followed by migration in groundwater, and atmospheric transport as suspended particulates. The latter transport is significant due to the poorly vegetated, sandy nature of the area where the site is suspected to have been located. Because both the residual lead and PAHs are strongly bound to soil, migration along with infiltrating water in the vadose zone and further migration in groundwater would be expected to be slow or non-existent.

4.4.2 Previous Site Investigations The SI sampling program consisted of the collection of surface soils in a grid pattern designed to delineate the approximate position of the Old Firefighting Demonstration Area. A total of 54 sample locations were explored. Soil samples, including five duplicate samples, were collected from a depth of between 1 and 2 feet on a 100-foot grid pattern (see Figure 4-5). These samples were analyzed for lead, because it was considered the most likely residual constituent of AVGAS that might remain to support location of the site.

Ten of the soil samples contained detectable levels of lead, ranging from 15 milligrams per kilogram (mg/kg) in WHF-SS-22B-A7 to 364 mg/kg in WHF-SS-22B-F7. Table 4-5 presents a summary of the lead analytical data, which are arrayed on Figure 4-5. All other samples were free from detectable lead. Detection limits ranged from 6.8 to 8.3 mg/kg. Nine of the 10 samples containing detectable lead were collected between grid locations E4 to 7 and I4 to 7. The highest lead concentrations are located at the southern portion of the grid at grid positions F7 and H7. Figure 4-5 depicts the area of elevated lead. Background lead in the area sampled appears to be below the limit of detection. The lead content of the samples greater than 15 to 20 mg/kg is in excess of geometric mean concentrations for clay, clay loams, and sandy soils (Kabata-Pendias and Pendias, 1984) as tabulated in Table 4-3.

Table 4-5
Summary of Positive Results for Lead of Surface Soil Samples, Old Firefighting Demonstration Area, Site 22B

RI/FS Workplan
OLF Barin, Foley, Alabama

Sample No.	Lead Concentration (mg/kg)	Sample No.	Lead Concentration (mg/kg)
WHF-SS-22B-I6	72	WHF-SS-22B-F6	149
WHF-SS-22B-H4	73	WHF-SS-22B-F7	364
WHF-SS-22B-H5	146	WHF-SS-22B-E4	19/<6.9
WHF-SS-22B-H7	338	WHF-SS-22B-E5	30
WHF-SS-22B-G7	31	WHF-SS-22B-A7	15

Notes: Sample WHF-SS-E4 duplicate was non detect (<6.9 mg/kg).
All other samples were below detection limits.
mg/kg = milligram per kilogram.

4.5 SITE 23B, DRAINAGE DITCH LEADING TO SANDY CREEK.

4.5.1 Site Description and History The drainage ditch system (Figure 4-6) runs east from Guadalcanal Road, turning north approximately 500 feet east of the Command Building (Building 2768), travels approximately 2,500 feet north, and intersects another open ditch, which flows approximately 2,000 feet east to Sandy Creek. This drainage ditch is unlined throughout its length from Guadalcanal Road to the ends of the runway. The ditch exists only as a swale along the north end of the runway. Soil in the ditch sides and bottom is similar to the soil types found in the relevant part of the installation, Lakeland loamy fine sand (see Figure 3-6). This latter drainage ditch (swale), travels around the ends of Runways 15, 18, and 21 and into an asphalt drainage gutter. The gutter diverts flow around the Rubble Landfill and through a concrete drainage pipe to a small stream that discharges into Sandy Creek.

The drainage ditch system reportedly carried runoff from the Former Hangar Maintenance Area, Site 19B, as well as discharged water from the aquafarm fuel system (Site 20B) and provided an avenue for contaminants to travel toward Sandy Creek. A 2,000-gallon fuel spill, which occurred in 1954, migrated toward Sandy Creek via the drainage ditch. During the 1940's, aircraft were washed on wash racks in the Former Hangar Maintenance Area using kerosene as a cleaner. Reportedly (NEESA, 1984), kerosene was reclaimed through the use of an oil-water separator. Discharge of rinse water through the oil-water separators was conveyed toward Sandy Creek via the Site 23B ditch.

After the SI field investigation was completed, additional blue line drawings of underground utilities were obtained by ABB-ES from the public works department at NAS Whiting Field. One of the maps showed an 18-inch diameter reinforced concrete storm sewer running along the north side of Guadalcanal Road under the northern end of the runways and discharging into a ditch adjacent to the 48-inch

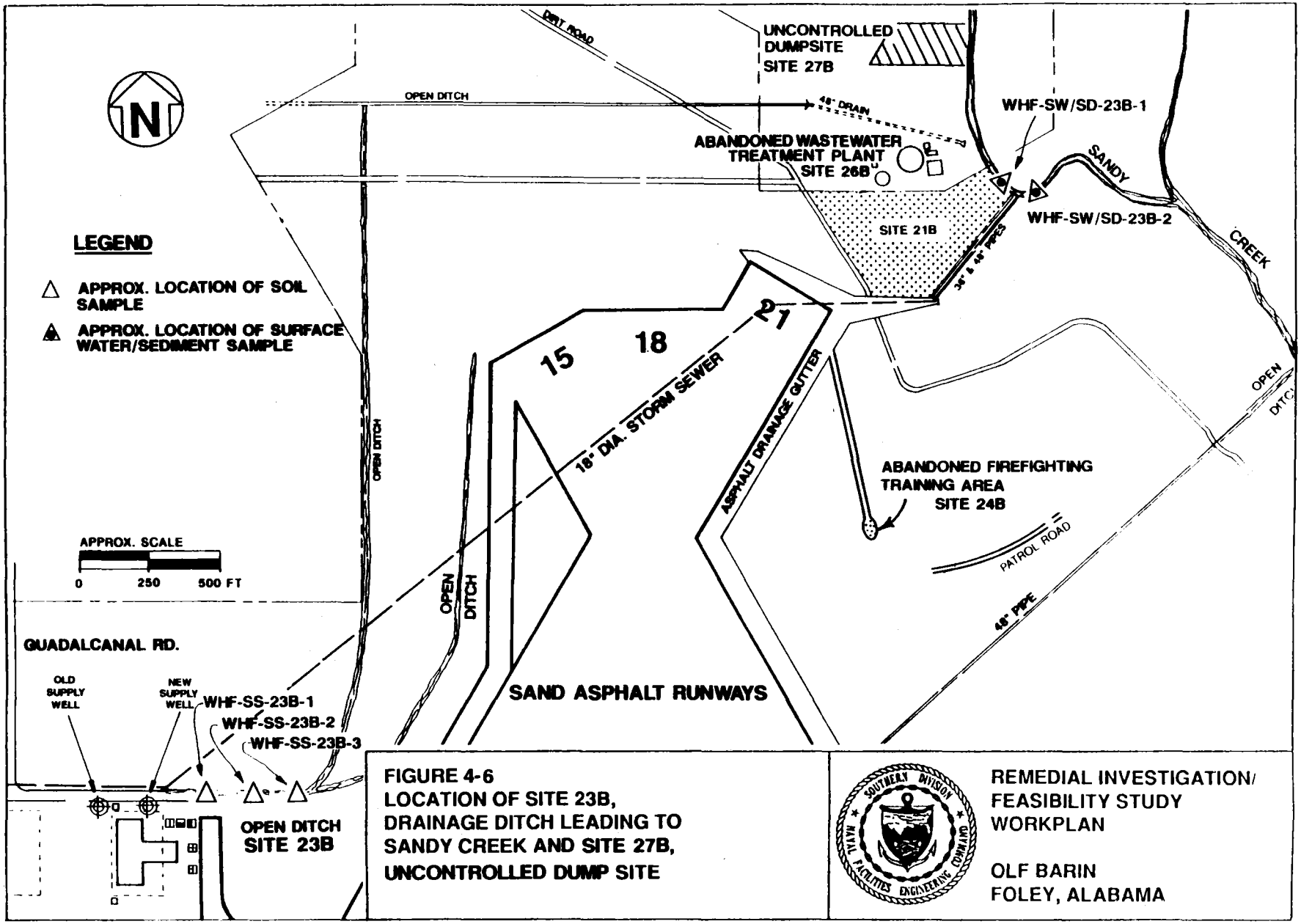


FIGURE 4-6
LOCATION OF SITE 23B, DRAINAGE DITCH LEADING TO SANDY CREEK AND SITE 27B, UNCONTROLLED DUMP SITE

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pipe used to drain the runways (Figure 4-6). The ditch is approximately 400 feet long and discharges into Sandy Creek.

The 18-inch storm sewer drained runoff from the underground storage tank area, Guadalcanal Road, the aircraft maintenance hangars, and the aircraft wash racks. Six-inch diameter vitrified clay pipe drained stormwater from the four maintenance hangars and fluids generated from wash rack activities. These 6-inch drainage pipes discharged fluids into the 18-inch storm sewer on the north side of Guadalcanal Road (Figure 4-6). All of the storm sewer lines are reportedly still in place.

Sandy Creek was reported to be unfishable due to kerosene contamination when the aircraft washing operations were underway at OLF Barin. Fishing in Sandy Creek was discontinued in the early 1950's according to the PA (NEESA, 1989).

The potential releases to the upper reaches of the storm drainage ditch via the storm sewer along Guadalcanal Road include solvents, battery electrolytes, and cleaners from the Former Hangar Maintenance Area, as well as the fuel spill and discharge water from the aquafarm.

4.5.2 Previous Investigations The SI exploration program for Site 23B was conducted at two general locations. The first consisted of collection of soil samples from the upper end of the drainage ditch. The second consisted of collection of surface water and sediment samples from two locations in Sandy Creek. Sample locations are shown in Figure 4-6.

Drainage Ditch. A total of four soil samples, including one duplicate sample, were collected from three locations in the drainage ditch at the east end of Guadalcanal Road and analyzed for total lead and PAHs. Both of these analyte groups are residual constituents of AVGAS. The soil samples were taken at depths between 1 and 2 feet bls starting at the storm sewer outfall on Guadalcanal Road and extending down the ditch at 100-foot intervals (see Figure 4-6). The purpose of this sampling was to assess the presence of residual fuels from the 1954 fuel spill, presumed to be AVGAS.

Results of lead and PAH analyses are presented in Appendix B. No lead or PAHs were detected from the soils in the upper reaches of the ditch. Lead detection limits ranged from 7.1 to 7.5 mg/kg in the four samples. The detection limits for PAHs was 10 µg/kg in the samples collected 100 and 200 feet downstream of the storm sewer outfall.

Surface Water and Sediment. Two surface water and two sediment samples were collected at the confluence of the drainage ditch and Sandy Creek (see Figure 4-6). One surface water and sediment sample set was collected approximately 50 feet upstream of the drainage ditch discharge point and the other sample set was collected approximately 50 feet downstream of the discharge point. The downstream set was collected in duplicate. Analytical results are summarized in Tables 4-6 and 4-7.

Table 4-6
Summary of Surface Water Data, Drainage Ditch Leading to Sandy Creek, Site 23B

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OLF Barin, Foley, Alabama

	Surface Water Sample Location		
Compound	WHF-SW-23B-1-1	WHF-SW-23B-2-1	WHF-SW-23B-2-D1
Inorganic Compounds (mg/ℓ)			
Total aluminum	0.5	<0.5	<0.5
Total calcium	2.8	2	1.7
Total cyanide	0.006	<0.005	<0.005
Total iron	0.36	0.32	0.3
Total potassium	0.8	0.8	0.7
Total magnesium	1.7	1.7	1.7
Total manganese	0.03	<0.01	<0.01
Total sodium	3.5	3.1	3
Total zinc	0.05	<0.01	<0.01

Notes: All surface water sample results for total phenols, semivolatile organic compounds (SVOC), pesticides, polychlorinated biphenyls (PCB), and volatile organic compounds (VOCs) were below detection limits (see Appendix B).

All other metals were below the following detection limits:

Total silver	<0.002
Total arsenic	<0.001
Total barium	<0.1
Total beryllium	<0.01
Total cadmium	<0.0002
Total cobalt	<0.05
Total chromium	<0.01
Total mercury	<0.0005
Total nickel	<0.05
Total lead	<0.004
Total antimony	<0.1
Total selenium	<0.003
Total vanadium	<0.2
Total thallium	<0.4

mg/ℓ = milligram per liter

Table 4-7
Summary of Sediment Data, Drainage Ditch Leading to Sandy Creek, Site 23B

RI/FS Workplan
OLF Barin, Foley, Alabama

	Sediment Sample Location		
Compound	WHF-SD-23B-1-1	WHF-SD-23B-2-1	WHF-SD-23B-2-D1
Total Phenols (mg/kg)			
Total phenols	3.6	3.8	0.35
Inorganic Compounds (mg/kg)			
Silver	<0.014	0.021	0.014
Aluminum	979	5,417	3,056
Barium	<7.1	9	<6.9
Calcium	<71	136	132
Chromium	<0.71	4.9	2.8
Copper	<2.1	2.8	<2.1
Iron	407	2,639	1,215
Potassium	<43	69	65
Magnesium	17	76	47
Manganese	<0.71	0.71	<0.70
Sodium	20	<14	14
Arsenic	0.21	0.69	0.42
Selenium	<0.21	0.28	0.21
Zinc	<1.4	1.4	2.1
Pesticides and polychlorinated biphenyls (PCB) (μg/kg)			
4,4'-DDD	<1.0	2	2
4,4'-DDE	<1.0	5	4
4,4'-DDT	<1.0	14	10
Dieldrin	<1.0	10	8
Volatile Organic Compounds (μg/kg)			
Toluene	229	115J	155J
2-Butanone (MEK)	43	<38	56
Methylene chloride	100	<38	113
Ethyl benzene	57	26	42
Total xylenes	286	128	226

Notes: All samples for acid extractables and base neutrals were below detection limits (see Appendix B).
mg/kg = milligram per kilogram.
μg/kg = microgram per kilogram.
4,4'-DDD = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethane.
4,4'-DDE = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethylene.
4,4'-DDT = 1,1,1-trichloro 2,2-bis (p-chlorophenyl) ethane.
MEK = methyl ethyl ketone.
J = Concentration is estimated due to being <10 times the concentration in the method blanks (see Section 4.2).

Surface water quality results are tabulated in Table 4-6. No detectable organic chemicals (VOCs, SVOCs, pesticides, PCBs, or total phenols) were detected at either sampling location. As shown in Table 4-6, none of the metals, with the exception of the typical major dissolved constituents of uncontaminated surface water, were detected.

A trace of total cyanide (0.006 mg/ℓ) was detected in the sample upstream from Sandy Creek. As shown in Figure 4-6, this sampling location may not be upstream of groundwater discharge from the Rubble Landfill. Cyanide in the Sandy Creek sample at WHF-SW-23B-1-1 may be related to a release from the Rubble Landfill (Site 21B) or may be migrating from farther upstream. Cyanide is a component of metal plating waste, color photographic processing, and metal polishing and is an ingredient in some types of fungicides and pesticides.

Table 4-7 is a summary of the results of analyses of sediments from WHF-SD-23B-1-1 and the duplicate analysis of WHF-SD-23B-2-1. The results of metals analyses of the sediments can be compared with results of surface soils analyses (Table 4-4) at the Rubble Landfill (Site 21B) and with Table 4-3, which presents the mean and range of metals in background soils in the Eastern United States, the Gulf Coast of Florida and Alabama, and clay, clay loam, sandy, and alluvial soils. None of the metals found in the sediments were greater than the expected mean for background soils.

Total phenols were detected at 0.35, 3.6, and 3.8 mg/kg. No acid-extractable organic chemicals were detected at detection limits of 0.47 to 3.6 mg/kg for individual TCL phenolics. In the absence of any of the TCL phenols or phenol itself, the total phenol results are interpreted as likely being a result of natural decaying organic material. Phenols also may be the result of the weathering of hydrocarbons in fuels, however.

Evidence of fuel-related contamination of Sandy Creek is present in the sediment samples. Toluene, ethyl benzene, and xylenes were present at consistent concentrations in the upstream sample and both replicates at the downstream location as shown in Table 4-7. Toluene, however was observed at 18 μg/ℓ in the accompanying method blanks. All toluene detected in the sediment data above 180 μg/kg were therefore flagged "J" as an estimated value. This is because much of the concentration may not be unequivocally interpreted as resulting from the environmental sample and not from the method blank. Ethyl benzene, toluene, and xylenes, when present together (and usually also accompanied by benzene) are characteristic of gasoline, aviation fuel, diesel fuel, or light fuel oil contamination.

2-Butanone and methylene chloride were detected in one of the downstream replicates and in the upstream sample. Because of the frequent encountering of these chemicals as laboratory artifacts, their presence is suspected to be the result of sample handling or a laboratory artifact.

Residual persistent chlorinated pesticides were detected in both replicates of the downstream Sandy Creek location (samples WHF-SD-23B-2-1 and WHF-SD-23B-2-D1). The chemicals detected were 1,1,1-trichloro 2,2-bis (p-chlorophenyl)ethane (4,4'-DDT), 1,1,-dichloro 2,2-bis(p-chlorophenyl)ethane (4,4'-DDD), 1,1,-dichloro 2,2-

bis (p-chlorophenyl)ethylene (4,4'-DDE), and dieldrin. No longer used in agriculture or military pest control, these chemicals have environmental half-lives in excess of 10 years and are frequently observed in low concentrations in the sediments of streams draining agricultural lands. Their presence in only the downstream sample suggests that they may either have migrated from the landfill or have been transported by storm water runoff from OLF Barin.

4.6 SITE 24B, ABANDONED FIREFIGHTING TRAINING AREA.

Site Description and History. The firefighting training area was built in July 1989 to comply with the Navy's crash crew firefighting training requirements. The burn pit is 50 feet in diameter and is located about 1,000 feet south of Site 21B (Figure 4-7). According to Whiting Field Public Works Department, three firefighting exercises were conducted every Thursday for 125 weeks between July 1989 and December 1991. Approximately 300 gallons of JP-5 jet fuel were used per training day and 37,500 gallons of JP-5 jet fuel were used over the entire operation of the burn pit. The fires were extinguished with a mixture of aqueous film forming foam (AFFF) and water (12 gallons of AFFF to 200 gallons of water). Only JP-5, which was either clean or contaminated with water or hydraulic fluid, was used. No other fuels, solvents, or other chemicals were used in the exercises.

The burn pit consists of a 60 mil polyethylene synthetic liner covered with 18 inches of clay and 6 inches of sand (Figure 4-7). The berm around the burn pit has recently been built up to prevent ponding water contaminated with JP-5 from overflowing. However, stressed vegetation and stained soils indicate that contaminated water from the burn pit has previously overflowed. The runoff path from the burn pit is approximately 30 feet wide and is toward Sandy Creek. Surface soils of the runoff path contain a slight diesel odor.

The firefighting training area was deactivated in December 1991 and was subsequently added to the RI. The Navy plans to construct a state of the art firefighting training area to prevent the contamination of soil and groundwater. No previous investigations have been conducted at the abandoned firefighting training area.

4.7 SITE 25B, MACHINE GUN BUTT

Site Description and History. The machine gun butt is located just east of the suspected location of the old firefighting demonstration area (Figure 4-5). The butt is composed of soil and is estimated at 50 to 75 feet wide by 100 to 150 feet long and 10 to 15 feet high. The machine gun butt was used as a target for fire from 0.50 caliber machine guns and other firearms during the 1940's and 1950's.

The machine gun butt site was identified as a potential contaminant site during SI and HRS II site visits in 1991. During the site visits, spent lead, steel, and copper jacketed bullets, shotgun lead shot, and bullet fragments (ranging from 0.22 to 0.50 caliber) were observed littering the ground on the north side of the machine gun butt. However, during a site visit in September 1991 it was discovered that most of the bullets and spent shells had been scooped up with the

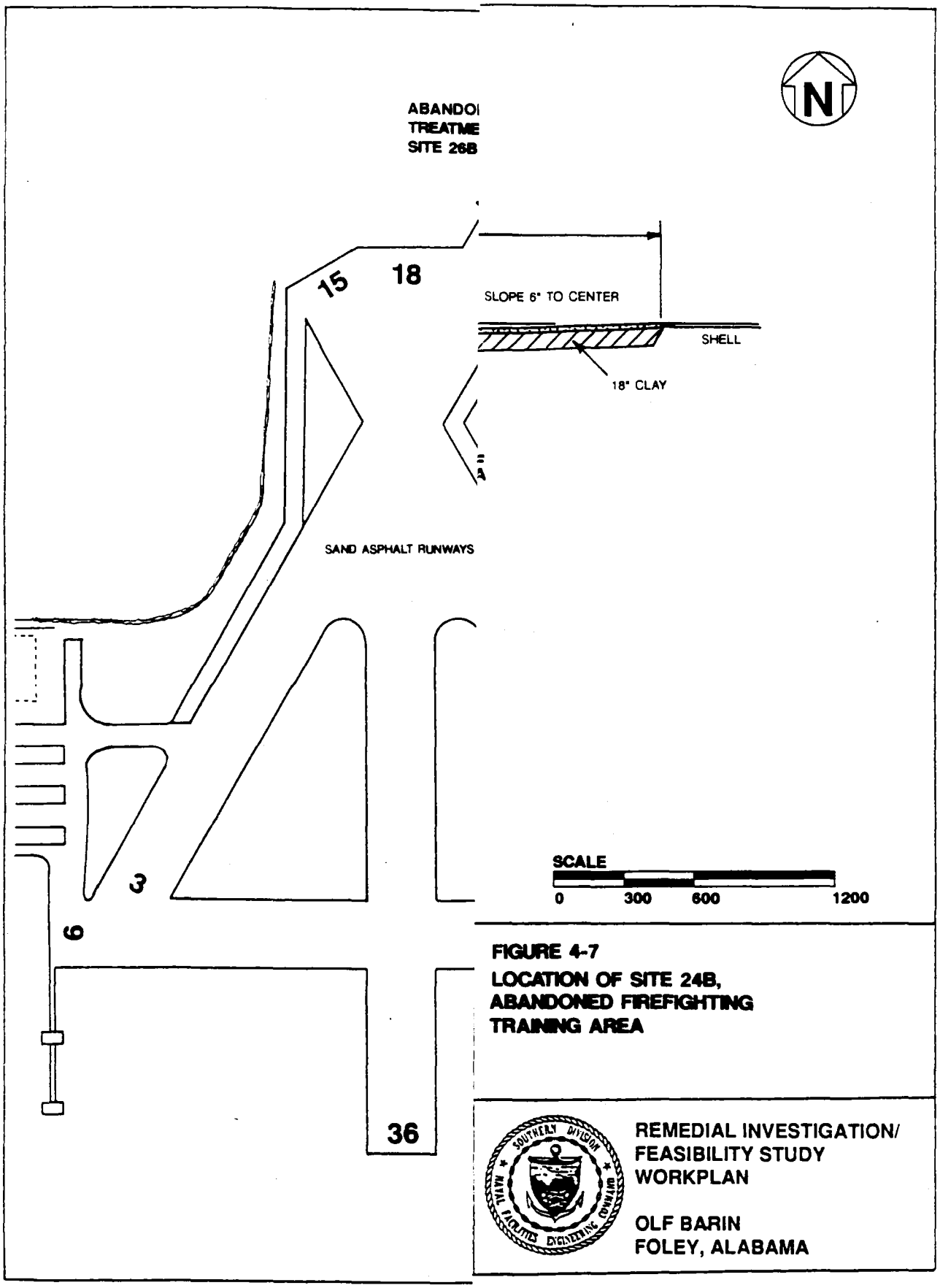

FIGURE 4-7
LOCATION OF SITE 24B, ABANDONED FIREFIGHTING TRAINING AREA

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dirt from the machine gun butt to be used as fill for the repair of a washed out patrol road at the east end of OLF Barin. No previous investigations have been conducted at the machine gun butt site.

4.8 SITE 26B, ABANDONED WASTEWATER TREATMENT PLANT

Site Description and History. The OLF Barin Wastewater Treatment Plan was taken out of service in 1959 when the installation was deactivated and the Administrative Area and West Field excessed.

The abandoned wastewater treatment plant (AWTP) is located directly north and adjacent to the rubble landfill (Figure 4-4). The AWTP covers an area of approximately 160 feet by 260 feet (1 acre) and is overgrown with vegetation, limiting visibility. Remaining components of the AWTP include primary and final settling tanks, trickling filter, digester tank, chlorination chamber, and a 46 foot by 56-foot sludge drying bed.

The AWTP site was identified during SI and HRS II site visits in 1991. No previous investigations have been conducted at the AWTP.

4.9 SITE 27B, UNCONTROLLED DUMPSITE

Site Description and History. This site comprises an area estimated as 0.5 to 0.75 acre located at the northeastern boundary of OLF Barin where the boundary fence has been torn down (Figure 2-3). Motor vehicle access is possible to the area and it has become a dump area for used appliances, paint cans, garbage, as well as tires, auto parts, and used motor oil cans. Three rusted 55-gallon drums were observed during the limited inspection. Much of the site is overgrown with vines and brush, restricting visibility.

In addition to uncontrolled dumping of trash, garbage, and unknown material that appears to be ongoing, the area also represents an attractive play area for children. A housing area consisting of approximately 30 homes and mobile homes is located from 500 to 1,500 feet north of the dumpsite along U.S. Highway 98. During the HRS II site visit there was abundant evidence of fishing activities, picnicking, and body contact water sports activities along Sandy Creek adjacent to the uncontrolled dumpsite.

The uncontrolled dumpsite was identified during SI and HRS II site visits in 1991. No previous investigations have been conducted at the uncontrolled dumpsite.

4.10 SITE 28B, FUEL PIT DRAINAGE DITCH.

Site Description. The fuel pit drainage ditch is located at the south end of the fuel pit area (Figure 4-8). The ditch runs west to the installation boundary, turns south, travels approximately 700 feet to an open ditch, continues south approximately 70 feet, runs out the southwest corner of the installation boundary, and travels approximately 2,600 feet before discharging into Wolf Creek.

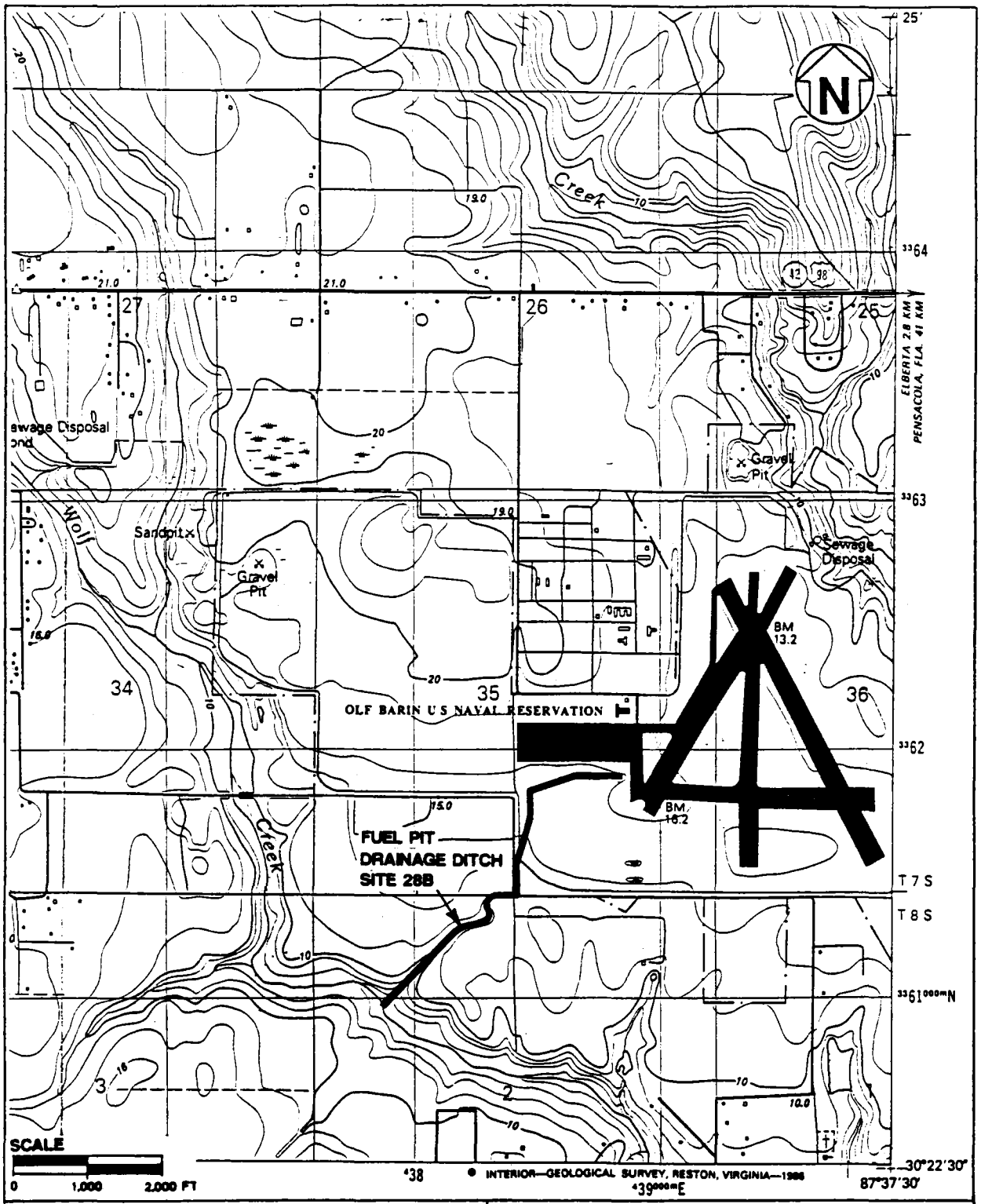

FIGURE 4-8

LOCATION OF SITE 28B, FUEL PIT DRAINAGE DITCH

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The first 2,000 feet of the drainage ditch are lined with concrete, however, it is unlined throughout its remaining length to Wolf Creek. A review of historical aerial photographs show the concrete portion of the ditch was originally an unlined swale. The ditch received stormwater that drained from the concrete fuel pit area. The potential releases to the unlined ditch and eventually Wolf Creek include solvents, waste oil, and fuel.

The drainage ditch was identified as an area of concern during a RI site visit in January 1992.

5.0 GENERAL DESCRIPTION OF REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) TASKS

The RI/FS process will be tailored to allow prioritization of sites according to potential threat to human health and the environment. The process will initially focus on source identification, with delineation of soil and sediment contamination and confirmation of groundwater and surface water contamination.

If groundwater or surface water contamination is not judged to be an immediate threat, delineation of the complete extent of groundwater and surface water contamination may be performed on a larger scale, after source data on several sites have been gathered. This allows delineation on a larger scale by viewing local aquifer and surface water systems as an individual operable unit(s) that may be impacted by several sites simultaneously.

If initial data evaluation at any site shows groundwater or surface water contamination to be an immediate threat to human health or the environment, interim or early remedial actions may be performed to mitigate further transport from the site.

In this process, data are continually assessed and sites are evaluated to determine: (1) if contamination is present, (2) if it presents a threat, (3) if it has been delineated, and, finally, (4) what further action is needed (i.e., delineation, interim or early remedial actions, or evaluation of remedial alternatives). The process eliminates lengthy interim report development and review times by allowing continual data assessment and rapid decision making.

Through this approach, the RI/FS process can be responsive to individual site characteristics and technical requirements without lengthy delays between field actions. This provides the flexibility to address any site, operable unit, or set of operable units separately or as a whole. In addition, specific matrices (i.e., soil, sediment, groundwater, surface water, or air) of individual sites, or operable units, can be treated separately if necessary, or a single matrix may be investigated at one time across the entire facility.

5.1 DATA QUALITY OBJECTIVES (DQOs). The intended use of data and the required DQOs are best defined during the planning stages to ensure that collection, decontamination, containerization, shipping, and analytical methods are consistent with the degree of confidence required of the resultant data. The following sections provide a brief description of USEPA DQO levels and identifies the levels associated with each RI/FS field task.

5.1.1 Data Quality Objectives (DQOs), General Description DQOs refer to standards for analytical precision, accuracy, reproducibility, completeness, and comparability (PARCC). Five DQO levels have been defined by the USEPA: Level I, Field Screening; Level II, Field Analysis; Level III, Laboratory Analysis; Level IV, Contract Laboratory Program-Routine Analytical Services (CLP-RAS); and Level V, Non-Conventional Parameter Analysis (USEPA, 1991c). Details of the DQO levels are provided in the QAPP (Volume II).

NEESA has adopted three of these levels as QA requirements; Levels C, D, and E, which correspond with USEPA Levels III, IV, and V (NEESA, 1988). For the purposes of this document, the USEPA nomenclature (Levels I through V) will be used.

The DQO level needed for a specific task is generally based on the intended use of the data and on the limitations of the analytical instrumentation. Many field screening and field analytical techniques are intended to provide a rapid turn-around time and qualitative data for decision making in the field. Field techniques necessarily involve rugged instrumentation with less sample preparation and rapid analysis. More precise and accurate analytical methods are used when both qualitative and quantitative data are needed, such as to support site characterization, confirmation, enforcement, treatability, and/or remedial action. The five broad categories of data quality used in the RI/FS process are described in Section 4.1 of the QAPP.

5.1.2 Task Specific Data Quality Objectives (DQOs) Tasks for the RI/FS at the OLF Barin will involve data collection with DQOs ranging from Level I through Level IV. Table 4-1 in Volume IIB, QAPP of this report presents the primary RI/FS tasks to be conducted at OLF Barin and the associated DQO level.

5.1.3 Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) Definition Parameters used within the data validation process to evaluate data quality include measurement of PARCC. The achievable limits for these parameters vary with the DQO level of the data. The limits used for laboratory analytical data in this RI program will be those set by the CLP for Level IV DQOs. These parameters are defined and methods of calculation are discussed in Volume IIB (QAPP, Section 4.3).

5.2 PRELIMINARY ACTIVITIES.

5.2.1 Subcontractor Coordination Upon receipt of notice to proceed, ABB-ES will contact all appropriate subcontractors to finalize any remaining contractual matters and plan the mobilization and related activities associated with fieldwork for each site. Coordination activities include: scheduling, staffing, and procurement of all personnel, materials, equipment, and supplies required to complete the proposed work. Such subcontractors may include drillers, land surveyors, explosive ordnance location and disposal specialists, and analytical laboratories.

5.2.2 Permitting, Authorization, and Site Access In conjunction with subcontractor scheduling, ABB-ES will ensure that the necessary authorization and approval is secured for site access by all personnel scheduled for field activities. The Environmental Coordinator at NAS Whiting Field will be contacted to arrange site access for both ABB-ES and subcontractor personnel. In addition, ABB-ES will ensure that all necessary permits (e.g., monitoring well installation permits) have been obtained prior to mobilization for fieldwork.

5.2.3 Utility Identification and Location Prior to mobilization for fieldwork, ABB-ES will coordinate with NAS Whiting Field and OLF Barin personnel to identify and locate all underground utilities and other underground structures, as well as overhead utilities at each site that may obstruct field activities. Upon mobilization to the field, ABB-ES will work with base personnel to mark each utility for future reference, to minimize the risk of jeopardizing the health and safety of field personnel or the integrity of the utility. Identification and location of utilities may include referring to blueprints and using electronic equipment in the field for physical location of utility lines. NAS Whiting Field will assume final responsibility for the location and identification of utilities or other subsurface structures.

5.3 COMMUNITY RELATIONS. NAS Whiting Field will be responsible for conducting a community relations program for OLF Barin consistent with USEPA guidance and perceived community needs. The community relations program will promote community awareness through fact sheets, public meetings, and/or news releases. The program will solicit community input during the decision-making process through Technical Review Committee (TRC) meetings and public review of primary documents. ABB-ES will provide technical support to Naval personnel in conducting the community relations program, including assistance with preparation and review of fact sheets and news releases.

5.4 GENERAL DESCRIPTION OF FIELD INVESTIGATIVE TASKS. The purpose of the RI/FS field program is: to collect sufficient data to characterize and quantify the extent of contamination, to assess potential risks to human health and the environment posed by contaminants of concern, to support an FS at sites where remedial action is warranted, and to support an ROD at all sites.

The investigative methods and techniques that will be used to collect RI/FS data include geophysics; soil gas surveying; soil boring; test pitting; monitoring well installation; soil, groundwater, surface water and sediment sampling, aquifer characterization; elevation surveying and ecological and population surveys. A detailed discussion of each method, including decontamination and waste disposal procedures, is presented in Part A (FSP) of the SAP (Volume II of this report). Rationale concerning site-specific investigation and sampling activities are discussed in Section 5.5 of this Workplan and described in detail in the FSP (Volume IIA). QA/QC procedures are detailed in the QAPP (Volume IIB).

5.5 TECHNICAL APPROACH. The RI technical approach developed for each site is based on several considerations including:

- the physical characteristics and geographic location of the site;
- the history and previous use of each site;
- results, conclusions, and recommendations of previous investigations; and
- site reconnaissance.

This section provides a summary of the proposed technical approach for each of the RI activities to be conducted at the 10 sites.

5.5.1 Rationale for Technical Approach The objectives of the proposed RI field investigation of Sites 19B through 28B, are summarized in Table 5-1. Proposed field exploration and sampling programs at the 10 sites are presented in Table 5-2.

The proposed RI field investigative methods that will be used to achieve the objectives include: geophysics; soil gas survey; test pitting, subsurface soil boring and sampling; monitoring well installation; groundwater, surface water, soil, and sediment sampling; aquifer characterization; elevation surveying and background sample collection. Locations of these field investigations are presented in Figures 5-1 through 5-6. Details of the field exploration and sampling methods are presented in Section 2.2 and Tables 3-2 and 3-4 of the FSP. Site-specific rationales for technical approaches are detailed in Sections 3.1 through 3.5 of the FSP.

5.6 LABORATORY ANALYSIS. Sample analyses range from screening techniques and field analysis to laboratory analyses.

Soil, groundwater, surface water (where present), and sediment samples will be collected from each site for laboratory analysis. These analyses are intended to provide confirmatory information concerning the nature and distribution of contamination at the site. All laboratory analytical samples will be analyzed in conformance with Level III (10 percent at Level IV) DQOs.

The choice of parameters for analysis is based on several factors including: (1) previous analytical results (contaminants detected or contaminants not adequately tested), (2) previous sampling locations (sufficient and representative downgradient locations), and (3) site history (types of wastes disposed). All samples collected for laboratory analysis will be analyzed for USEPA TCL VOCs, TCL semi-volatile organic compounds (SVOCs), TCL pesticides and PCBs, and TAL inorganic chemicals. A summary of the RI analytical program is presented in Table 3-4 of the FSP.

Standard field methods and equipment decontamination procedures for Level III DQOs will be followed in accordance with USEPA Region IV Standard Operating Procedures (SOPs) (USEPA, 1991c). Deviations will be documented in the field logbook or in the approved workplan.

Sample handling and documentation are described in the QAPP, which is incorporated as Part B of the SAP (Volume II of this report). The site-specific QAPP includes procedures for sample container and preservation requirements, sample labelling, chain-of-custody and sample tracking, and shipping.

5.7 DATA ASSESSMENT. Data collected from investigation activities include survey data, field screening data, and laboratory analytical data. The ultimate data uses include site characterization, the assessment of potential risk to human health and the environment, and the development of effective remedial measures, where necessary.

Table 5-1
Site-Specific Objectives and Methodologies

RI/FS Workplan
OLF Barin, Foley, Alabama

Site	Objectives	Methods
Site wide background	Evaluate the presence of naturally occurring inorganic chemicals in soils, sediments, surface water, and groundwater.	• Collection of soil, sediment, surface water, and groundwater samples.
19B and 20B	Confirm the status of the sites as a source of groundwater contamination.	• Sampling of existing monitoring wells and supply wells.
		• Monitoring well installation and groundwater sampling.
	Evaluate the existence of residual soil contamination.	• Soil gas survey • Test pitting • Soil boring • Subsurface sampling
21B	Define landfill depth and boundaries and locate buried wastes.	• EM and GPR
	Characterize and quantify the extent of soil contamination.	• Test pitting • Surface and subsurface soil sampling
	Characterize and quantify the extent of groundwater contamination.	• Monitoring well installation • groundwater sampling
22B and 25B	Characterize and quantify the extent of soil contamination.	• Surface soil sampling • Soil boring and subsurface sampling
	Define the boundaries of the old fire-fighting area.	• Review aerial photographs • Evaluate drainage patterns through site reconnaissance. • Surface soil sampling
23B	Characterize and quantify the extent of soil contamination in the upper drainage ditch.	• Soil boring and subsurface soil sampling.
	Characterize and quantify the extent of soil contamination in the storm drainage ditches.	• Surface soil or sediment sampling
	Characterize and quantify the extent of surface water and sediment contamination in Sandy Creek.	• Surface water and sediment sampling.
24B	Characterize and quantify the extent of soil and groundwater contamination.	• Surface and subsurface soil sampling • Soil borings • Monitoring well installation • Groundwater sampling • Surface soil sampling
26B	Verify the contamination status of the wastewater treatment plant.	• Site reconnaissance • Sludge or sediment sampling

See notes at end of table.

Table 5-1 (Continued)
Site-Specific Objectives and Methodologies

RI/FS Workplan
OLF Barin, Foley, Alabama

Site	Objectives	Methods
27B	Characterize and quantify the extent of soil contamination.	• Site reconnaissance • Surface soil sampling
28B	Characterize and quantify the extent of soil contamination in the unlined part of the fuel pit drainage ditch.	• Surface soil sampling
	Characterize and quantify the extent of surface water and sediment contamination in Wolf Creek.	• Surface water and sediment sampling.

Notes: EM = electromagnetic induction.
GPR = ground penetrating radar.

Table 5-2
Summary of Proposed Field Exploration and Sampling Program

RI/FS Workplan
OLF Barin, Foley, Alabama

Site	Geophysics EM/GPR	Soil Gas	Monitoring Well Installation		Groundwater Sampling	Exploratory Soil Borings	Test Pits	Surface Soil Samples	Subsurface Soil Samples	Surface Water and Sediment Samples
			Production Zone	Water Table						
Site wide background	0	0	(see Sites 19B/20B)	(see Site 21B and Sites 19B/20B)	0	0	0	8	0	(see Sandy Creek)
Supply well (full scan)	0	0	0	0	1	0	0	0	0	0
During pumping test	0	0	0	0	3	0	0	0	0	0
Former Hangar Maintenance Area, Abandoned USTs, and Fuel Pits Area, Sites 19B and 20B	0	100 points	3	11	22	0	40	0	[1]20	0
Pumping test (VOC only)	0	0	0	0	15	0	0	0	0	0
Rubble Landfill, Site 21B	3.1 acres	0	0	3	3	0	[2]3	0	3	0
Old Firefighting Demonstration Area, Site 22B	0	0	0	0	0	1	0	22	4	0
Displaced Machine Gun Butt Soils	0	0	0	0	0	0	0	2	0	0
Drainage Ditch leading to Sandy Creek, Site 23B										
Upper Ditch at Guadalcanal Road	0	0	0	0	0	1	0	0	3	0
Southern Ditch Outfall	0	0	0	0	0	0	0	1	0	0
North Area Ditch Outfall	0	0	0	0	0	0	0	1	0	0
18-inch Storm Sewer Outfall	0	0	0	0	0	0	0	3	0	0
Sandy Creek	0	0	0	0	0	0	0	10	0	10
Firefighting Training Area, Site 24B	0	0	0	5	5	0	0	6	4	0

See notes at end of table.

Table 5-2 (Continued)
Summary of Proposed Field Exploration and Sampling Program

RI/FS Workplan
OLF Barin, Foley, Alabama

Site	Geophysics EM/GPR	Soil Gas	Monitoring Well Installation		Groundwater Sampling	Exploratory Soil Borings	Test Pits	Surface Soil Samples	Subsurface Soil Samples	Surface Water and Sediment Samples
			Production Zone	Water Table						
Machine Gun Butt, Site 25B	0	0	0	0	0	1	0	14	4	0
Abandoned Wastewater Treatment Plant, Site 26B	0	0	0	0	0	0	0	3	0	0
Uncontrolled Dumpsite, Site 27B	0	0	0	0	0	0	0	5	0	0
Fuel Pit Drainage Ditch, Site 28B	0	0	0	0	0	0	0	2	0	0
Wolf Creek	0	0	0	0	0	0	0	2	0	3
Total Installation	3.1 acres	100 points	3	19	49	3	43	79	38	13

[1]From test pits.
[2]Depends on geophysics.

Notes: EM = electromagnetic induction.
GPR = ground penetrating radar.
USTs = underground storage tanks.
VOC = volatile organic compound.

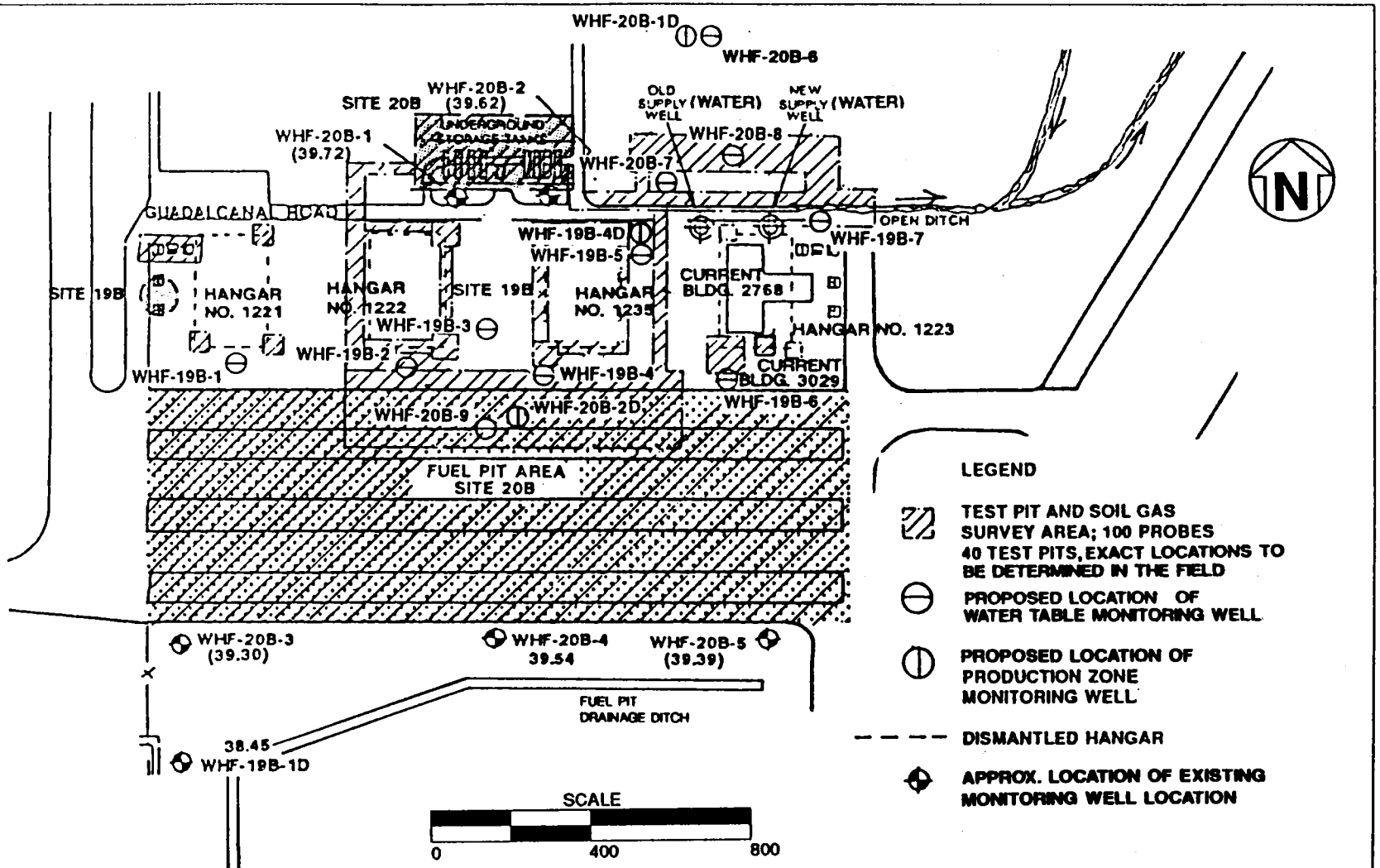
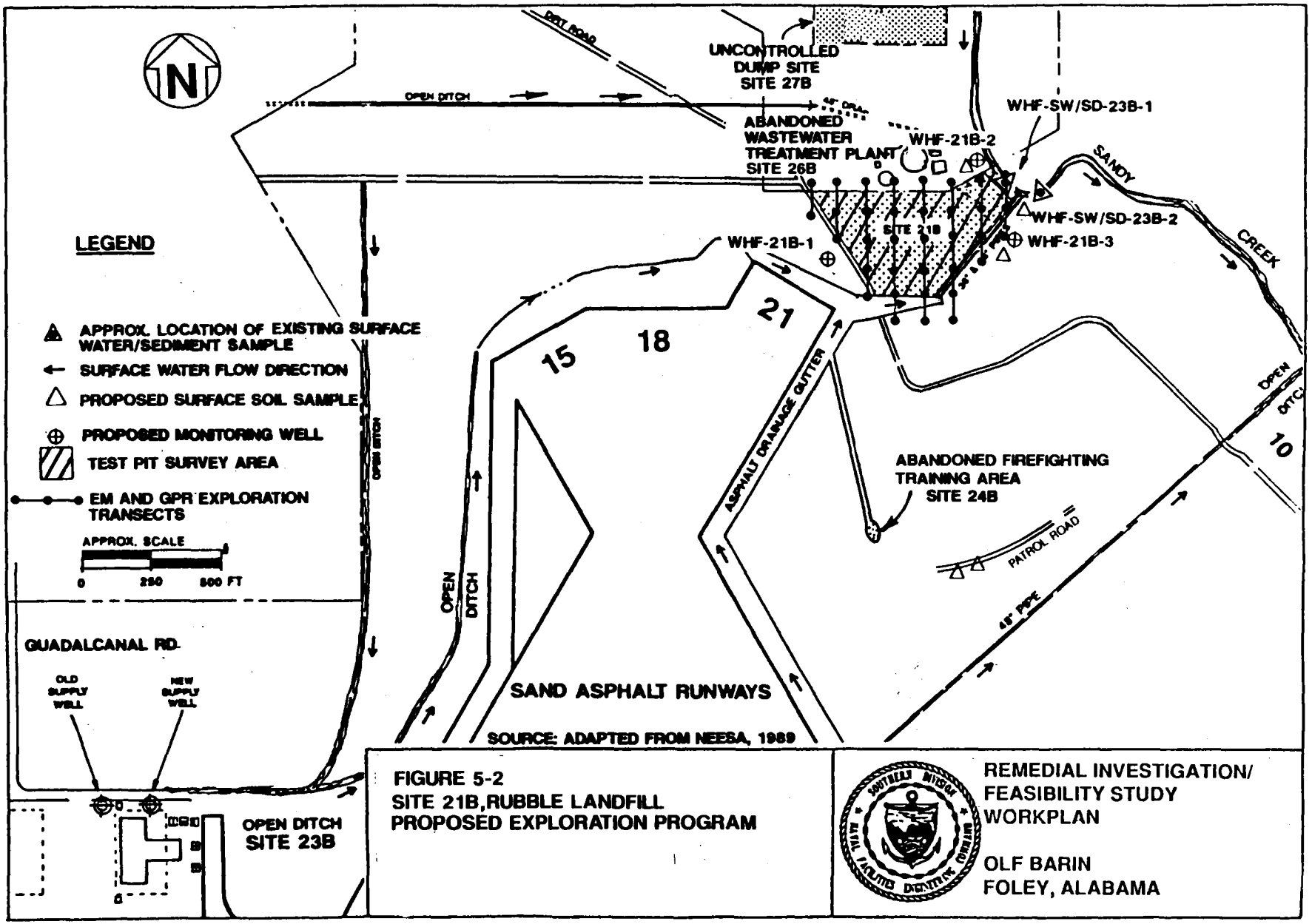


FIGURE 5-1
SITES 19B, FORMER HANGAR MAINTENANCE AREA, & 20B, ABANDONED UNDERGROUND STORAGE TANKS & FUEL PIT AREA, PROPOSED EXPLORATION PROGRAM

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA



SOURCE: ADAPTED FROM NEESA, 1989

FIGURE 5-2
SITE 21B, RUBBLE LANDFILL
PROPOSED EXPLORATION PROGRAM

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

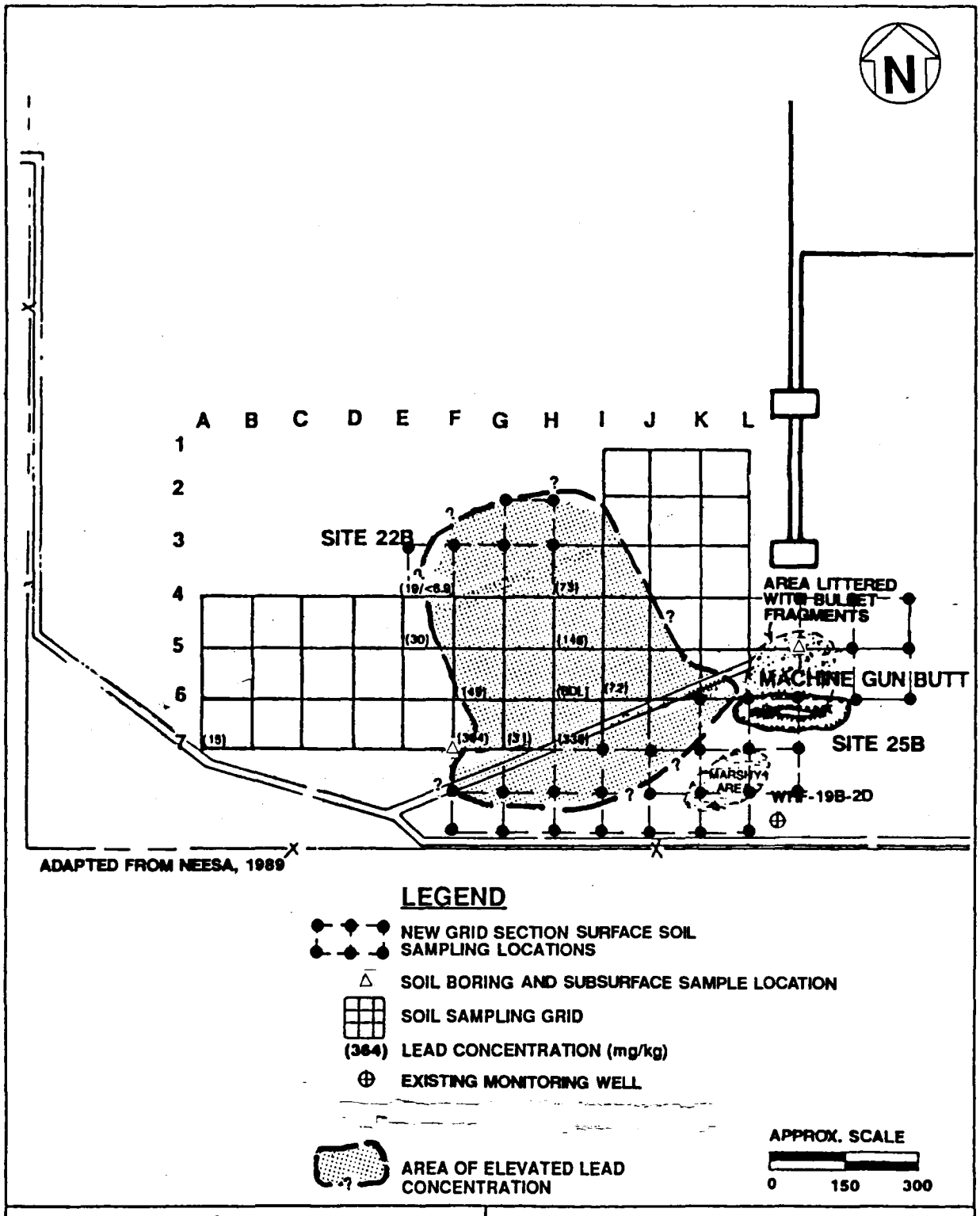


FIGURE 5-3
SITE 22B, OLD FIREFIGHTING DEMONSTRATION AREA AND SITE 25B, MACHINE GUN BUTT PROPOSED EXPLORATION PROGRAMS

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

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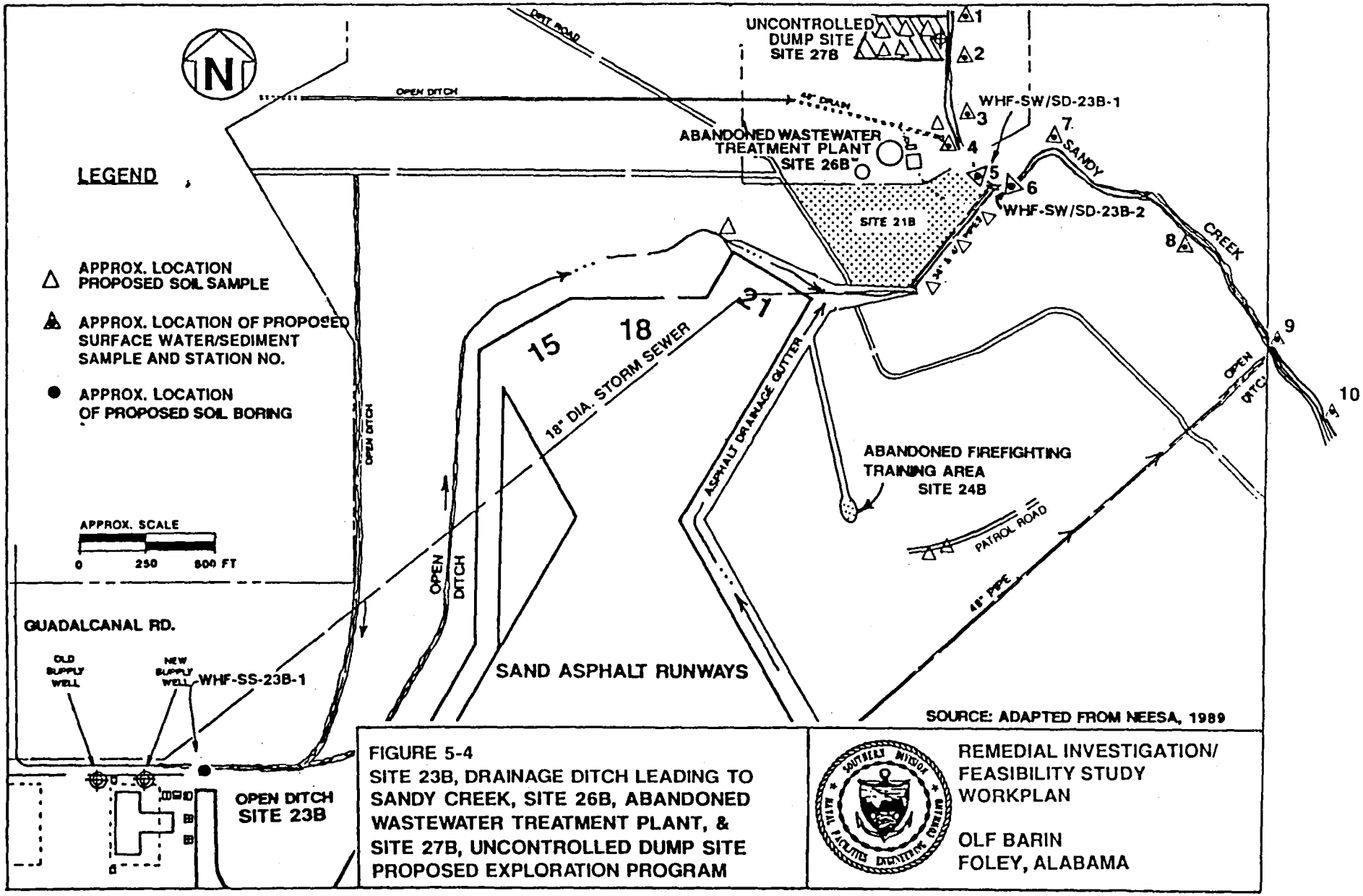

SOURCE: ADAPTED FROM NEESA, 1989

FIGURE 5-4
SITE 23B, DRAINAGE DITCH LEADING TO SANDY CREEK, SITE 26B, ABANDONED WASTEWATER TREATMENT PLANT, & SITE 27B, UNCONTROLLED DUMP SITE PROPOSED EXPLORATION PROGRAM

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

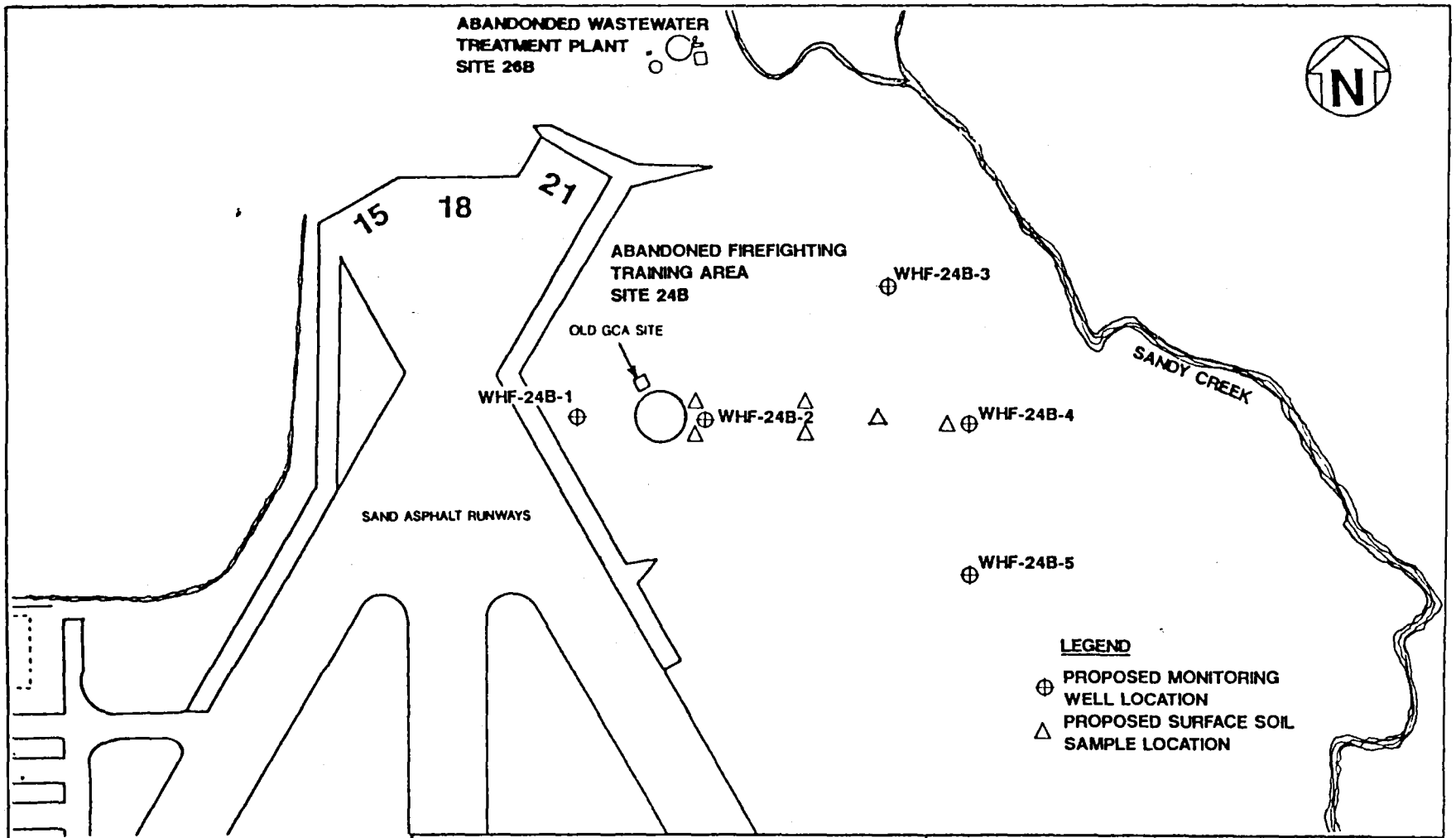

FIGURE 5-5
SITE 24B, ABANDONED FIREFIGHTING
TRAINING AREA
PROPOSED EXPLORATION PROGRAM

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

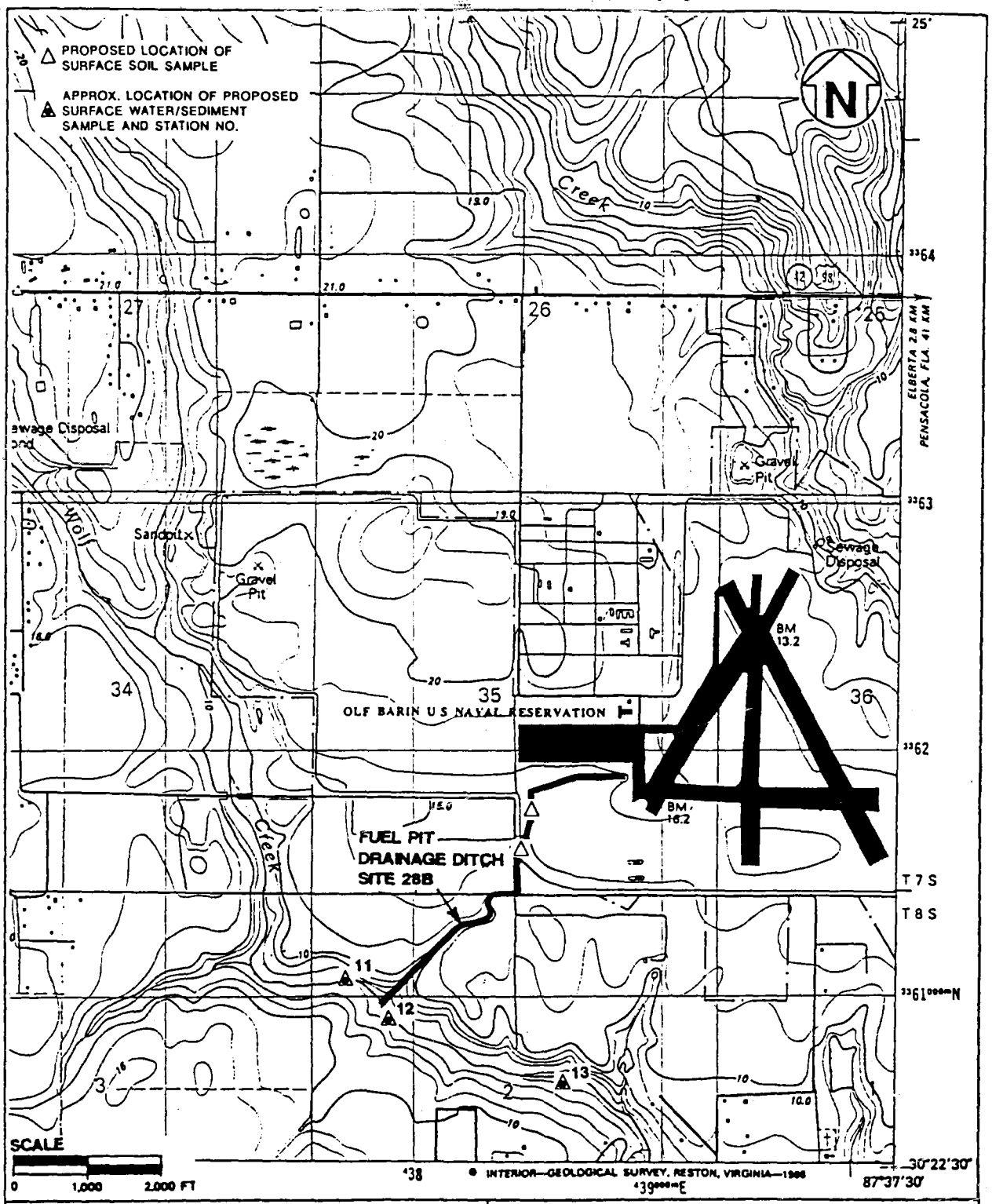

FIGURE 5-6

LOCATION OF SITE 28B, FUEL PIT DRAINAGE DITCH

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORKPLAN

OLF BARIN
FOLEY, ALABAMA

5.7.1 Screening Data Screening data will include results from geophysical surveys (terrain conductivity and ground penetrating radar [GPR]), soil sample screening at discrete depths, air quality monitoring, and field parameter (pH, temperature, and specific conductance) measurements.

Screening activities allow real-time or rapid analysis of contaminant distribution or of indicator parameters that may correlate with the presence of contamination. Quality control procedures used with qualitative screening instruments (e.g., pH meter, photoionization meter, etc.) include calibration and comparison of results.

Field screening data provide real-time qualitative data and level II quantitative data. This information is useful for site characterization and for determining strategic sampling locations. Laboratory analytical data provides qualitative and quantitative confirmation data concerning the type, quantity, and distribution of contaminants.

5.7.2 Laboratory Data Validation Laboratory data must be validated and assessed to determine the validity of the data and to ensure that DQOs are met. Sample results are validated through comparison to QA/QC data to assure that analytical results fall within acceptable accuracy and precision confidence limits, and to eliminate, correct, or flag matrix and other interference effects. Validated data are summarized and organized into formats that facilitate data evaluation. Data evaluation includes site characterization and analysis of contaminants, contaminant distribution, and transport, fate, and risk assessment.

Upon receipt, analytical data are systematically validated in conformance with USEPA *Functional Guidelines for Evaluating Organic Analyses* (USEPA, 1988b) and *Functional Guidelines for Evaluating Inorganic Analyses* (USEPA, 1988a). These guidelines provide a systematic procedure for evaluating laboratory QA/QC measures such as holding times, blank analyses, surrogate recoveries, matrix spike results, GC/MS tuning, instrument calibration, compound identification, and method performance.

Validated data will be prepared in three initial formats: raw laboratory data, data marked with validation qualifiers or annotations, and corrected or validated data. The validated data can then be used for site contaminant characterization and assessment.

5.7.3 Data Management Plan Sampling locations and laboratory analytical data will be organized and reported in accordance with USEPA Locational Data Policy and Region IV Environmental Monitoring and Data Reporting Requirements (Appendix B). These requirements were developed to provide a standardized reporting system for locating and tracking environmental data.

These policy documents require: (1) the identification of sampling locations in terms of latitude and longitude coordinates in accordance with the Federal Interagency Coordinating Committee for Digital Cartography (FICCDC) recommendations, and (2) the development of four databases or data files with electronic copies in American Standard Code for Information Interchange (ASCII) file format.

The four data files include the following.

- **STATION.DAT**. This file contains basic information about the type and location of the sampling or monitoring station. Data fields include information concerning the type, location, and elevation of sampling locations.

- **WELL.DAT**. This file contains detailed information about the construction and characteristics of groundwater monitoring stations. Data fields include information concerning well location, construction methods, construction materials, development methods, availability of lithologic logs, and the use of the well (i.e., monitoring, drinking water, irrigation, etc.).

- **SAMPLE.DAT**. This file contains basic information about the collection and characteristics of samples. Data fields include information concerning station status, field parameter measurements, water level, wind speed and direction, sample collection methods, and name of sampling agency.

- **PARM.DAT**. This file contains measured values and reporting units for specific parameters. Data fields include information concerning sampling station type and unique identifier characters, the Chemical Abstract Service (CAS) number of the constituent(s) to be analyzed, the reported analytical results, reporting units, name or code of analytical method, date of analysis, detection limit, and the name of the analytical laboratory.

For USEPA computing purposes, the first line of EACH of the four files MUST contain the following text starting in position one: 19901001. USEPA Region IV *Interchange File Format for Electronic Data Reports* (Appendix B) details specific field names, field lengths, data types, and descriptions for each of the four data files.

Each data file must be updated as new stations or sampling locations are created and/or as new samples are collected. Data will be submitted in ASCII format using 5.25-inch flexible disk or nine-track magnetic tape and as a printed hardcopy.

5.7.4 Data Evaluation Chemical and physical data collected during the RI will be used to characterize the site and to evaluate the potential levels of risk posed to human health and the environment. Physical data (groundwater and surface water elevations and flow, soil composition, hydraulic conductivity, etc.) and chemical data (laboratory analyses and field screening data) will be integrated to form a conceptual overview of the site.

Data will be summarized and plotted on scaled maps to facilitate the analysis of contaminant distribution and potential mechanisms of transport. Chemical data will be compared to Applicable or Relevant and Appropriate Requirements (ARARs) and contaminants of concern will be identified.

Physical and chemical data will be evaluated to determine the distribution of contaminants, contaminant interactions, transport mechanisms, and potential fate. This includes an evaluation of factors such as: groundwater transport, groundwater-surface water interactions, surface water transport, vadose zone transport, volatilization and advection, soil erosion, retardation, degradation, and transformation. The evaluation of the factors listed above will be subject to the availability of sufficient experimental and empirical reference data.

Groundwater, solute transport, geochemical, and/or ecosystem fate and transport modeling may be performed after initial data evaluation. There are currently insufficient data to determine which model(s) may be useful for these sites.

Plausible exposure pathways and exposure scenarios will be evaluated to assess potential levels of risk posed by the contaminants of concern. The risk assessment is based on an evaluation of exposure patterns, available toxicity data, and dose-response relationships.

Ultimately, the data collected will be evaluated to support no further action or remedial action decisions, treatability studies, and remedial design.

5.7.5 Evaluating of Data Gaps All data will be continually assessed and sites will be evaluated to determine: (1) if contamination is present, (2) if it presents a threat, (3) if it has been delineated, and, finally, (4) what further action is needed (i.e., delineation, interim or early remedial action, or evaluation of remedial alternatives). The goal is to eliminate lengthy interim report development and review times by allowing continual data assessment and rapid decision making.

Data gaps will be addressed in Project Managers' meetings, as described in Section 5.7.6. This approach allows additional data to be collected when it is needed and minimizes reporting, review, and mobilization costs. Where appropriate, data gaps may be addressed by integrating data from several sites and viewing the facility, or sections of the facility, on a larger scale. This should simplify addressing sites with overlapping plumes, surface water systems, and/or complex groundwater systems.

5.7.6 Addressing Data Gaps The RI/FS process will be tailored to allow prioritization of sites according to potential threat to human health and the environment. The process will initially focus on source identification, with delineation of soil and sediment contamination and confirmation of groundwater and surface water contamination.

Decisions concerning data assessment and actions to be taken will be made during Project Management meetings that will include representatives from the Navy, USEPA, and ABB-ES. These meetings will provide a forum for discussion of investigative results and proposed actions. The verbal decisions made in these meetings may be final with no reporting or review time.

If initial data evaluation shows groundwater or surface water contamination to be an immediate threat to human health or the environment, interim or early remedial actions may be performed to mitigate further transport from the site.

systems as an individual operable unit(s) that may be impacted by several sites simultaneously.

5.8 PHASE I REMEDIAL INVESTIGATION (RI) TECHNICAL MEMORANDA PREPARATION. ABB-ES will evaluate both field and laboratory data and provide five technical memoranda summarizing the Phase I RI data. The five technical memoranda will provide geological assessment, hydrogeologic assessment, soils assessment surface water and sediment assessment, and groundwater quality assessment of the conditions at OLF Barin as determined from the Phase I RI. Draft, Draft Final, and Final versions of each Technical Memorandum will be provided to the Navy for review and a formal response to comments will be prepared. The Technical Memoranda are as follows:

Technical Memo No. 1, Geologic, Hydrologic, and Hydrogeologic Assessment;
Technical Memo No. 2, Soils Assessment;
Technical Memo No. 3, Surface Water and Sediment Assessment;
Technical Memo No. 4, Groundwater Assessment; and
Technical Memo No. 5, Overall Phase I Assessment and Recommendations and 90 percent Draft Phase II Workplans.

Upon completion of data evaluation and submittal of the first four Final Technical Memoranda, a fifth Technical Memorandum shall be generated. The contents of this memorandum will include a presentation of existing data, including that generated previous to the Phase I RI and will present the current description and understanding of conditions at each of the sites investigated.

In addition to the presentation of current understanding, the fifth Technical Memorandum shall address data gaps and make recommendations as to a Phase II RI approach on a site-by-site basis.

In an effort to expedite the RI/FS process and decrease workplan production costs the USEPA approved Phase I RI Workplan including the SAP (composed of the FSP and QAPP) and the HASP will not be supplanted by a new set of Phase II workplans. Technical Memorandum No. 5 will present the proposed scope of work to be conducted during the Phase II RI and will include any amendments to the Phase I workplans that may need to be included due to changes in regulations, methodologies, etc.

5.9 BASELINE RISK ASSESSMENT. Human health and ecological Baseline Risk Assessments will be conducted for each of the 10 sites listed below to determine if contaminants at these sites pose a risk to human and/or ecological receptors.

- Site 19B, Former Hangar Maintenance Area;
- Site 20B, Abandoned USTs and Fuel Pit Area;
- Site 21B, Rubble Landfill;
- Site 22B, Old Firefighting Demonstration Area;
- Site 23B, Drainage Ditch Leading to Sandy Creek;
- Site 24B, Firefighting Training Area;
- Site 25B, Machine Gun Butt;
- Site 26B, Abandoned Wastewater Treatment Plant;
- Site 27B, Uncontrolled Dump Site; and
- Site 28B, Fuel Pit Drainage Ditch.

At sites where analytical data and use history indicate that risks may be similar or that contaminants from two or more sites affect the same area, sites may be combined for risk assessment purposes. The Human Health Risk Assessment will be conducted in accordance with the following USEPA guidance documents: (1) *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual (Part A)* (USEPA, 1989a); (2) *Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors* (USEPA, 1991d); (3) *Supplemental Region IV Risk Assessment Guidance* (USEPA Region IV, 1991); and (4) *Risk Assessment Guidelines for Non-Superfund Sites* (FDER, 1990). Guidance followed in conducting the Ecological Risk Assessments will include the *Risk Assessment Guidance for Superfund; Environmental Evaluation Manual* (USEPA, 1989b).

The Baseline Risk Assessment for the OLF Barin sites will consist of three components: (1) data evaluation and data summarization, (2) Human Health Risk Assessment, and (3) Ecological Risk Assessment. Data evaluation and summarization will be performed to determine which environmental data are suitable for use in the risk assessment and to organize data in a useful format. The Human Health Risk Assessment will be performed to determine if the contamination present at these sites poses significant risks to public health in the absence of any remedial action. The Ecological Risk Assessment will be performed to define potential ecological effects resulting from chemicals in environmental media at each site.

The following sections summarize the approach and principal assumptions proposed for the Baseline Risk Assessments. Proposed site-specific approaches to each component of the risk assessments are presented where appropriate.

5.9.1 Data Evaluation and Summarization Sampling data from each of the eight sites will be evaluated independently to determine (1) which detected chemicals are believed to be site-related, and (2) which data are of sufficient quality for use in a quantitative risk assessment. The individual steps involved in this process are briefly discussed below.

Sort Data By Medium. Data from the RI and previous investigations will be compiled and sorted by environmental medium (i.e., soil, groundwater, surface water, sediment, and air). Data collected from previous sampling events (e.g., NEESA, 1989; E.C. Jordan Company, 1991) will be compared to data developed during the RI/FS for similarity of types of analyses and results. If the data are similar, previous data may be combined with current data to provide more complete characterization of the sites. All chemicals detected in at least one sample in each medium will be identified.

Evaluate the Quality of the Data. Based on the results of the data validation described in Section 5.7.2, the overall quality of the data will be reviewed to determine which data are of sufficient quality for use in a quantitative risk assessment. This review will be conducted in accordance with the USEPA's *Guidance for Data Useability in Risk Assessment (Interim Final)* (USEPA, 1990a).

The data review will address the following six criteria cited in the guidance:

1. appropriate data sources,
2. documentation of data collection activities,
3. appropriate analytical methods and limits of detection,
4. completeness,
5. comparability, and
6. representativeness.

Comparison With Background. A comparison of sample concentrations from the different source areas with site-specific and/or southeastern United States background concentrations will be performed to determine which chemicals may reasonably be attributed to the site. Where possible, site-specific background concentrations will serve as the primary comparison point and local and/or references for regional background concentrations will be used as a secondary source for comparison.

Develop Data Set for Use in Risk Assessment. The ultimate product of the data evaluation and summarization is a set of analytical data in a form that can be used as input for quantitative risk assessments. Data that has been determined to be site related and of sufficient quality will be summarized in tables that will include: (1) all compounds detected in at least one sample from each sampling event, (2) ranges of detected concentrations, (3) frequencies of detection, (4) mean concentrations, and (5) background concentrations.

In calculating mean concentrations in these tables, the following adjustments will be made as appropriate: (1) results from duplicate samples from the same location will be averaged to yield one number, (2) non-detect (ND) values will not be incorporated into the mean concentrations, and (3) the data will be normalized (e.g., log-transformed) and the means calculated from the normalized data. The presence of potential hot spots and trends in concentrations will be noted as appropriate.

Data Uncertainty. A discussion of the uncertainties, both inherent and site specific, associated with the data collection or analyses will be included. The potential effects of these uncertainties on the remaining portions of the risk assessment will be discussed.

Preliminary List of Site-Related Chemicals. Based on the results of sampling conducted at the OLF Barin sites in 1989 and 1991 (NEESA, 1989; E.C. Jordan, Company, 1991), a preliminary list of site-related chemicals has been developed for each site. These lists are presented in Table 5-3.

5.9.2 Human Health Risk Assessment The purpose of the Human Health Risk Assessment will be to determine if contamination at the OLF Barin sites could pose a health risk to individuals under current or foreseeable future site conditions. This assessment will be conducted in accordance with appropriate USEPA guidance (USEPA, 1989a; 1991c) in four basic steps:

- identification of contaminants of concern,
- exposure assessment,

Table 5-3
Range of Detected Contaminants, 1989 and 1991 Sampling

RI/FS Workplan
OLF Barin, Foley, Alabama

	Groundwater (mg/ℓ)	Soil or Sediment (mg/kg)
Sites 19B and 20B		
Total phenols		
Total phenols	0.006 to 0.011	NS
Volatile organics		
Acetone	0.03 to 0.044	NS
2-Butanone	0.005 to 0.113	NS
Toluene	0.002	
Vinyl acetate	0.006	NS
Metals		
Aluminum	0.8 to 3.3	NS
Antimony	0.1	NS
Arsenic	0.001	NS
Cadmium	0.0002 to 0.001	NS
Calcium	1.8 to 14	NS
Iron	0.19 to 2	NS
Lead	0.005 to 0.03	NS
Magnesium	0.18 to 0.91	NS
Mercury	0.0007 to 0.0058	NS
Potassium	0.7 to 18	NS
Sodium	0.9 to 12	NS
Site 21B		
Volatile Organics		
Methylene chloride	NS	0.448
Toluene	NS	0.021J

See notes at end of table.

Table 5-3 (Continued)
Range of Detected Contaminants, 1989 and 1991 Sampling

RI/FS Workplan
OLF Barin, Foley, Alabama

	Groundwater (mg/ℓ)	Soil or Sediment (mg/kg)
Site 21B--continued		
Metals		
Aluminum	NS	1,711 to 24,167
Arsenic	NS	0.63 to 2.2
Barium	NS	7.4 to 24
Calcium	NS	63 to 167
Chromium	NS	1.1 to 24
Copper	NS	3.2 to 11
Iron	NS	2,526 to 11,611
Magnesium	NS	66 to 167
Manganese	NS	7.4 to 44
Potassium	NS	36 to 117
Vanadium	NS	11 to 40
Zinc	NS	1.1 to 6.1
Site 22B		
Metals		
Lead	NS	15 to 364
Site 23B		
Volatile Organics		
2-Butanone	NS	43 to 56
Ethyl benzene	NS	26 to 57
Methylene chloride	NS	100 to 113
Toluene	NS	115J to 229
Total xylenes	NS	128 to 286

See notes at end of table.

Table 5-3 (Continued)
Range of Detected Contaminants, 1989 and 1991 Sampling

RI/FS Workplan
OLF Barin, Foley, Alabama

	Groundwater (mg/ℓ)	Soil or Sediment (mg/kg)
Site 23B--continued		
Metals		
Aluminum	0.5	979 to 5,417
Arsenic		0.21 to 0.69
Barium		9
Calcium	1.7 to 2.8	132 to 136
Chromium		2.8 to 4.9
Copper		2.8
Iron	0.3 to 0.36	407 to 2,639
Magnesium	1.7	17 to 76
Manganese	0.03	0.71
Potassium	0.7 to 0.8	65 to 6
Selenium		0.21 to 0.28
Silver	0.05	1.4 to 2.1
Sodium	3 to 3.5	14 to 20
Zinc	0.05	1.4 to 2.1
Pesticides		
4,4'-DDD		0.002
4,4'-DDE		0.004 to 0.005
4,4'-DDT		0.01 to 0.014
Dieldrin		0.008 to 0.01
Total phenols and cyanide		
Total phenols		0.34 to 3.8
Cyanide	0.006	

See notes at end of table.

Table 5-3 (Continued)
Range of Detected Contaminants, 1989 and 1991 Sampling

RI/FS Workplan
OLF Barin, Foley, Alabama

	Groundwater (mg/ℓ)	Soil or Sediment (mg/kg)
OLF Barin Water Supply Wells		
Volatile Organics		
trans-1,2-Dichloroethene	0.0132	NS
Tetrachloroethene	0.006 to 0.007	NS
Trichloroethene	0.004 to 0.008	NS
Metals		
Lead	0.004	NS
Magnesium	0.88	NS

(NEESA, 1989; E.C. Jordan Company, 1991).

Notes: NS = Not sampled in indicated medium.
mg/ℓ = milligram per liter.
mg/kg = milligram per kilogram.
4,4'-DDD = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethane.
4,4'-DDE = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethylene.
4,4'-DDT = 1,1,1-trichloro 2,2-bis (p-chlorophenyl) ethane.

- toxicity assessment, and
- risk characterization.

Collectively, these components describe (1) the contaminants at the site in each medium that may pose a hazard to human health, (2) the populations that might come in contact with site-related chemicals and the pathways through which they might be exposed, (3) the toxicity of contaminants of potential concern and the relationship between the dose and potential toxic effects, and (4) the likelihood of potential adverse health effects associated with contaminant exposure. The paragraphs that follow describe the proposed approach to each of these individual components as they apply to the 10 OLF Barin sites.

5.9.2.1 Identification of Contaminants of Potential Concern In selecting chemicals of concern for human health at OLF Barin, the data set will be reviewed in two stages. First, chemicals of potential concern will be selected using the criteria presented in the current USEPA risk assessment guidance (USEPA, 1989a). Second, contaminants of potential concern (CPCs) at each site will include all chemicals that are:

- positively identified in at least one sample, and
- detected at levels significantly elevated above (5 to 10 times) blank concentrations, and
- detected at levels significantly elevated above (3 times) natural background levels and
- tentatively identified but may be associated with the site based on historical information, or
- transformation products of chemicals known or suspected to be present.

Chemicals not retained as CPCs will be clearly identified and the justification for their exclusion will be noted. Examples of chemicals not included as CPCs would include chemicals that are not detected in any sample. Also, some chemicals found at the sites are naturally occurring compounds (i.e., metals and other inorganics) that may be present within normal background ranges (USEPA, 1989a; 1990a).

USEPA Region IV prefers to remove chemicals that do not contribute significantly to risk from the list of chemicals of concern. One approach to screening chemicals approved by Region IV is use of a Risk-Based Concentration Table developed by USEPA Region III (USEPA Region III, 1991). This table presents concentrations associated with a 10^{-6} cancer risk or 1.0 Hazard Index under "standard" exposure scenarios. Because health effects are assumed to be additive, a chemical will be retained as a CPC unless its concentration is less than 0.1 times the Risk-Based Concentrations.

<u>Preliminary Contaminants of Potential Concern</u>. A preliminary list of contaminants of potential concern has been developed based on the results of previous investigations and the screening process identified above and is presented in

Table 5-4. This list will be revised based on the results of sampling and analyses conducted during the RI.

5.9.2.2 **Exposure Assessment** The overall objective of the Exposure Assessment is to estimate the amount of contaminants to which individuals may be exposed via multiple exposure pathways. This process involves exposure characterization, pathway identification, and exposure quantification. First, exposure settings are characterized in terms of physical characteristics and the populations that could be exposed to site-related chemicals. The second step identifies all pathways through which exposure could occur. The final step is quantification of exposure for each population in terms of the amount of chemical either ingested, inhaled, or absorbed through the skin from all exposure pathways. This assessment process is performed for both current and foreseeable future site conditions.

Characterization of Exposure Setting. The first step in the Exposure Assessment of a site is to characterize the physical and demographic features of the site that may influence the degree of human exposure. The physical setting at each site will be characterized in terms of the following attributes:

- climate,
- meteorology,
- geology,
- vegetation,
- soil type,
- groundwater, and
- surface water.

This information will be gathered from previous investigations and additional information collected during the RI. The information generated from this analysis will aid in defining the physical mechanisms that control or influence how people could be exposed at each site.

This initial step in the Exposure Assessment will also involve identifying potentially exposed populations surrounding each site and OLF Barin as a whole. The focus of this step will be on identifying (1) the populations residing or working near each site, (2) the activity patterns of residents and/or workers, and (3) the locations of potentially sensitive subgroups. The following steps will be performed in order to characterize potentially exposed populations:

- determine current land use of the sites and surrounding areas (e.g., residential, commercial-industrial, or recreational),

- determine foreseeable future land use of the sites and surrounding areas, and

- identify potentially sensitive subpopulations.

Sources for this information will include the following: (1) site visit to OLF Barin, (2) previous investigations, (3) information generated in the RI, (4) maps and photographs, and (5) interviews with OLF Barin personnel.

Table 5-4
Preliminary Contaminants of Potential Concern

RI/FS Workplan
OLF Barin, Foley, Alabama

	Groundwater	Soil	Sediment
Sites 19B and 20B	Lead	--	--
	Mercury	--	--
Site 21B	--	Methylene chloride	--
Site 22B	--	Lead	--
Site 23B	--	--	Ethyl benzene
	--	--	Methylene chloride
	--	--	Toluene
	--	--	Xylenes
	--	--	4,4'-DDD
	--	--	4,4'-DDE
	--	--	4,4'-DDT
	--	--	Dieldrin
	--	--	Cyanide
OLF Barin water supply	trans-1,2-Dichloroethene	--	--
	Tetrachloroethene	--	--
	Trichloroethene	--	--

Notes: -- = none detected.
4,4'-DDD = dichlorophenyl dichloroethane.
4,4'-DDE = dichlorophenyl dichloroethene.
4,4'-DDT = dichlorophenyl trichloroethane.

Potentially Exposed Populations. Based on current and expected future land use at the 10 OLF Barin sites and adjacent areas, the following potentially exposed populations have been identified: (1) child and adult residents, (2) trespassers and recreational populations, and (3) OLF Barin workers. OLF Barin operations at the 10 sites are not expected to change so the current and expected future uses of the each site are assumed to be the same with the same potentially exposed populations. The potentially exposed populations may be revised as more information is gathered. The final list of potentially exposed populations for each site will reflect those individuals that may reasonably be expected to be exposed to site-related contaminants under current and foreseeable site conditions.

Identification of Exposure Pathways. The purpose of this step in the Exposure Assessment is to identify all pathways through which people may be exposed to site-related contaminants. An exposure pathway consists of four necessary elements: (1) a source or mechanism of chemical release, (2) a transport or retention medium, (3) a point of human contact with the chemical, and (4) a route of exposure at the point of contact (USEPA, 1989b). In some cases, the source of release may be the point of contact, such as direct contact with a spill area.

Potential exposure pathways will be identified by first identifying sources of contamination and receiving media (i.e., groundwater, soils, surface water, or air). Once sources are identified, relevant fate and transport mechanisms will be evaluated to predict future exposures. Exposure points and exposure routes (i.e., ingestion, inhalation, or dermal absorption) will be identified by determining the areas where people could come in contact with contaminated media and the likely mechanisms of exposure. Exposure pathways are considered complete if they contain a source or mechanism of release, an exposure point where contact can occur, and an exposure route at the point of contact.

Complete pathways will be identified in the exposure assessment. Each complete pathway will be selected for quantitative evaluation in the risk assessment unless it can be shown that one of the following criteria applies (USEPA, 1989a):

- exposure from one pathway is much less than that from another involving the same medium and exposure point;
- the potential magnitude of exposure from a pathway is low; or
- the probability of the exposure occurring is very low and the risks associated with the occurrence are not high.

Justification will be provided for the exclusion of pathways from the quantitative evaluation.

Potential Exposure Pathways. Potential exposure pathways for each of the 10 OLF Barin sites have been identified based on current knowledge of the sites. The similarities among the 10 sites in terms of location and physical characteristics have lead to the identification of the same pathways for each of the 10 sites. These pathways have been classified under three broad headings: (1) residential,

(2) occupational, and (3) recreational or trespasser. A list of potential exposure pathways is presented in Table 5-5.

Unless information gathered in the RI indicates that these pathways are not relevant to the sites, these pathways will be evaluated in the Baseline Risk Assessment. Additional pathways may also be added, as appropriate, based on any new information. The following describes the rationale for the selection of these pathways.

The OLF Barin property currently encompasses approximately 490 acres, which is mostly taken up by three airstrips with associated flat grassland and pine plantations. Activities on OLF Barin are largely restricted to a 4-acre area containing the firefighting operations, storage buildings, a parking lot, and a recreational area. The northeastern and eastern edges of the installation are part of a 70 acre forested area. Approximately 6 acres on the southern edge of the property are also forested. The land uses adjacent to OLF Barin were evaluated in the SI (E.C. Jordan Company, 1991) using recent aerial photographs and the Baldwin County Land Atlas and Plat Book (Baldwin County Soil and Water Conservation District, 1988) to classify land use within 4 miles from OLF Barin. Land use is primarily agricultural, forest, or wetlands with sparsely populated areas containing residences and mobile homes. No heavy industry is located in the area of OLF Barin. Principal local industry has traditionally been forestry, cropland agriculture, and service-oriented commercial activities. According to the SI (1991), manufacturing in Foley includes assembly of aluminum, steel, and silk-screened products, synthetic fiber, marine nets, and filters; seafood processing; precision tool manufacture; lingerie; and three aerospace-related companies. The Town of Foley has purchased 284 acres, formerly belonging to the U.S. Navy, adjacent to OLF Barin. As of 1988, industrial development had not commenced in the latter area.

Residential. None of the 10 OLF Barin sites are currently used as residential areas. OLF Barin is not on the list of bases potentially to be closed under the Base Realignment and Closure Action 1991. Closure of OLF Barin is therefore not planned in the immediate future. If, in the future, OLF Barin is closed, potential residential exposures to surface soil would be addressed during base closure.

There is a potential for contaminant migration from soil to groundwater at each site. Groundwater from deeper aquifers is used as a source of potable water both on base and off base. The discovery of trans-1,2-dichloroethene, tetrachloroethene, and trichloroethene in OLF Barin supply wells raises the possibility of migration to other local wells. Therefore, ingestion of and dermal contact with contaminated groundwater and inhalation of volatilized contaminants from showering will be evaluated for on-base and off-base residents. Concentrations of volatile compounds released during showering will be estimated using a model developed by Foster and Chrostowski (1987).

Occupational. Base personnel could be exposed to contaminants at the OLF Barin sites if job-related activities require them to come in contact with the sites. Examples of activities that could result in exposure at these sites include installing and repairing fences and road construction. The actual relevance of

Table 5-5
Matrix of Potential Current and Future Exposure Pathways

RI/FS Workplan
OLF Barin, Foley, Alabama

Exposure Medium and Exposure Route	Exposure Point	Residential Population	Occupational Population	Recreational or Trespasser Population
Groundwater				
Ingestion	Sites 19B, 20B, 21B, 22B, 23B, 25B, 26B, and 27B.	A, C	W	
Dermal contact	Sites 19B, 20B, 21B, 22B, 23B, 25B, 26B, and 27B.	A, C	W	
Surface Soil				
Ingestion	Sites 19B, 20B, 21B, 22B, 23B, 25B, 26B, and 27B.	A, C	W	T
Dermal contact	Sites 19B, 20B, 21B, 22B, 23B, 25B, 26B, and 27B.	A, C	W	T
Surface Water				
Ingestion	Sites 21B, 23B, 25B, 26B, and 27B.			A, C
Dermal contact	Sites 21B, 23B, 25B, 26B, and 27B.			A, C
Fish				
Ingestion	Site 23B			A, C
Air				
Inhalation	Sites 22B, and 25B	A, C	W	T
Showering	Sites 19B, 20B, 21B, 22B, 23B, 25B, 26B, and 27B.	A, C		

Notes: A = Adult (18 to 70 years).
C = Child (1 to 6 years).
W = Adult worker.
T = Trespasser.

these activities to each of the 10 sites will be determined based on interviews with base personnel regarding future plans for the sites. The frequency and duration of such activities are highly variable and will depend on the specific activities, if any, that are planned for these sites.

Recreational-Trespasser. As indicated above, exposure to surface soil under residential conditions at any of the sites is not likely; however, adults and children could trespass through the sites to varying degrees. Therefore, base populations could be exposed to surface soil via incidental ingestion and dermal contact as a result of trespassing on each site under both current and future site conditions.

Quantification of Exposure. Once complete exposure pathways are selected for evaluation, the final step is to quantify exposure (i.e., intake) for each pathway. This quantification process involves developing exposure scenarios to estimate the total amount of contaminants that a hypothetical individual may ingest, absorb, or inhale from each exposure pathway. These exposure scenarios are based on several variables that can be grouped into the following categories:

- chemical-related variables,
- population-related variables, or
- assessment-related variables.

The ultimate goal of the step, as defined by USEPA guidance, is to identify the combination of these exposure variables or parameters that results in the most intense level of exposure that may "reasonably" be expected to occur under current and future site conditions (USEPA, 1989a). This is performed for each complete exposure pathway selected for evaluation. The resulting exposure scenarios are referred to as the "Reasonable Maximum Exposure" (RME) for each exposure pathway. The relative "intensity" of exposure for each pathway is a function of the potentially exposed population (e.g., child, adult, or worker) and the characteristics of exposure, such as frequency and duration.

The chemical-related variable in exposure quantification is the exposure concentration. The exposure concentration is the chemical concentration in the environmental medium that will be used to estimate intake.

Exposure concentrations will be calculated in accordance with the USEPA RAGS guidance (USEPA, 1989a) and the Region IV supplemental guidance (USEPA Region IV, 1991b). Data used in determining exposure point concentrations within a medium will be log-transformed. The 95th percentile upper confidence limit (UCL) of the arithmetic average of the transformed data will be calculated from the formula:

$$UCL = \exp\left(\bar{x} + 0.5s^2 + \frac{sH}{\sqrt{n-1}}\right)$$

where UCL = 95th upper confidence limit on the arithmetic mean of transformed data,
$\bar{x}$ = the arithmetic mean of the transformed data,
s = the standard deviation of the transformed data,
H = statistic from provided table, and
n = sample size.

For groundwater, only data from wells located within contaminant plumes will be used in determining the exposure concentrations. The strategy for determining exposure concentrations for soils will depend on the spatial distribution of the contaminant. If a contaminant is evenly distributed throughout the site, the exposure concentration will be based on the 95 percent UCL of the arithmetic average for all site samples, including non-detects. One half the detection limit will be used as a surrogate value for concentration at any non-detect point. If the contamination is unevenly distributed (i.e., if "hotspot" areas exist), exposure concentrations will be determined for these areas. A percentage of time spent in the "hotspot" areas will be factored into intake equations. If the 95 percent UCL exceeds the maximum contaminant concentration measured in a medium, the maximum concentration detected will be used, instead of the 95 percent UCL, as the exposure concentration.

Population-related variables describe the characteristics of a hypothetical individual within each potentially exposed population. These variables are either contact rates, such as exposure frequencies, and water and soil ingestion rates, or physical characteristics of human bodies, such as body weights and surface areas. When applicable, contact rates will be selected from the USEPA supplemental RAGs guidance "Standard Default Exposure Factors" (USEPA, 1991e). If site-specific factors indicate that such parameters are not appropriate, alternative parameters will be used based on knowledge of human behavior and the relative accessibility of the sites. Parameters describing the physical characteristics of the exposed populations will be identified from appropriate USEPA guidance (e.g., Exposure Factors Handbook, USEPA, 1989c).

The assessment-related variable involved in exposure quantification is the averaging time (time over which exposure is averaged). Averaging time reflects the duration of exposure and depends on the type of effect being evaluated. Exposure intake during a defined interval (e.g., a lifetime) is averaged over the entire period, resulting in an estimate of average daily intake. This averaging is performed regardless of whether exposure actually takes place on a daily basis. It is assumed that infrequent exposure to chemicals over the exposure period is equivalent to daily exposure to a proportionately lesser amount as long as the total intake over the exposure period is the same.

There are essentially two types of effects typically evaluated in human health risk assessment: (1) carcinogenic effects, and (2) noncarcinogenic effects. The averaging time for carcinogenic effects is assumed to be a 70-year lifetime according to USEPA guidance (USEPA, 1989a).

The averaging times for noncarcinogenic effects are equivalent to the duration of the exposure event and may vary depending on the nature of exposure. There is a wide range of possible estimates, from a few weeks to a lifetime. However, based on USEPA RAGS guidance, exposure duration for noncarcinogenic effects can roughly be categorized into one of three periods: (1) chronic exposures, 7 years to a lifetime; (2) subchronic exposures, 2 weeks to 7 years; and (3) acute exposures, less than 2 weeks (USEPA, 1989a). The length of the exposure period will depend on the potentially exposed population and the characteristics of exposure.

As indicated, USEPA has established default values for many of the variables that may be used in the risk assessments of the OLF Barin sites. Table 5-6 presents a summary of some of these variables. Unless site-specific factors indicate otherwise, the values listed in Table 5-6 will be used to estimate intake.

Based on these variables, the RME intake for each exposure pathway selected for quantitative evaluation will be calculated. The equations used to calculate intake are those presented in Section 6 of USEPA's RAGS guidance, Exposure Assessment. The general equation for calculating chemical intake is as follows:

$$Intake = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

where Intake = daily intake averaged over the exposure period,
C = concentration of the chemical in the exposure medium,
CR = contact rate for the medium of concern,
EF = exposure frequency,
ED = exposure duration,
BW = body weight of the hypothetically exposed individual, and
AT = averaging time (for carcinogens AT equals 70 years, for noncarcinogens, AT equals ED).

5.9.2.3 Toxicity Assessment The purpose of the Toxicity Assessment is to weigh available evidence regarding the potential for a chemical to cause adverse effects in exposed individuals and to provide an estimate of the relationship between the extent of exposure to the chemical and the increased likelihood or severity of adverse effects. The Toxicity Assessment is generally accomplished in two steps: hazard identification and dose-response assessment.

Hazard identification is the process of determining whether exposure to an agent can cause an increase in the incidence of a particular adverse health effect (e.g., cancer or birth defects) and whether that effect is likely to occur in humans. In this instance, hazard is defined as any chemical, substance, or situation at a site that is capable of doing harm to human health. The object of the dose-response assessment is to define the relationship between the dose of a substance and the likelihood that a toxic effect, either carcinogenic or noncarcinogenic, will result from exposure to that substance. As a result of this assessment, dose-response values are derived that will be used to estimate the incidence of adverse effects as a function of human exposure to an agent.

There are two types of dose-response values: cancer slope factors (SF) and reference doses (RfD). The derivation of each value for a particular compound depends on the toxicity of that compound and whether it displays carcinogenic or noncarcinogenic effects. For many compounds, both types of values have been developed by USEPA because many compounds elicit both carcinogenic and noncarcinogenic (systemic) effects. In addition, because the toxicity and carcinogenicity of a compound can depend on the route of exposure (oral, inhalation, or dermal), unique dose-response values have been developed for the oral and inhalation exposure routes. In the absence of analogous values for the dermal route, the oral values will be used.

In most cases, the hazard identification and dose-response assessments have been performed by the USEPA. That is, USEPA has determined the hazards (carcinogenic versus systemic effects) associated with most chemicals detected at hazardous waste sites, and has derived appropriate dose-response values for use in characterizing risks. The purpose of the dose-response assessment for the OLF Barin sites will be to identify appropriate dose-response values for the contaminants of potential concern at each site.

Sources of Dose-Response Values. The primary source for identifying dose-response values for the contaminants of potential concern at the OLF Barin sites will be the USEPA's Integrated Risk Information System (IRIS). IRIS is an on-line database containing health risk and USEPA regulatory information about specific chemicals. Health risk information is included on IRIS only after a comprehensive review of chronic toxicity data by work groups composed of USEPA scientists. If no information can be found in IRIS, the USEPA Health Effects Assessment Summary Tables (HEAST) will be used (USEPA, 1990b). If appropriate dose response values cannot be located from either of these two sources, other USEPA sources will be consulted. As a last resort, surrogate values will be developed from other chemicals based on similarities in toxicity and chemical structure of the compounds.

Preliminary List of Dose-Response Values. The IRIS database and HEAST tables were searched to develop a set of dose-response values for the preliminary list of contaminants of potential concern identified in Section 5.9.2.1. Presented in Table 5-7 are the chronic oral dose-response values that were available from IRIS and HEAST. These values will be used in the quantitative human health risk assessment to calculate potential risks to human health. Prior to using these values, the appropriate sources will be consulted to ensure that these values are the most current dose-response values endorsed by USEPA. For those chemicals for which values could not be located (e.g., lead), a surrogate value or another method of assessing risks will be used.

Toxicity Assessment for Lead. At the present time (1992), there are no suitable dose-response values for assessing the risks associated with exposure to lead. However, USEPA has developed a biokinetic model to estimate blood-lead levels in children resulting from exposure via multiple sources (e.g., soil, water, air, food, and paint). This model will be used in the risk assessments to assess the potential risks associated with lead, as appropriate, rather than develop a surrogate dose-response value.

5.9.2.4 **Risk Characterization** Risk Characterization is the final step in the Human Health Risk Assessment in which the exposure and toxicity information generated in previous sections are integrated to qualitatively or quantitatively evaluate the potential health risks associated with exposure to chemicals at a site. For the OLF Barin sites, quantitative estimates of both carcinogenic and noncarcinogenic risks will be calculated for each contaminant of potential concern identified in the Toxicity Assessment and each complete exposure scenario selected for evaluation in the Exposure Assessment.

Table 5-6
Default Exposure Parameters

RI/FS Workplan
OLF Barin, Foley, Alabama

Parameter	Value	Units
Soil and Sediment Ingestion		
Adult	100	mg/day
Child (1 to 6)	200	mg/day
Occupational	50	mg/day
Soil-skin adherence factor	1.45	mg/cm^2
Drinking Water Ingestion		
Residential	2	liters/day
Occupational	1	liter/day
Surface Water Ingestion	50	mℓ/hour
Inhalation Rate		
Adult, ambient air	20	m^3/day
Adult, indoor air	15	m^3/day
Adult, showering	0.6	m^3/hour
Fish consumption	54	g/day
Body Weight		
Child (1 to 6)	15	kg
Adult	70	kg
Averaging Time		
Lifetime	70	years
Exposure Frequency		
Swimming	45	days/year
Residential	350	days/year
Occupational	250	days/year
Exposure Duration		
Residential	30	years
Occupational	25	years

Sources: USEPA, 1989a; 1991.

Notes:
mg/day = milligrams per day.
mg/cm^2 = milligrams per square centimeter.
liters/day = liters per day.
mℓ/hour = milliliters per hour.
m^3/day = cubic meters per day.
m^3/hour = cubic meters per hour.
g/day = grams per day.
kg = kilogram.
days/year = days per year.

Table 5-7
Oral Dose-Response Values for Contaminants of Potential Concern

RI/FS Workplan
OLF Barin, Foley, Alabama

	Cancer Slope Factor (mg/kg/day)	Source	Chronic Reference Dose (mg/kg/day)	Source
Cyanide	–	–	2×10^{-2}	IRIS
4,4'-DDD	2.4×10^{-1}	IRIS	–	–
4,4'-DDE	3.4×10^{-1}	IRIS	–	–
4,4'-DDT	3.4×10^{-1}	IRIS	5×10^{-4}	IRIS
t-1,2-Dichloroethylene	–	–	2×10^{-2}	IRIS
Dieldrin	$1.6 \times 10^{+1}$	IRIS	5×10^{-5}	IRIS
Ethyl benzene	–	–	1×10^{-1}	IRIS
Lead[1]	–	–	–	–
Mercury	–	–	3×10^{-4}	HEAST
Methylene chloride	7.5×10^{-3}	IRIS	6×10^{-2}	IRIS
Tetrachloroethene	5.1×10^{-2}	HEAST	1×10^{-2}	IRIS
Toluene	–	–	2×10^{-1}	IRIS
Trichloroethylene	1.1×10^{-2}	HEAST	–	–
Xylenes	–	–	$2 \times 10^{+0}$	IRIS

[1] USEPA biokinetic model will be used (see text).

Notes: mg/kg/day = milligrams per kilograms per day.
IRIS = Integrated Risk Information System, October, 1991.
HEAST, Annual FY-1991, January 1991.
4,4'-DDD = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethane.
4,4'-DDE = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethylene.
4,4'-DDT = 1,1,1-trichloro 2,2-bis (p-chlorophenyl) ethane.

Quantifying Risks. Carcinogenic risks associated with exposure to individual chemicals will be estimated by multiplying the estimated chemical intake for each carcinogen (in units of milligrams per kilograms per day [mg/kg/day]) by its USEPA cancer SF (in units of $mg/kg/day^{-1}$). The result is a chemical-specific lifetime incremental cancer risk. This value represents the probability of developing cancer over the course of a 70-year lifetime as a result of exposure to a chemical. Within each exposure pathway, cancer risks associated with multiple carcinogenic compounds will be determined by summing the chemical-specific risks to yield a pathway-specific lifetime incremental cancer risk. The equations for calculating chemical-specific and pathway-specific cancer risks are the following.

Chemical-specific lifetime incremental cancer risk

$$Risk_i = CDI_i \times SF_i$$

where

$Risk_i$ = unitless probability of an individual developing cancer as a result of exposure to a chemical i,

CDI_i = chronic daily intake of chemical i averaged over 70 years (mg/kg/day), and

SF_i = USEPA cancer slope factor for chemical i $(mg/kg/day)^{-1}$.

Pathway-specific lifetime incremental cancer risk

$$Risk_T = \sum Risk_i$$

where

$Risk_T$ = unitless probability of an individual developing cancer as a result of multiple chemical exposure, and

$Risk_i$ = unitless cancer risk estimate for the ith chemical.

Noncarcinogenic risk estimates will be determined by dividing estimated chemical intakes for each noncarcinogen (in units of mg/kg/day) by the appropriate RfD (in units of mg/kg/day). The resulting ratio is called the hazard quotient. The hazard quotients for individual compounds within an exposure pathway will be summed resulting in a hazard index for that pathway. The equations that will be used to calculate hazard quotients and hazard indices are as follows.

Hazard quotient

$$HQ_i = \frac{I_i}{RfD_i}$$

where

HQ_i = hazard quotient of chemical i,

I_i = intake of chemical i averaged over the exposure period (chronic, subchronic, or acute) (mg/kg/day), and

RfD_i = reference dose for chemical i corresponding to the same exposure duration as the intake (mg/kg/day).

Hazard index

$$Hazard\ Index = \sum HQ_i$$

where
HQ_i = hazard quotient for the ith chemical.

Separate hazard indices will be calculated for the three lengths of exposure discussed earlier; chronic, subchronic, and acute. Depending on the type of chemicals present, a separate hazard index might also be calculated for developmental toxicants.

Combination of Risks Across Exposure Pathways. USEPA guidance states that risk estimates should be combined across exposure pathways if the same individual could reasonably be exposed to more than one pathway, and it is reasonable to assume that the same individual would consistently experience the RME intake estimated in the exposure assessment (USEPA, 1989a). Therefore, if the same potentially exposed population could be exposed to contaminants via more than one pathway, the pathway-specific risks will be summed to yield a single risk estimate for each population. Similarly, the hazard indices from multiple pathways will be summed to yield a single hazard index for each population.

Uncertainty Evaluation. The interpretation of risk estimates is subject to a number of uncertainties as a result of the multiple layers of conservative assumptions inherent in risk assessment. All quantitative estimates of risk are based on numerous assumptions, most intended to be protective of public health (i.e., conservative). As such, risk estimates are not truly probablistic estimates of risk, but rather conditional estimates given a series of conservative assumptions about exposure and toxicity.

In general, sources of uncertainty can be categorized into site-specific factors and toxicity assessment factors. A thorough discussion of all potential sources of uncertainty in risk assessment is not feasible. However, a discussion of the major sources of uncertainty and their potential effects will be provided to aid the reader in interpreting the relative significance of the results.

Summary. The risk estimates calculated for each of the OLF Barin sites will be presented in tabular form by potentially exposed population. The calculations of these estimates will be documented in spreadsheets in an appendix. Within the summary text, a discussion will be provided of the relative significance of each risk estimate.

The relative significance of risk estimates will be evaluated in terms of a comparison with target risk levels established by the USEPA. USEPA's guidelines state that the total incremental carcinogenic risk for an individual resulting from exposure at a hazardous waste site should not exceed a range of 10^{-6} to 10^{-4} (USEPA, 1989a). The target risk level for noncarcinogenic effects is a hazard index of 1 (USEPA, 1989a).

The significance of an elevated hazard index requires evaluation on a case-by-case basis. It is assumed that if the hazard index is less than or equal to 1,

no adverse health effects will result from the predicted exposure level. If the ratio is greater than 1, the predicted exposure level could potentially cause adverse health effects. This determination is necessarily imprecise because the derivation of RfDs involves the use of multiple safety factors. In addition, although hazard quotients are typically summed regardless of target organ effects, hazard quotients for individual compounds should properly be summed only if their target organs or mechanisms of action are similar. Therefore, the potential for adverse health effects for a mixture having a hazard index in excess of 1 will be assessed on a case-by-case basis.

5.9.3 Ecological Risk Assessment The purpose of the Ecological Risk Assessments for OLF Barin is to provide a baseline evaluation of actual and potential risks to the natural environment posed by chemicals present in environmental media at the sites. This information, in conjunction with the Human Health Risk Assessments (Section 5.9.2) and other information collected, will be used to determine appropriate future action at the site. The *Risk Assessment Guidance for Superfund (RAGS), Volume 2, Environmental Evaluation Manual* (USEPA, 1989b), will be used to prepare the ecological risk assessments.

Each ecological risk assessment will include the following elements:

- biological characterization (Section 5.9.3.1),
- identification of chemicals of potential concern (Section 5.9.3.2),
- ecological exposure assessment (Section 5.9.3.3),
- ecotoxicity assessment (Section 5.9.3.4), and
- ecological risk characterization (Section 5.9.3.5).

The following sections describe the proposed approach for each of these components of the risk assessment and, where possible, discuss site-specific information.

5.9.3.1 **Biological Characterization** The biological characterization will serve as a basis for identifying potential ecological receptors at OLF Barin. It will provide a description of the different biological habitats located at OLF Barin, and of the animal life expected to be found associated with these habitats. This characterization will be based on a site reconnaissance, background information available for the site, literature information on the range and distribution of wildlife species, and interviews with local, State, and Federal wildlife officials. Particular emphasis will be placed on the following: assessing habitat suitability for aquatic and terrestrial organisms; assessing the potential occurrence of rare, threatened, or endangered species; and identifying wetland or other aquatic areas that may be receptors of site-related contaminants. Additionally, plant communities at each site will be described and observations of aquatic or terrestrial organisms will be recorded. The results of the receptor analysis will be used to further develop exposure scenarios for the ecological exposure assessment.

Using information presented in SI (E.C. Jordan, Company, 1991), a brief discussion of the environmental setting of OLF Barin is provided in the following paragraphs.

The forested ecological communities within a 4-mile radius surrounding OLF Barin include remnants of longleaf pine-turkey oak upland forest, pine plantations, coastal strand, pine flatlands, bottom land hardwoods, and swamp hardwoods. The wetland and aquatic ecological communities within the drainage basin of Sandy Creek and up to 15 miles downstream into Perdido Bay include freshwater marsh and swamps, floodplain forest, cypress stands, salt marsh, intertidal mud flats, medium salinity estuary, high salinity estuary, and the coastal offshore Gulf of Mexico waters. Major wetland systems abutting the eastern edges of OLF Barin are palustrine forested swamp and palustrine shrub swamp. Seagrass flats occur in the Old River estuary adjacent to the barrier strand along Perdido Key near Alabama Point.

As shown in 1988 aerial photography (E.C. Jordan, Company, 1991), much of the upland area within 4 miles has been greatly changed due to agriculture and silviculture. Cropland agriculture systems are the predominant terrestrial system. Human influenced systems represented by old field and shrub successional stages and successional forest appear to dominate areas not maintained as pasture, cropland, or managed residential yards and gardens.

Wetland and aquatic ecosystems in the area surrounding OLF Barin appear much less affected by man's activity. The flora and fauna of these systems are well described by O'Neil and Mettee (1982). All the wetlands surrounding OLF Barin are within the Coastal Zone Federal Management Area (U.S. Fish and Wildlife Service, 1982). Dominant wetlands in the reaches of Sandy Creek and Wolf Creek adjacent to and downstream from OLF Barin are palustrine forested swamps or forest and shrub mixed swamps with broad-leafed deciduous, broad-leafed evergreen, and narrow-leafed evergreen dominants and codominants. Downstream within 15 miles of OLF Barin these systems are replaced in the tidal and estuarine reaches by estuarine intertidal emergent vegetation or salt marsh, intertidal swamp forest, subtidal open water estuarine system, intertidal mud flat, and dredged areas.

According to the PA (NEESA, 1989), no State or Federal endangered plant species are known to occur on OLF Barin. A SOUTHNAVFACENGCOM endangered plant species survey is currently ongoing. More recent surveys of threatened or endangered animal species that may reside in the area of OLF Barin have been conducted by SOUTHNAVFACENGCOM. SOUTHNAVFACENGCOM (Burst, 1990) has compiled a list of rare, threatened, or endangered species that could occur on or near OLF Barin as part of a survey of the biota of NAS Whiting Field, Florida, and each of its subinstallations. Table 5-8 lists each of the species, its likelihood of occurrence, and its status at OLF Barin.

Suitable habitat exists for a number of species on OLF Barin. The alligator and alligator snapping turtle might be expected to inhabit the palustrine and riverine wetlands in the immediate area of the installation. Whereas, likely present in freshwater marshes near OLF Barin, the woodstork is unlikely to occur on the installation or in the wooded swamps of Sandy or Wolf Creeks. In addition, the red-cockaded woodpecker also would not be likely to occur on OLF Barin because of its restricted habitat of large mature stands of longleaf pine. The brown pelican, *Pelecanus occidentalis*, although not listed by Burst (1990),

Table 5-8
Rare, Threatened, or Endangered Species
Occurrence at Outlying Landing Field (OLF) Barin

RI/FS Workplan
OLF Barin, Foley, Alabama

Organism		Legal Status		Occurrence at
Common Name	Scientific Name	Alabama	Federal	OLF Barin
Animals				
Eastern indigo snake	Drymarchon corais couperi	T	T	PR
Dusky gopher frog	Rana areloata	T	C-2	PR
Black pine snake	Pituophis melanoleucus loding	T	C-2	PR
Southern hog-nose snake	Heterodon simus	T	N	LR
Gopher tortoise	Gopherus polyphemus	N	C-2	PR
Flatwoods salamander	Ambystoma cingulatum	SC	C-2	PR
American alligator	Alligator mississippiensis	SC	E	PR
Woodstork	Myceteria americana	E	E	PV
Bald eagle	Haliaeetus leucocephalus	E	E	PV
Mississippi sandhill crane	Grus canidensis pulla	E	E	UR
Red-cockaded woodpecker	Picoides borealis	E	E	PV
Bachman's sparrow	Aimophila aestivalis	N	C-2	
Bachman's warbler	Vermirora bachmanii	E	E	UR
Southeastern myotis	Myotix austroriparus	SC	E-2	PR

See notes at end of table.

Table 5-8 (Continued)
Rare, Threatened, or Endangered Species
Occurrence at Outlying Landing Field (OLF) Barin

RI/FS Workplan
OLF Barin, Foley, Alabama

Organism		Legal Status		Occurrence at
Common Name	Scientific Name	Alabama	Federal	OLF Barin
Animals (Continued)				
Rafinesque's big-eared bat	Plecotus rafinesquii	SC	C-2	PR
Alligator snapping turtle	Macroclemys temminckii	SC	C-2	NH
Southeastern American kestrel	Falco sparverius paulus	N	C-2	LR
Migrant loggerhead shrike	Lanius ludovicianus migrans	N	C-2	LWR
Arctic peregrine falcon	Falco perogrinus tundrius	T	T	WV
Plants				
Orange azalea	Rhododendron austrinum	N	C-5	PR
Incised groove bur	Agrimonia incison	N	C-2	PR
Southern three-awn grass	Aristidia simplicifolia	N	C-2	PR
Eliott's croton	Croton elliottii	N	C-2	PR
Serviceberry holly	Ilex amelanchier	N	C-2	PR
Carolina false lily	Lilaeopsis carolinensis	N	C-2	PR
Piedmont water milfoil	Myreophyllium laxum	N	C-2	PR
Naked-stemmed prairie grass	Panicum nudicarli	N	C-2	PR
Hacry fevertree	Pinckneya pubes	N	C-5	PR
Chapman's butterwort	Pinguicula planifolia	N	C-2	PR
Chaff seed	Schwalbec americana	N	C-2	PR

See notes at end of table.

Table 5-8 (Continued)
Rare, Threatened, or Endangered Species
Occurrence at Outlying Landing Field (OLF) Barin

RI/FS Workplan
OLF Barin, Foley, Alabama

Organism		Lega Status		Occurrence at
Common Name	Scientific Name	Alabama	Federal	OLF Barin
Plants				
Cooley's meadowrue	Thalictrum cooleyi	N	C-1	PR
Drummond's yellow-eyed grass	Xyris drummondii	N	C-2	PR
Harper's yellow-eyed grass	Xyris scabrifolia	N	C-2	PR
Panhandle lilly	Lilium iridollae	N	C-2	PR
Florida jointtail	Coelorachis tuberulosa	No data		
Florida pondweed	Potamiooeton floridana	No data		

Source: Burst, 1990

Legal Status

E = endangered.
N = not protected or not applicable.
T = threatened.
SC = species of special concern.

C-1 = Federal candidate for Listing; substantial evidence for need to list.
C-2 = Federal candidate for Listing; not enough evidence for listing at this time.
C-5 = Former Federal candidate for listing; more common than previously thought.

Occurrence at OLF Barin

C = confirmed L = likely P = possible R = resident
W = winter V = visitor U = unlikely NH = no habitat

would be expected in the medium and high salinity estuarine and salt marsh systems.

The final HRS II rule lists a set of sensitive environments recognized as specific targets or receptors of contaminants migrating from potential hazardous waste sites. Those found at OLF Barin are listed in Table 5-9, along with their respective distance overland or downstream tabulated.

5.9.3.2 **Identification of Chemicals of Potential Concern** A summary of contaminants detected at each site during the 1989 and 1991 sampling is presented in Table 5-3. Based on the data evaluation described in Section 5.9.1 and other information (including new data), the list of detected chemicals will be screened and a list of ecological contaminants of concern (COCs) will be developed. This screening process limits the number of chemicals evaluated by focusing on those chemicals expected to pose ecological risks at each site. The identification of chemicals of potential concern will be based on:

- the measured chemical concentrations and frequency of detection in various media at the various sites,
- the inherent toxicity and bioaccumulation potential of chemicals detected,
- the probability of significant exposure,
- the physical and chemical properties of chemicals detected, and
- for inorganics, the chemical concentration in background samples.

Limiting the chemicals evaluated in the ecological risk assessments at this time is not warranted given the amount of available data; therefore, for the purposes of this work plan, all chemicals listed in Table 5-4 will be considered as potential COCs.

5.9.3.3 **Ecological Exposure Assessment** The purpose of the ecological exposure assessment is to evaluate the potential for ecological exposure to site-related chemicals at OLF Barin. This involves identification of actual or potential exposure routes to receptors (identified based on the biological characterization) and the evaluation of the magnitude of exposure. The exposure information is used in conjunction with toxicological information presented in Section 5.9.3.4 to evaluate risk in the ecological risk characterization (Section 5.9.3.5).

<u>Identification of Potential Receptors</u>. In this section, potential receptor areas and associated receptor species at each site at OLF Barin will be described. If appropriate, indicator species will be selected for exposure modeling. The potential receptor areas will be evaluated and described in greater detail after completing the biological survey for each site. Some or all of these receptor areas exist near the 10 sites. Various aquatic and terrestrial organisms are expected or have been documented in these areas. Organisms living in these areas

Table 5-9
Relationship of Sensitive Environments[1] to Outlying Landing Field (OLF) Barin

RI/FS Workplan
OLF Barin, Foley, Alabama

Designation	Sensitive Environment
Habitat known to be used by Federally and Alabama designated threatened or endangered species	On OLF Barin to a distance of 4 miles and in the aquatic systems for 15 river miles downstream including the estuarine areas of Wolf Bay, Perdido Bay, and the Gulf of Mexico near shore waters.
Coastal barrier	Bayou St. John's, Perdido Key, and Alabama Point and Perdido Pass, 10 to 15 miles from OLF Barin.
Spawning areas critical for the maintenance of fish and shellfish species within river, lake, or coastal tidal waters	Sea grass flats in Bayou St. John's, approximately 10 miles from OLF Barin Salt marshes in lower Wolf Bay, 5 river miles from OLF Barin.
State designated areas for protection of maintenance of fish and aquatic life	All waters of Sandy Creek and Wolf Creek are designated F & W (Fish and Wildlife Propagation) use classification by Alabama Department of Environmental Management (DEM). With the exception of Wolf Creek, all waters of Sandy Creek and the estuarine system are designated as suitable for body contact recreation (S) by Alabama DEM. All tidal and estuarine waters, except Mifflin Creek and Hammock Creek, are also designated SH and F&W designating their classification as suitable for shellfish harvesting (within 5 river miles of OLF-Barin) by Alabama DEM.

[1] As defined in Table 4-23 of the HRS II Rankings (United States Environmental Protection Agency, 1990).

or passing through the study area may come into contact with contaminated water, sediment, and soil.

Identification of Ecological Exposure Pathways. To determine if exposure might occur, at present or in the future, the most likely pathways of chemical release and transport and the activity patterns of potential receptors that occur near the site need to be defined. In this section, exposure pathways to these ecological receptors will be identified and the magnitude of potential exposure estimated.

Exposure pathways describe how ecological receptors may come in contact with contaminated media and are based on identifying (1) the contaminant source, (2) the environmental transport medium, (3) the point of receptor contact, and (4) the exposure route (e.g., ingestion of prey items that have bioaccumulated chemicals in their tissues, drinking of contaminated surface water, incidental soil ingestion, or dermal absorption).

There are three environmental media by which environmental receptors may come into contact with chemical constituents present at OLF Barin: surface water (including groundwater as it discharges to surface water), sediments, and surface soil. Exposure to constituents in these media at OLF Barin may occur via several pathways. This assessment will be expanded and revised based on agency reviews and as additional information becomes available.

Incidental ingestion of contaminated surface soil by environmental receptors associated with foraging and preening activities may result in exposure. The consumption of prey items that have bioaccumulated chemicals in their tissues is another potentially significant exposure pathway.

Potential exposures to terrestrial organisms (birds, mammals, reptiles, and amphibians) are expected to vary considerably between species due to differences in feeding behavior, habitat preferences, and other factors affecting exposure. Because of this variability, indicator species will be selected as part of the exposure assessment to best represent the species of terrestrial wildlife potentially exposed.

Direct contact with soil by terrestrial organisms is not considered a likely exposure pathway because fur, feathers, and chitinous exoskeletons act to impede chemical absorption across the dermal layer or body integument. Inhalation of particulate airborne constituents by terrestrial organisms is also not considered a significant route of exposure due to the limited extent of barren soil associated with the various sites, which would be necessary to produce significant airborne dust concentrations.

Estimation of Exposure. Based on chemical concentration data, exposure concentrations will be estimated for aquatic and terrestrial organisms identified as potential receptors at each site. Exposure levels for terrestrial and aquatic organisms are developed separately because terrestrial and aquatic organisms are exposed to different media. If sufficient information exists, integrated exposure analyses will be performed by combining exposure information (e.g., populations exposed, duration and frequency of exposure, and routes of exposure)

to calculate a quantitative estimate of the exposure concentration for representative receptor species.

To evaluate exposure to aquatic organisms, the reported concentrations of site-related chemicals in surface water and sediment will serve as representative exposure concentrations. Average and maximum values will be used to represent chronic and acute exposures, respectively.

The process of evaluating the degree of terrestrial exposure involves estimating the likely exposure dosage for each relevant pathway, and then summing these estimates to derive an expected total body dosage for each receptor type. The degree of exposure will depend on various factors including the type of food consumed, feeding rates, habitat preference, and home range. Indicator species will be chosen to best characterize the organisms and trophic levels potentially at risk due to incidental ingestion of contaminated soil and consumption of contaminated prey items. It is assumed that each species chosen will be representative of other species at a similar trophic position. The documentation of exposure parameters for each representative species will be presented in tabular format (an example is presented in Table 5-10).

A simple food web model will be used to estimate contaminant levels in the various prey items consumed by each receptor species. Estimated contaminant tissue residues in each prey species will be calculated using specific bioaccumulation factors obtained directly or extrapolated from values in the scientific literature as shown in the following equation:

$$\textit{Prey tissue concentration (mg/kg)} = \textit{soil concentration (mg/kg)} \times \textit{bioaccumulation factor (BAF)}$$

The potential dietary exposure (PDE) level, for each modeled receptor species, will be calculated by multiplying each predicted prey species' tissue concentration by the proportion of that prey type in the diet, summing these values, adding soil exposure (soil ingestion will be assumed to be 5 percent of diet), and multiplying by the receptor species' Site Foraging Frequency (SFF). PDE is represented by the following equation:

$$PDE = [\sum_{1 \to n} P_1 \times T_1 + P_2 \times T_2 + \ldots P_n \times T_n + \textit{soil exposure}] \times SFF$$

where

PDE = potential dietary exposure (mg/kg),
P_n = percent of prey item ingested,

T_n = tissue concentration in prey item n (mg/kg),
soil exposure = (0.05) (soil concentration in mg/kg), and
SFF = area of contaminated soil (acres) divided by home range (acres).

Table 5-10
Ecological Exposure Parameters, Example Table

RI/FS Workplan
OLF Barin, Foley, Alabama

Receptor Species	Exposure Parameter	Reported Values	Reference	Value Selected for Ecological Risk Assessment
Gray squirrel (Sciurus carolinensis)	Home range (acres)	2 to 7 acres, >1.24 acres, 1.2 acres, and 1.4 acres.	DeGraaf and Rudis, 1986	1.4 acres
	Percent prey items	**Plant food**: 10 to 50 percent oak acorns and flowers 10 to 25 percent hickory, 5 to 10 percent beech and maple, and <5 percent other plant species. **Animal food**: incidental ingestion of weevils; occasionally eats caterpillars, beetles, and ants.	Martin, and others 1951	Plants: 80% Invertebrates: 15% Soil: 5%
	Ingestion rate (kilograms per day)	Allometric relationship between body weight (W) and ingestions rate (F) for laboratory mammals: F = 0.056 × W^0.-6611	USEPA, 1988b	0.035 kilograms per day
	Body weight (kg)	0.34 to 0.68 kg	Baker, 1983	[1]0.5 kilogram
	Drinking water intake rate (1 per day)	Allometric relationship between body weight (W) and drinking water intake rate (L) for laboratory mammals: L = 0.10 × W^-0.7377	USEPA, 1988	0.06 liter per day
	Density (number per acre)	2 per acre, 1 per acre, and 0.65 per acre	Baker, 1983	1 per acre
	Lifespan (years)	>3 to 4 years, and 7 to 8 years	Baker, 1983	6 years

Note: kg = kilograms.

Finally, the PDE for each receptor species is multiplied by the receptor-specific ingestion rate and divided by the estimated body weight to calculate a total body dose (TBD) expressed in milligrams per kilogram body weight per day (mg/kg BW/day):

$$TBD = PDE \times IR \times \frac{1}{BW}$$

where

TBD = total body dose (mg/kg BW/day),
PDE = potential dietary exposure (mg/kg),
IR = ingestion rate (kg/day), and
BW = body weight (kg).

These TBD estimates are directly comparable to available toxicological test data, which are discussed in the ecotoxicity portion of the workplan (Section 5.9.3.4).

5.9.3.4 **Ecotoxicity Assessment** In the Ecotoxicity Assessment, the environmental hazards associated with the chemicals of concern identified in Section 5.9.3.2. will be described, and the relationship between the concentration to which an organisms is exposed and the potential for adverse environmental effects will be evaluated.

The toxicological evaluation comprises the process of characterizing the inherent toxicity of the compounds. Information necessary to evaluate the potential impacts to receptors at the exposure concentration determined in Section 5.9.3.3 consists of laboratory-derived toxicological data published in the literature. Toxicological effects considered include the acute and chronic toxic effects of hazardous constituents on aquatic biota and terrestrial wildlife.

Toxicological effects considered in the ecotoxicity assessment include concentration-response data on the acute and chronic toxic effects of hazardous constituents on aquatic biota and terrestrial wildlife. The concentration-response information, in conjunction with exposure information presented in Section 4.3.3, is used to develop Reference Toxicity Values (RTVs) for each COC.

Toxicity to Terrestrial Receptors. Toxicity data for terrestrial receptors consist of acute and chronic ingestion studies. Based on these data, RTVs are developed for terrestrial organisms that represent a threshold concentration for effects to terrestrial organisms. RTVs are expressed in mg/kg BW per day. From the toxicological data set (Table 5-11), the lowest acute and chronic values for each type of receptor (representative species) will be selected as the RTV. The preliminary RTVs for chemicals identified at the site are presented in Table 5-11.

Toxicity to Aquatic Receptors. Information available to evaluate the toxicity of COCs in surface water includes AWQC, laboratory-derived toxicity data, and toxicity threshold values developed using extrapolation techniques. These sources will be used to generate RTVs for the COCs in surface water. The aquatic

toxicological data available for all preliminary COCs are presented in Table 5-11; however, this list will be modified as more data become available (e.g., if all chemicals listed are not detected in surface water). As noted earlier, aquatic organisms will not be exposed to chemicals in groundwater unless the groundwater is discharged to a surface water body. Therefore, the aquatic RTVs apply to exposure to aquatic organisms in the water column and do not apply to groundwater directly.

If AWQC are not available for certain site chemicals, USEPA Lowest Observed Effect Levels (LOEL) will be used. The LOEL values, which are the lowest concentrations causing toxicity reported in the literature, are used instead of AWQC when insufficient data exist for USEPA to develop a national criterion.

For certain chemicals, toxicity data may be limited to the results of acute toxicity studies. To develop a chronic RTV for these chemicals, a Quantitative Structure Activity Relationship (QSAR) model presented in Hermens and others (1984) or other appropriate references will be used to estimate an RTV.

Sediment Quality Criteria (SQC) for hydrophobic organic chemicals (USEPA, 1988a) and "non-polluted threshold values" for inorganic chemicals are available to evaluate the effects of the COCs in sediment on aquatic life. SQCs have been developed for a number of hydrophobic organic compounds based on their expected partitioning between sediment organic matter and interstitial water, and are dependent on the total organic carbon (TOC) present in the sediment. Using this equilibrium-partitioning approach, an SQC value will be calculated for COCs detected in sediment.

SQCs are not suitable for evaluating the effects of the inorganic COCs on aquatic life. In lieu of SQCs, "non-polluted threshold values" have been calculated based on USEPA water quality criteria and assumed partitioning equilibrium between sediment and water. These threshold values are based on the assumption that the distribution of a chemical between the organic carbon phase of the sediment and the soluble phase in interstitial water of the sediment is described by the organic carbon-water partition coefficient (K_{oc}) for the chemical. The sediment threshold value is the concentration in sediment that will not exceed the USEPA water quality criterion in the interstitial water.

5.9.3.5 Ecological Risk Characterization This section characterizes the risk to aquatic and terrestrial receptors potentially exposed to COCs at OLF Barin. The magnitude of risk present depends upon the magnitude, duration, and frequency of exposure to the chemicals and on the characteristics of the exposed populations. This exposure information, detailed in Section 5.9.3.2, combined with the appropriate toxicity data presented in Section 5.9.3.3, will be the basis for the risk characterization. Risks to aquatic and terrestrial receptors will be characterized for each site.

The projected intakes and exposure concentrations calculated in the exposure assessment for each COC and exposure route will be compared with the RTVs developed in the ecotoxicity assessment. The ecological risk assessment will also include a discussion of visual observations of ecosystem degradation and

Table 5-11
Reference Toxicity Values for Aquatic Organisms

RI/FS Workplan
OLF Barin, Foley, Alabama

Chemical	Reference Toxicity Value		
	Surface Water		Sediment
	Chronic (μg/ℓ)	Acute (μg/ℓ)	Chronic (mg/kg)
Volatile Organics			
trans-1,2-Dichloroethene	1,160	11,600	NA
Ethyl benzene	3,200	32,000	NA
Methylene chloride	12,000	99,000	NA
Tetrachloroethylene	840		
Toluene		17,900	NA
Trichloroethylene	21,900	45,000	NA
Xylenes	591	3,190	NA
Pesticides			
4,4'-DDD			
4,4'-DDE			
4,4'-DDT	0.001	1.1	NA
Dieldrin	0 (1.1 μg/ℓ)		
Inorganics			
Cyanide			
Lead	3.2	82	132
Mercury	0.012	2.4	0.8

Notes: ug/ℓ = microgram per liter.
mg/kg = milligram per kilogram.
NA = toxicity criterion not available.
4,4'-DDD = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethane.
4,4'-DDE = 1,1-dichloro 2,2-bis(p-chlorophenyl) ethylene.
4,4'-DDT = 1,1,1-trichloro 2,2-bis (p-chlorophenyl) ethane.

qualitative species diversity, abundance, and distribution among trophic levels, if observable during the site reconnaissance.

Risks to Aquatic Receptors. Comparison of the average and maximum concentrations of chemicals detected in surface water and sediments with RTVs for aquatic organisms provides a means of evaluating the potential for adverse effects from exposure to site-related chemicals. Hazard Indices (HI) will be calculated by dividing the exposure concentration by the RTV. A cumulative HI will then be determined by summing the HIs for each chemical. If the cumulative HI value is greater than 1.0, effects to aquatic organisms may be occurring. From this comparison, it will be possible to determine if COCs are posing a threat to aquatic organisms.

Risks to Terrestrial Receptors. Risks to terrestrial receptors will be evaluated by calculating an HI by dividing the estimated body dose by the RTV for each COC. A cumulative HI will then be determined by summing the HIs for each chemical. If the cumulative HI value is greater than 1.0, effects to terrestrial organisms may be occurring. HIs will be calculated on the same spreadsheets used to estimate terrestrial exposure presented.

5.10 PROJECT MANAGER MEETINGS. During the RI program, and prior to initiation of FS activities, a Project Managers meeting will be held. The meeting will consist of a presentation of work performed and data evaluated, a verbal report of significant findings, identification of data gaps, and a decision for additional data collection or further action needed at any of the sites. All decisions will be made jointly by USEPA, Alabama Department of Environmental Management (ADEM), OLF Barin and SOUTHNAVFACENGCOM. These decisions will be documented in meeting minutes and implemented in a timely manner.

Final data interpretation will conclude with an evaluation of the degree and distribution of contamination, and one of the following recommendations:

- take no further action or initiate long-term monitoring and prepare an ROD,
- perform source removal or migration mitigation (interim or early remedial action),
- obtain additional RI data needed for adequate characterization,
- conduct a Focused Feasibility Study (FFS),
- conduct Treatability Studies, and/or
- conduct a Feasibility Study.

5.11 FEASIBILITY STUDY PROCESS. If the site has a limited number of remedial alternatives, an FFS may be conducted. Interim or early remedial actions may be performed if site conditions pose an immediate threat to human health or the environment. Details of interim or early remedial actions and FFS processes will

be determined on a site-specific basis. The standard RI/FS approach consists of an RI, treatability studies, an FS, preparation of a ROD, and remedial action.

The standard FS will consist of the following tasks:

- compilation of ARARs,
- development of remedial alternatives,
- screening of remedial alternatives,
- detailed analysis of remedial alternatives,
- engineering description of selected remedial alternatives,
- RI/FS reports, and
- public meetings.

The overall objective of the FS is to develop and evaluate remedial alternatives to allow the selection of a remedial action that is protective of public health and the environment, implementable, cost effective, and meets CERCLA requirements, as amended by SARA.

5.11.1 Applicable or Relevant and Appropriate Requirements (ARARs) ARARs are used to help determine the appropriate extent of site cleanup, develop site-specific remedial response objectives, develop remedial action alternatives, and direct site cleanup. SARA (Section 121) and National Contingency Plan (NCP) require that CERCLA remedial actions comply with Federal ARARs and State requirements when applied legally and consistently statewide. Appendix C contains a preliminary checklist of Federal and Alabama ARARs pertinent to the OLF Barin RI/FS program.

Applicable requirements are Federal and State requirements that specifically address substances or contaminants and actions at CERCLA sites. Relevant and appropriate requirements are Federal and State requirements that, while not legally applicable, can be applied if the site circumstances are sufficiently similar to those covered by jurisdiction, and if use of the requirement is appropriate. For example, MCLSs under the Safe Drinking Water Act (SDWA) would be applicable if groundwater is being used as drinking water, but may be considered relevant and appropriate if groundwater is not currently being used for drinking water but may be used under a future residential scenario. Applicable requirements and relevant and appropriate requirements are considered equivalent compliance standards for CERCLA site cleanups.

SARA also identifies a "to be considered" (TBC) category, which includes Federal and State non-regulatory requirements such as criteria, advisories, and guidance documents. TBCs do not have the same status as ARARs; however, if no ARAR exists for a chemical or particular situation, TBCs can be used to ensure that a remedy is protective.

ARARs must be attained for hazardous substances remaining onsite at the completion of the remedial action. Remedial action implementation should also comply with ARARs (and TBCs, as appropriate) to protect human health and the environment. Generally, ARARs pertain to either contaminant levels or to performance or design standards to ensure protection at all points of potential

exposure. ARARs are divided into three general categories: chemical specific, location specific, and action specific.

Both Federal and State ARARs must be considered; prior to the 1986 SARA amendments, compliance to State requirements was not required. In addition, USEPA draft guidance entitled *CERCLA Compliance With Other Laws Manual*, revised in August 1988, identifies new methods and guidance for identifying, categorizing, and evaluating ARARs.

ARARs are usually identified and considered during several phases of the RI/FS process. A preliminary checklist of probable ARARs has been compiled during the scoping of the RI/FS (see Appendix C). Additional chemical- and location-specific ARARs will be identified during the site characterization phase of the RI. Consideration and identification of additional action-specific ARARs will take place during the development and screening of alternatives during the FS.

Action-specific ARARs for each proposed alternative and compliance of each alternative to all ARARs will be discussed during the detailed analysis and selection of the preferred alternatives section. ARARs are also summarized in RODs and play an important role in remedial design and remedial action plans.

Examples of ARARs of importance in determining clean-up standards, restricting location of activities, and specifying design and operation features follow. ARARs will also play an important role in determining the cost of proposed remedial alternatives.

Chemical-specific ARARs (e.g., Federal MCLs for drinking water) will be used to help set clean-up levels for water. Appendix C contains a listing of compounds and elements with their associated action or clean-up levels based on USEPA standards, MCLs, and maximum contaminant limit goals (MCLG).

The Clean Water Act (CWA) and U.S. Army Corps of Engineers (USACE) regulations are location-specific ARARs. These ARARs will limit activities in and near a wetland that may have a detrimental impact on the functioning of the wetland. If Federal or State endangered or threatened species are identified at the site, the Federal and State laws protecting these species must also be complied with.

Federal RCRA regulations are action-specific ARARs. These ARARs will govern the location, design, construction, operation, performance, and closure of all activities generating, storing, transporting, treating, or disposing of hazardous waste. In addition, these ARARs play an important role in determining the cost of design, construction, operation, and closure of proposed remedial response alternatives. The RCRA land-ban regulations will also determine the degree of treatment and the possibility of land disposal for certain wastes. Other important action-specific ARARs include the Federal CWA National Pollution Discharge Elimination System (NPDES) program and State-specific surface water and groundwater discharge standards, if any. These standards will determine the type, quantity, and concentrations of wastewater discharge allowable. For incineration alternatives, proposing to incinerate waste or treat groundwater via air stripping for example, the Federal and State Clean Air Act and emissions standards are considered ARARs that must be complied with.

TBCs, such as USEPA guidance on landfill liners and caps and conducting RI/FSs, and USEPA health advisories and risk-related criteria will be identified and used where necessary.

5.11.2 Development of Remedial Alternatives There are four standard steps for developing remedial alternatives:

- development of remedial response objectives,
- development of general response actions,
- identification and screening of applicable remedial technologies, and
- assembly of remedial alternatives.

5.11.2.1 Development of Remedial Response Objectives Remedial response objectives consist of medium-specific or operable-unit-specific goals to protect public health and the environment; they may also be site-specific if the site consists of one medium (e.g., soils). Remedial response objectives specify primary contaminants of potential concern by medium, exposure routes, and receptors, and list target compound levels for each contaminant.

Standard preliminary response objectives (USEPA standards, MCLs, and MCLGs) are listed in Appendix D. More specific objectives will be developed based on information obtained from the RI site characterization and risk assessment. These objectives will specify COCs, exposure routes and receptors, and potentially acceptable contaminant levels or ranges of levels for each exposure route.

5.11.2.2 Development of General Response Actions General response actions are general purpose statements describing probable remedial activities at a given site according to response objectives. Preliminary response actions will be refined throughout the FS as technologies and action-specific ARARs are identified and as a more complete understanding of a site is reached. As with remedial response objectives, general response actions may be medium, operable unit, or site specific.

5.11.2.3 Identification and Screening of Applicable Remedial Technologies Documented technologies will be reviewed to identify those representative of general response actions. This initial assessment will involve a literature search of USEPA-published reports, environmental journals, and vendor information. Results of the literature search will be presented as an identification table including the general response action category, the specific technology, and a brief technology description. The initial identification will be performed once for OLF Barin as a whole, with consideration to general response actions for individual sites and media of concern.

Data needs for remediation can include environmental factors such as topography, climate, site geology and hydrogeology; physical and chemical characteristics of the matrices and contaminants of concern; and site characteristics such as area for equipment set-up, site accessibility, and proximity of utilities, sewer systems, and water supplies. Appendices E and F contains a detailed list of data needs for a representative selection of remedial technologies.

After the RI, other applicable technologies may be identified and screened. The screening step assesses each technology for its probable effectiveness and implementability with regard to site-specific conditions, known and suspected contaminants, and affected environmental media. These factors will be incorporated into two screening criteria: waste- and site-limiting characteristics.

Waste-limiting characteristics consider the effect that physical and chemical properties of individual compounds, and of compound mixtures, might have on a given process. Physical and chemical properties considered might include volatility, solubility, specific gravity, sorption potential, degradation, co-solvent effects, and reactivity. Waste-limiting characteristics largely determine effectiveness and performance of a technology.

Site-limiting characteristics consider site-specific physical features including topography, buildings, underground utilities, available space, and proximity to sensitive operations. For example, a mobile incinerator may require an area of 2 acres, which may not be available at a particular site. Site-limiting characteristics affect implementability of a technology.

5.11.2.4 Assembly of Remedial Alternatives A range of remedial alternatives will be developed that, as a group, addresses each remedial response objective established for a particular site. The range of alternatives will reflect (1) a no-action alternative, (2) various volumes of media and/or areas of the site, (3) several degrees of long-term management, and (4) differences in reduction of mobility, toxicity, and volume.

For each alternative developed, a narrative description will be provided, including the logic used to develop the alternative and other information describing its implementation.

5.11.3 Screening of Remedial Alternatives Alternatives will be screened on the basis of effectiveness, implementability, and cost. These three screening criteria conform with remedy selection requirements of CERCLA and the NCP. Screening eliminates impractical alternatives or higher cost alternatives (i.e., order of magnitude) that provide little or no increase in effectiveness or implementability over the lower cost counterparts. The no-action alternative will not be evaluated according to screening criteria; this alternative will be evaluated during detailed analysis as a baseline for other alternatives.

The effectiveness criteria are based on factors such as reductions in mobility, toxicity, and volume in terms of protection of public health and the environment. Both short- and long-term aspects will be evaluated. Short-term aspects refer to risks posed to the community and workers during the construction and implementation period, the alternative's compliance with chemical- and location-specific ARARs, and the time required to achieve remedial action objectives. Long-term aspects, which apply after the remedial action has been completed, consider the magnitude of the remaining risk due to untreated wastes and waste residuals, and the adequacy and reliability of specific technical components and control measures.

The implementability criteria are a measure of technical and administrative feasibility. Short-term technical feasibility considers the availability of a technology for construction or mobilization and operation, as well as compliance with action-specific ARARs during the remedial action. After the remedial action is complete, technical feasibility focuses on operation and maintenance (O&M), replacement, and monitoring of technical controls of residuals and untreated wastes. Administrative feasibility addresses coordination with regulatory and other agencies, and the availability of required services, and trained specialists or operators.

Costs include an estimate of both capital and O&M expenditures. Accuracy of -30 to +50 percent is not required at this stage; the focus is to identify costs of primary technical components to facilitate a comparative analysis. Indirect costs, contingencies, and costs common to all alternatives need not be considered.

Based on this screening evaluation, a decision will be made to either eliminate an alternative from further consideration or retain it for detailed analysis. Recommendations will be documented in a conclusion for each alternative. Before proceeding further in the FS process, a meeting will be held among the Navy, USEPA, and ABB-ES representatives to discuss recommendations. The objective of this forum will be to discuss alternatives to be carried into detailed analysis.

5.11.4 Detailed Analysis of Remedial Alternatives A detailed analysis of each remedial alternative may include the following:

- detailed descriptions of each alternative, with emphasis on application of various technologies as components of the alternative, and

- detailed analysis of each remedial alternative relative to the nine evaluation criteria outlined in the NCP and established to address CERCLA requirements (Section 121[b]).

Where appropriate, alternative descriptions may present preliminary design calculations, process flow diagrams, sizing of key components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative.

As part of the criteria analysis, remedial alternatives are examined with respect to requirements stipulated in CERCLA (Section 121), as amended by SARA. CERCLA emphasizes the evaluation of long-term effectiveness and related considerations for each remedial alternative. The statutory considerations listed in Section 121 include the following seven criteria:

- long-term uncertainties associated with land disposal;

- goals, objectives, and requirements of the Solid Waste Disposal Act;

- persistence, toxicity, and mobility of hazardous substances and their constituents and their propensity to bioaccumulate;

- short- and long-term potential for adverse health effects from human exposure;

- long-term maintenance costs;

- potential for future remedial action costs if the remedial alternative were to fail; and

- potential threat to public health and the environment associated with excavation, transportation, and redisposal or containment.

USEPA's nine criteria will be used to address these considerations, as well as technical and policy factors likely to be important for selecting remedial alternatives (USEPA, 1988c). These criteria are:

- short-term effectiveness;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume;
- implementability;
- cost;
- compliance with ARARs;
- overall protection of human health and environment;
- State acceptance; and
- community acceptance.

5.12 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY (RI/FS) REPORTS. The RI/FS report will address the field program methods and results, laboratory analytical results, site characterization, and risk assessment based on evaluations and interpretations of RI data. Hydrogeologic, hydrologic, contaminant assessment, and risk assessment data will be synthesized to provide a comprehensive understanding of site conditions. These data will be used to identify ARARs, to identify and screen applicable remedial technologies, to select remedial alternatives, and to prepare RODs.

Primary documents will include a Draft RI/FS Report, an Interim Draft RI/FS Report, and the Final RI/FS Report. Each document will be submitted to the Navy for review. After comments have been addressed, the Navy will release the Interim Draft RI/FS report to USEPA for review and comment.

5.13 RECORD OF DECISION. Records of Decision will be prepared in accordance with USEPA *Interim Final Guidance on Preparing Superfund Decision Documents* (OSWER Directive 9355.3-02) and USEPA *Guide to Developing Superfund No Action, Interim Action, and Contingency Remedy RODs* (USEPA, 1991c).

No-Action Record of Decision. A No-Action ROD may be prepared after completion of the RI at sites or portions of sites (operable units) where one or more of the conditions listed below apply.

1. The site posed no current or potential threat to human health or the environment. For example, sites where the baseline risk assessment

determines that site conditions do not pose unacceptable risks to human health or the environment.

2. Sites where the authority for remedial action is not covered under CERCLA. For example, a release that contained only petroleum product that is exempt under CERCLA Section 101.

3. Sites where previous response actions eliminated the need for further action. For example, where a previous removal action eliminated potential risks to human health and the environment.

Interim Action Record of Decision. An Interim Action ROD is an intermediate decision document that addresses specific actions or temporary measures taken to mitigate an imminent threat to human health or the environment. Interim Actions are not final remedial solutions and must be followed by a standard operable unit ROD. Examples of Interim Actions are listed below (USEPA, 1991d):

- installing extraction wells to restrict the migration of contaminated groundwater, with the intention of later initiating a final remedial action;

- providing a temporary alternate source of drinking water, with the intention of later initiating a final remedial action;

- constructing a temporary cap to control or reduce migration and/or exposures until final action can be taken; or

- relocating contaminated material for temporary storage to reduce the risk of exposure. For example, moving excavated soil from a residential area. This could also be considered a final Early Action if no further excavation or treatment is required.

An RI/FS report is not required prior to initiation of an Interim Action; however, a brief description of alternatives considered and the rationale for the action selected must be documented.

Early Remedial Action. Early remedial actions can be divided into two categories: interim or final. The primary distinction between the two categories is that Interim and Interim-Early Remedial Actions are temporary measures taken to mitigate an imminent threat. In contrast, Early Remedial Actions are final actions that can lead to a No-Action ROD or may be a portion of a standard FS ROD.

Examples of final Early Remedial Actions include: source removal and contaminated soil excavation to the extent that no further action is required, or drum removal, limited soil excavation, and disposal.

FS Record of Decision (ROD). An FS ROD is a standard ROD describing the selected remedial action for a particular site or operable unit. In general, this document will summarize problems associated with a site, alternatives considered in addressing such problems, and a comparative analysis based on seven CERCLA

criteria (see Subsection 3.9.4). The components of a standard ROD, as stated in USEPA guidance (USEPA, 1991b), are outlined below.

1. **Declaration**
   Site name and location
   Statement of basis and purpose
   Assessment of the site
   Description of the selected remedy
   Statutory determinations
   Signature and support agency acceptance of the remedy

2. **Decision Summary**
   Site name, location, and description
   Site history and enforcement activities
   Highlights of community participation
   Scope and role of operable unit
   Site characteristics
   Summary of site risks
   Description of alternatives
   Summary of comparative analysis of alternatives
   Selected remedy
   Statutory determinations
   Documentation of significant changes

3. **Responsiveness Summary**
   Community preferences
   Integration of comments

Key aspects include presentation of the selected remedy with the rationale applied in its selection, and explanation of how the remedy satisfies the requirements of CERCLA, Section 121(b).

6.0 PROJECT MANAGEMENT

This section identifies key roles in the project organization, project deliverables, and the proposed project schedule included in the project Site Management Plan.

6.1 ORGANIZATION.

6.1.1 Project Organization These RI/FS planning documents have been prepared under the CLEAN contract with the SOUTHNAVFACENGCOM. Key individuals in the project structure are highlighted below and the project organization is depicted in Figure 6-1.

Naval Facilities Engineering Command Southern Division. SOUTHNAVFACENGCOM is responsible for establishing policy and guidance for the CLEAN program. SOUTHNAVFACENGCOM awards contracts, approves funding, and has primary control of report release and interagency communication.

SOUTHNAVFACENGCOM Engineer-in-Charge (EIC). The SOUTHNAVFACENGCOM, Engineer-in-Charge (EIC), Ms. Kim Queen, is responsible for the technical and financial management of the RI/FS and design activities at OLF Barin. Ms. Queen is the primary project contact. She prepares the project statement of work; develops the project Site Management Plan; manages project scope, schedule, and budget; and provides technical review and approval of all deliverables. Ms. Queen will be responsible for changes in the scope of work determined during Project Managers' Meetings.

NAS Whiting Field/OLF Barin Environmental Coordinator. The environmental coordinator, Mr. Jim Holland, will coordinate and monitor RI/FS activities at the OLF Barin. Mr. Holland maintains a working relationship with local, State, and Federal regulatory agencies.

Task Order Manager. The ABB-ES Task Order Manager for the OLF Barin RI/FS is Mr. Rao Angara. Mr. Angara is responsible for evaluating the appropriateness and adequacy of the technical and engineering services provided. He is responsible for financial and schedule management and for ensuring that the project fulfills and remains within the contracted scope of work. Mr. Angara will be responsible for changes in the scope of work determined during Project Managers' Meetings. Mr. Angara is also responsible for the daily conduct of work, including integration of input from supporting disciplines and subcontractors. Mr. Angara is the primary ABB-ES project contact.

RI Technical Leader. Mr. Eric Blomberg will be the technical activity leader for RI field studies and the development of the RI report. He will also be responsible for the quality and completeness of data gathered during the RI field program, including overall management and coordination of field work, and supervision and scheduling of work.

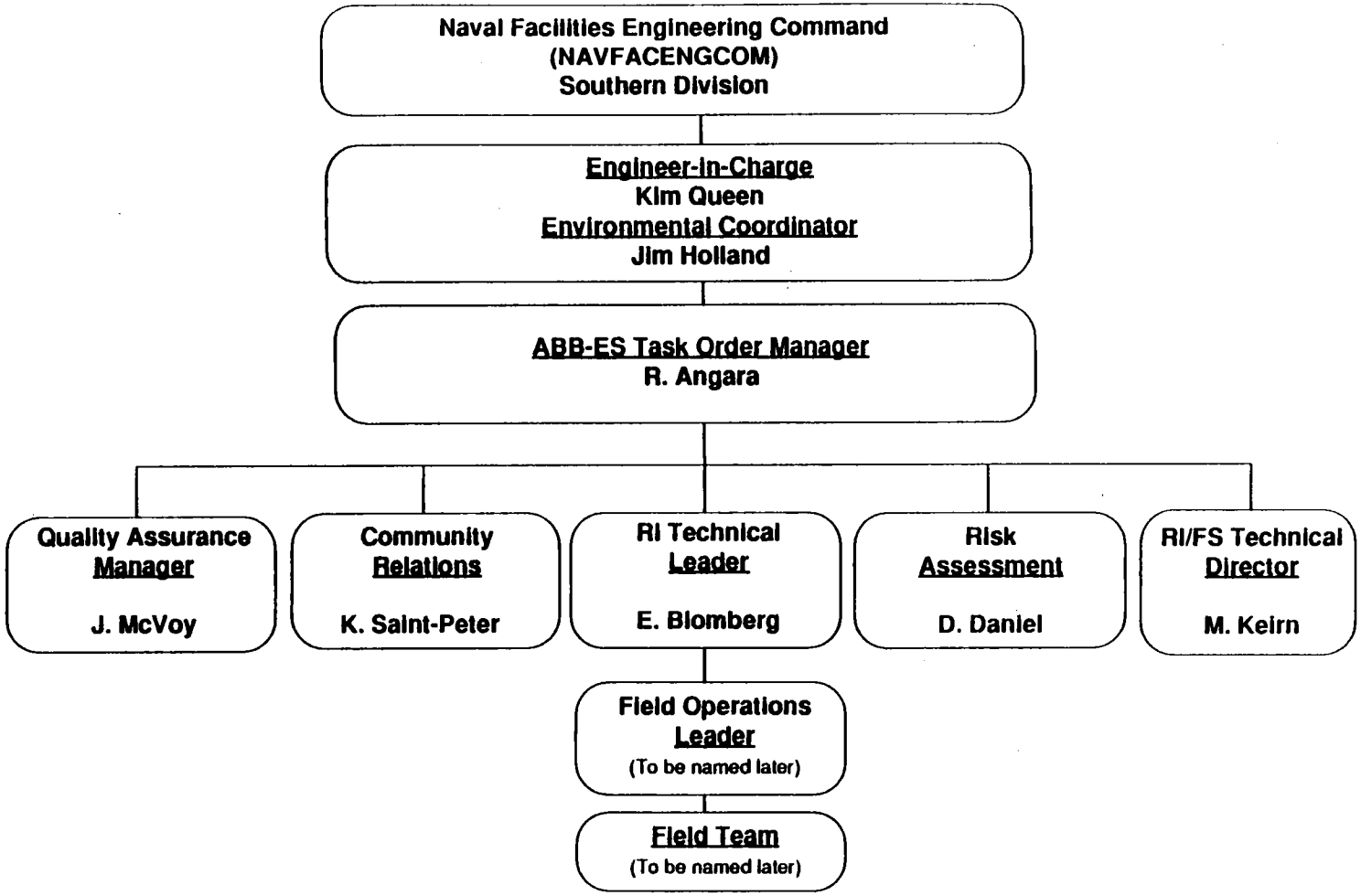

FIGURE 6-1
PROJECT ORGANIZATION

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN

OLF BARIN
FOLEY, ALABAMA

FS Leader. The FS leader will be responsible for coordinating FS activities and for ensuring that the FS progresses in accordance with project plans and supporting documents. The FS leader will oversee development and selection of remedial alternatives developmental records of decision and proposed plans.

Field Operations Leader. The Field Operations Leader will be responsible for ensuring that field activities are performed consistent with the project workplan and supporting documents. This will include appropriate logging and documentation of standard and approved drilling and monitoring well installation methods to ensure that pertinent drilling and testing information is obtained during the exploration program. Other responsibilities include oversight of sampling activities and site characterization studies, and communication with the RI Technical Leader.

Risk Assessment. Mr. David Daniel will be responsible for the public health assessment and the ecological assessment. Mr. Daniel will plan and perform the risk assessment supported by RI data. He will identify potential exposure pathways, evaluate available data, and propose compound target levels within acceptable risk ranges.

Quality Assurance Manager. As the Quality Assurance Manager, Mr. John McVoy will be responsible for ensuring that field and laboratory activities support DQOs and conform to project workplan. Mr. McVoy will perform periodic field and laboratory audits to monitor conformance with requirements.

Community Relations. Ms. Kathy Saint-Peter will be responsible for providing community relation support activities, if requested by OLF Barin. Support may include activities such as the development of fact sheets and press releases, or community interviews.

6.1.2 Program Organization The following highlights key individuals in the ABB-ES CLEAN program, and the program organization is depicted in Figure 6-2.

Naval Facilities Engineering Command Southern Division. SOUTHNAVFACENGCOM is responsible for establishing policy and guidance for the CLEAN program. SOUTHNAVFACENGCOM awards contracts, approves funding, and has primary control of report release and interagency communication.

Corporate Officer. The Corporate Officer and Vice-President of Southeastern Regional Operations is Mr. Tony Allen. Mr. Allen is responsible for committing the corporate resources necessary to conduct the program work activities, supplying corporate-level input for problem resolution, and assisting the Task Order Manager as needed in project implementation.

Program Manager. As Program Manager, Mr. William S. Lawrence, P.E., is responsible for administration and management of the ABB-ES SOUTHNAVFACENGCOM CLEAN contract. In this position, Mr. Lawrence is able to perceive program needs, promote technology and other information transfers between various CLEAN projects, and direct resources as appropriate for effective and timely completion of program activities.

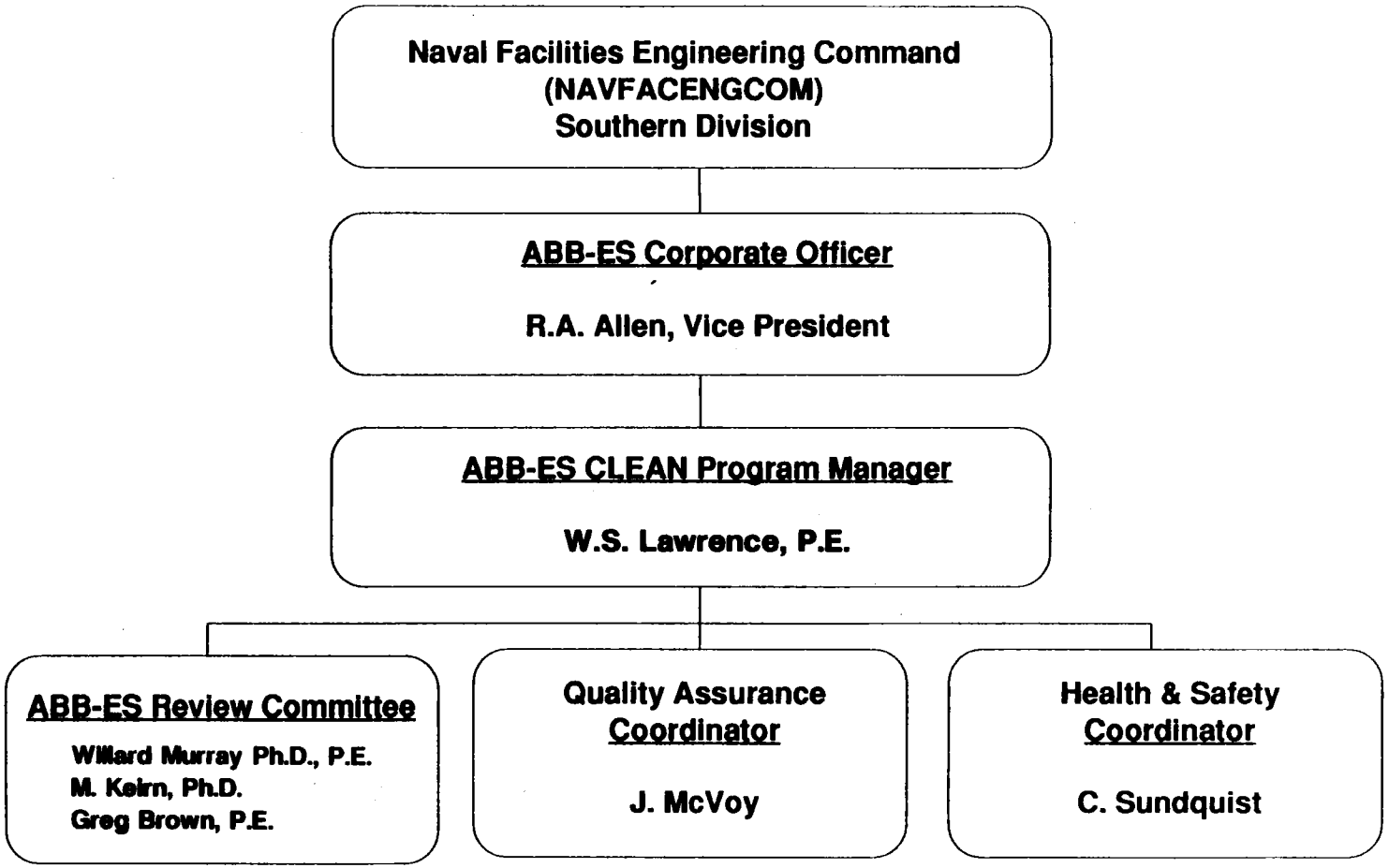

FIGURE 6-2
PROGRAM ORGANIZATION

REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
WORKPLAN
OLF BARIN
FOLEY, ALABAMA

Internal Review Committee. An Internal Review Committee, consisting of senior technical staff from the ABB-ES team, support the Task Order Manager by reviewing technical aspects of the project so that services (1) reflect the accumulated experience of the firm, (2) are produced according to corporate policy, and (3) meet the intended needs of the project. The primary function of the committee is to support the application of technically sound methodologies and the development of defensible data, interpretations, and conclusions. The committee will consist of Williard Murray, Ph.D., P.E., Michael Keirn, Ph.D., and Mr. Greg Brown, P.E.

QA Coordinator. The Task Order Manager is supported by a QA Coordinator who will report to the Program Manager. The QA Coordinator, Mr. John McVoy, will oversee the implementation of appropriate NEESA and USEPA protocols. The QA Coordinator will also work with the Task Order Manager to establish QC procedures.

Health and Safety Coordinator. The Health and Safety Coordinator, Ms. Cynthia Sundquist, is responsible for project team compliance with ABB-ES corporate requirements and the CLEAN Program HASP. Conformance with safety protocols will be assessed through periodic site visits and daily supervision by the site leaders.

6.2 PROJECT SCHEDULE AND DELIVERABLES. The following lists the primary deliverables and projected tasks for the RI/FS at OLF Barin. Note that dates included for projected tasks and deliverables are estimates and are subject to change.

1992 Projected Primary Tasks and Deliverables	Projected Completion Date
Draft RI/FS Workplan	May 1992
Draft-Final RI/FS Workplan	August 1992
Final RI/FS Workplan	October 1992

1993 Projected Primary Tasks and Deliverables	
Complete Phase I RI Field Work	March 1993
Complete Data Assessment	May 1993
Draft Technical Memoranda	July 1993
Draft-Final Technical Memoranda	September 1993
Final Technical Memoranda	October 1993

1994 Projected Primary Tasks and Deliverables	Projected Completion Date
RI Phase II Field Work	April 1994
Draft RI/FS Report	July 1994
Draft-Final RI/FS Report	September 1994
Final RI/FS Report	December 1994

1995 Projected Primary Tasks and Deliverables

Draft Proposed Plan	June 1995
Draft-Final Proposed Plan	August 1995
Final Proposed Plan	October 1995
Draft ROD	December 1995
Draft-Final ROD	--
Final ROD	--

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APPENDIX A

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND GUIDELINES FOR GROUNDWATER MONITORING WELL INSTALLATION

Rev; 4
Date: 27 MAR 89

SOUTHERN DIVISION NAVAL FACILITIES
ENGINEERING COMMAND

GUIDELINES FOR GROUNDWATER MONITORING WELL INSTALLATION

PART 1: GENERAL

1.1 Introduction

Groundwater monitoring wells shall be located at sites approved by the Southern Division Engineer-In-Charge (EIC) and the Activity Environmental Coordinator (EC). All applicable local, state and federal regulations concerning well installations or soil borings shall be followed.

1.2 Applicable Publications

The publications listed below form a part of this guideline to the extent referenced. The publications are referred to in this text by designation only. The latest revision of the specifications shall be followed.

1.2.1 American Association of State Highway and Transportation Officials (AASHTO)

Document No.	Title
M 220	Epoxy Coatings Specifications

1.2.2 American Society of Testing and Materials (ASTM)

Document No.	Title
A 120	Pipe, Steel, Black and Hot-dipped, Zinc coated, welded and seamless
A 312	Seamless and Welded Austenitic Stainless Steel Pipe
B 209	Aluminum and Aluminum-alloy Sheet and Plate
C 150	Portland Cement
C 778	Standard Sand
D 1457	Polytetrafluoroethylene (PTFE) Molding and Extrusion Materials

Document No.	Title
D 1785	Standard Specification of Polyvinyl Chloride Pipe (PVC Pipe, Schedules 40, 80, 120)
D 1586	Method for Penetration Test and Split Barrel Sampling of Soils
D 1587	Practice for Thin Wall Tube Sampling of Soils.
D 2113	Diamond Core Drilling for Site Investigation
F 480	Thermoplastic Water Well Casing, Pipe and Couplings Made in Standard Dimension Ratios (SDR)
F 883	Padlocks

1.2.3 **American Petroleum Institute (API)**

Document No.	Title
13-A	Oil Well Drilling Fluid Specifications

1.3 **Submittals**

1.3.1 A completed "Southern Division Naval Facilities Engineering Command Groundwater Monitoring Well Installation Report" will be submitted for each well installation.

1.3.2 Certificates of Conformance: A certificate of conformance shall be provided to the EIC for any of the items below that are used in a well installation. The certificate shall describe in detail how the material meets or exceeds the required specifications for the following, as appropriate:

a) Casing
b) Screen
c) Grout
d) Drilling Mud
e) Gravel Pack
f) Caps and Plugs
g) Centralizers
h) Surface Casing
i) Well Protective Cover
j) Flush Mount Protective Cover
k) Padlock
l) Protective Post
m) Well Designation Sign
o) Epoxy Paint

1.4 **Delivery and Storage**

All materials shall be delivered in undamaged condition, stored in accordance with manufacturer's recommendations (off the ground) and protected from the weather in an area designated by the EC. All defective or damaged material will be replaced with new material at no cost to the government.

PART 2: PRODUCTS

2.1 All materials shall conform to the respective specifications and other requirements as specified herein.

2.1.1 **Well Casing**

Material type will be approved by the EIC. The material provided will have adequate strength to resist external forces both during and after installation. The casing threads shall be compatible with the screen listed in 2.2.2. Markings, writing or paint strips are not allowable on any of the materials. The casing shall conform to the specifications listed below.

a. PVC, flush threaded joints (schedule 40) ASTM F480 and ASTM D1785

All PVC flush threaded joints will meet or exceed the water pressure ratings (at 73 degrees Fahrenheit) for the size and schedule of PVC pipe used in the project, as listed in ASTM D1785: Table XI.2.

b. Polytetrafluoroethylene (PT~E), flush threaded joints, ASTM D1457

Virgin materials shall be used to meet the ASTM specification. Certification of compliance and joint evaluation are required. Shall be shipped in sealed containers that are capable of preventing contact with any foreign substances. PTEF "O" rings are required to seal all joints.

c. 316 stainless steel, flush threaded joints, ASTM A312
d. 304 stainless steel, flush threaded joints, ASTM A312

End fittings shall be double entry flush screw threads. The casing shall be cleaned prior to delivery in the following manner: 5-minute immersion in static bath of dilute acid, pressure ~ash with detergent and cool water, rinse with warm water and allow to air dry.

2.1.2 **Well Screen**

Material type will be approved by the EIC. The material provided will have adequate strength to resist external forces both during and after installation. Water velocity through the screen openings shall not exceed 0.1 feet/sec. The opening size will be determined from an analysis of the material in geologic formation to be screened and/or the size of the filter pack material. Markings, writing or paint strips are not allowable on any of the materials. The screens shall conform to the specifications listed below.

a. PVC, flush threaded joints (schedule 40), slotted, ASTM F480 and ASTM D1785

Two inch I.D. screens will have 3 rows of slots with a spacing of 1/8 inch between slots. Four inch I.D. screens will have six rows of slots with a spacing of 1/8 inch between slots. All PVC flush threaded joints will meet or exceed the

water pressure ratings (at 73 degrees Fahrenheit) for the size and schedule of PVC pipe as listed in ASTM D1785, Table XI.2.

b. Polytetrafluoroethylene (PTFE), flush threaded joints, slotted, ASTM D1457

Virgin materials shall be used to meet the ASTM specification. Certification of compliance and joint evaluation are required. Shall be shipped in sealed containers. PTEF "O" rings will be used to seal all joints.

c. 316 stainless steel, wire wrapped, flush threaded joints, ASTM A312
d. 304 stainless steel, wire wrapped, flush threaded joints, ASTM A312

The well screen shall be of a continuous slot, wire wound design. It shall be fabricated by circumferentially wrapping a triangularly shaped wire around a circular array of internal rods. The configuration must produce sharp outer edges, widening inward. PTFE "O" rings will be used to seal all joints. End fittings will be welded to the screen body.

2.1.3 End Plugs

The end plug shall be flush threaded and shall be constructed of the same type of material selected for the screen or casing above. All ASTM specifications that apply to the screen and casing materials shall apply to the end plugs. Markings, writing or paint strips are not allowable on any of the above materials.

2.1.4 Well Caps

The well cap shall be flush threaded and be constructed of the same type of material selected for the casing above. All ASTM specifications that apply to the casing materials shall apply to the well caps. Markings, writing or paint strips are not allowable on any of the above materials.

2.1.5 Adjustable Centralizers

The centralizer shall be capable of maintaining the casing and screen straight and plumb in the borehole during well installation. The material type shall be the same type of material selected for the casing/screen above. No solvents or glues will be used.

2.1.6 Annular Space Fill Materials

a. Filter pack shall be 98% pure silica, cleaned with potable water, have a uniformity coefficient of 1-3, and a specific gravity of 2.6 - 2.7. The filter pack shall meet ASTM C 775 standard sand specifications.

b. 1/4-inch bentonite pellets shall be 90~ montmorillonite clay, with a bulk dry density 80 lbs/cu ft, a specific gravity 1.2, and a pH of 8.5-10.5.

c. Granular bentonite shall conform to API std 13-A for bentonite. -

d. Portland Cement shall conform to ASTM C 150 Type I.

2.1.7 **Surface Casing**: shall be constructed of steel meeting ASTM A 120 and shall have a wall thickness as specified below.

a. 24 inch diameter 0.25 inch wall thickness
b. 20 inch diameter 0.25 inch wall thickness
c. 16 inch diameter 0.25 inch wall thickness
d. 10.75 inch diameter 0.25 inch wall thickness
e. 24 inch diameter 0.50 inch wall thickness
f. 20 inch diameter 0.50 inch wall thickness
g. 16 inch diameter 0.50 inch wall thickness
h. 10.75 inch diameter 0.365 inch wall thickness

2.1.8 **Surface Completion**: all materials provided for a well surface completion shall conform to the specifications listed below.

a. Locking 16-gauge steel protective well cover, round or square and 5-ft in length

b. Flush mount 22-gauge steel, water resistant welded box with 3/8-inch steel lid, locking device and padlock guard

c. Concrete pad at ground surface (3' X 4' X 6") ASTM C 150

d. Padlock (brass, corrosion resistant, keyed alike) ASTM F 883

e. Steel protective post (4-inch diameter, 6-ft length, 1/4-inch thickness, concrete filled) ASTM A 120.

f. Well designation sign, sheet aluminum, ASTM B 209, 1/8 inch by 18 inch by 6 inch, anchors and fasteners compatible with sign, designation to be provided by EIC, the designation shall be stamped into the plate with 4-inch letters and numbers.

g. High visibility yellow epoxy paint AASHTO M220.

PART 3: EXECUTION

3.1 Drilling Method

The proposed drilling method must be approved by the EIC. Hollow-stem auger methods will be given first preference, rotary methods second and any other methods will require detailed evaluation by the EIC and written approval.

3.2 Well Installation

Well depths, length of screen and sump will be determined on a site specific basis with approval of the EIC. Screen lengths will be limited to 10 feet unless longer lengths are specifically approved in writing by the EIC. Two inch well diameters will be specified for shallow well installations. Deeper well installations or wells that will be converted to recovery wells may require four inch wells. Recovery well specifications will be approved by the EIC.

Well installation shall follow commonly accepted professional drilling procedures. The borehole will be logged by a qualified geologist/hydrogeologist as drilling proceeds. The minimum qualifications are those describing a "Geologist-in-Training", as described in Article 1, Chapter 23, Title 1, Code of Laws of South Carolina: Rules of the South Carolina State Board of Registration for Geologists. Soil samples shall be collected according to one of the following methods: ASTM D 1586-Method for Penetration Test and Split Barrel Sampling of Soils or ASTM D 1587-Practice for Thin Wall Tube Sampling of Soils. Consolidated Rock will be sampled according to ASTM D2113 Diamond Core Drilling for Site Investigation.

Gravel pack, seals, and grout will be installed using tremie methods. Bentonite seals shall be allowed to hydrate the time period specified by the manufacturer. Accurate measurements shall be made to the top of the gravel pack and seals with a weighted steel tape and adjusted to reflect the top of casing.

If water is used in the drilling process, a sample shall be collected from the source and analyzed for the parameters specified in the investigation. Results will be included in the investigation report.

3.3 Well Development

Well development shall commence no sooner than 24 hours after placement of the grout. The development method shall be approved by the EIC. The selected method shall be capable of removing all drilling fluids and cuttings from inside the well, within the gravel pack and from within the formation. The development method shall not introduce any type of contamination into the aquifer. Introduction of outside water to the well shall be minimized. Any water introduced into the well shall be recovered to the maximum extent possible. A written report will be required describing the reasons why any introduced water could not be recovered.

The development process should result in wells that are sediment free. A well that produces turbid water (as defined by the Safe Drinking Water Act PL 93-523) may be rejected by the EIC.

3.4 Material Disposal

All borehole cuttings and development water will be contained in - DOT 17-C Open-top 55-gallon drums, permanently labeled by well number and stored in a location designated by the EC. The material will be handled as hazardous waste until laboratory results are reviewed and certification of the waste is submitted to

the Navy. This requirement may be waived if approval is given in writing by the EIC. The material may then be disposed of as normal solid waste if it does not exceed any state or federal regulatory limits for the type of waste in question. The Navy will be responsible for disposal of all waste unless other direction is given by the EIC.

3.5 Decontamination

All down-hole drilling equipment the drill rig, tools, etc.) will be decontaminated according to the approved Quality Control Plan prior to beginning work, between each well location and after the last well is completed. The drill rig will be placed on 10-mil polyethylene sheeting at each drilling site to contain any spillage or leaking of hydraulic fluid or fuel. All of the decontamination waste will be handled according to section 3.4 above.

3.6 Well Protection

A steel, hinged, locking protective casing will be installed within a 3-ft by 4-ft by 6-inch thick concrete pad. The pad will be set level and 4-inches below grade. The pad shall be installed so that surface runoff does not pond around the well casing and protective cover. The concrete mix shall obtain a minimum 28-day compressive strength of 3000 pounds per square inch.

If designated by the EIC, four steel protective posts will be installed 0.5 ft from the corners of the pad but not set within the pad. The post will be 6-ft in length, 4-inch in diameter and have a wall thickness of 0.25-inch. The post will be filled with concrete and set three feet below grade in a 10-inch diameter hole with concrete backfill (as above).

The protective casing and any protective post installed shall be cleaned, primed- and then painted with two coats of high visibility yellow epoxy paint that meets the specifications of AASHTO M 200. The protective casing will be locked with a Type Pol (Key Operated), Option E (Corrosion Resistant) padlock that conforms to ASTM F 883. When multiple wells are installed, the padlocks for each well at an activity shall be keyed alike. The original and two copies of all keys shall be delivered to the EIC and two copies shall be delivered to the EC. All keys shall be tested to ensure performance prior to delivery.

3.7 Well Designation

A permanent well designation sign will be attached to the protective casing. The sign shall be a 18-inch by 6-inch by 1/8-inch thick sheet aluminum plate, bolted to 1/4-inch studs welded to the casing. The sign shall be stamped with 4-inch letters and numbers in accordance with the numbering system in section 4.0 of this specification.

PART 4. INSTALLATION RESTORATION PROGRAM WELL NUMBERING SYSTEM

The purpose of this well numbering system is to locate a particular well by activity, key it to the Initial Assessment Study (IAS) and sequentially number each well at each site. The EIC will provide designations for sites not included in the IAS.

Example:	CEF-1-1	Cecil Field, Site 1, Well number 1
	KYW-5-8	Key West, Site 5, Well Number 8

FLORIDA

Cecil Field	CEF
Ft. Lauderdale	FLD
Key West	KYW
NavHosp Key West	KWH
Homestead	HST
Jacksonville	JAX
Mayport	MPT
Panama City	PCY
Whiting Field	WHF
Andros Island	AIS
Pensacola	PEN
Saufley	SFY
Correy Station	CRY
Orlando	OLD

GEORGIA

Albany	ALB
Atlanta	ATL
Kings Bay	KBA
Athens	ATH

SOUTH CAROLINA

Parris Island	PAI
Beaufort	BFT
NavHosp Beaufort	BFH
NWS Charleston	NWS
NS Charleston	CSY

LOUISIANA

NAS New Orleans	NOA
NSA New Orleans	NOS

MISSISSIPPI

Gulfport	GPT
NavHome Gulfport	GPH
Meridian	MRD

TENNESSEE

Memphis	MPH
Bristol	BRT

TEXAS

Corpus Christi	CCT
Chase Field	CAF
Kingsville	KVE
NAS Dallas	DNA
NWIRP Dallas	DWP
McGregor	MGR

APPENDIX B

USEPA LOCATIONAL DATA POLICY AND REGION IV ENVIRONMENTAL MONITORING AND DATA REPORTING REQUIREMENTS

EPA LOCATIONAL DATA POLICY

EPA's Officer of Information Resources Management (OIRM) has developed a policy to be adopted by EPA, and its delegates and representatives, for collecting and documenting locational data about the entities tracked under Federal Environmental programs within EPA's jurisdiction. The policy clearly defines responsibilities for obtaining locational measurements for all facilities, sites and monitoring and observation points of primary interest to EPA. In addition, the policy explicitly specifies latitude and longitude, in an intentionally-compatible format, as the Agency's preferred locational coordinate system. Implementation of this policy will allow Agency data to be integrated based upon location, thereby promoting enhanced use of EPA's extensive data resources for cross-media environmental analyses and management decisions.

1. PURPOSE. This policy establishes the principles for collecting and documenting latitude/longitude coordinates for facilities, sites and monitoring and observation points regulated or tracked under Federal environmental programs within the jurisdiction of the Environmental Protection Agency (EPA). The intent of this policy is to extend environmental analyses and allow data to be integrated based upon location, thereby promoting the enhanced use of EPA's extensive data resources for cross-medial environmental analyses and management decisions. This policy underscores EPA's commitment to establishing the data infrastructure necessary to enable data sharing and secondary data use.

2. SCOPE AND APPLICABILITY. This policy applies to all Environmental Protection Agency (EPA) organizations and personnel of agents (including contractors and grantees) of EPA who design, develop, compile, operate or maintain EPA information collections developed for environmental program support. The requirements of this policy apply to existing as well as new data collections.

3. BACKGROUND.

   a. Fulfillments of EPA's mission to protect and improve the environment depends upon improvements in cross-programmatic, multi-media data analyses. A need for available and reliable location identification information is a commonality which all regulatory tracking programs share.

   b. Standard location identification data will provide a return yet unrealized on EPA's sizable investment in environmental data collection by improving the utility of these data for a variety of valued-added secondary applications often unanticipated by the original data collectors.

   c. EPA is committed to implementing its locational policy in accordance with the requirements specified by the Federal Interagency Coordinating Committee for Digital Cartography (FICCDC). The FICCDC has identified the collection of latitude/longitude as the most preferred coordinate system for identifying location.

4. AUTHORITIES

a. 15 CFR Part 6 Subtitle A, Standardization of Data Elements and Representations.

b. Geological Survey Circular 878-B, A U.S. Survey Data Standard, Specifications for Representation of Geographic Point Locations for Information Interchange.

c. Federal Interagency Coordinating Committee on Digital Cartography (FICCDC)/U.S. Office of Management and Budget, Digital Cartographic Data Standards: An Interim Proposed Standard.

d. EPA Regulations 40 CFR 30.503 and 40 CFR 31.45, Quality Assurance Practices under EPA's General Grant Regulations.

5. POLICY.

a. It is EPA policy that latitude/longitude ("lat/long") coordinated be collected and documented with environmental and related data. This is in addition to, and not precluding, other critical location identification data that may be needed to satisfy individual program or project needs, such ag depth, street address, elevation or altitude.

b. This policy serves as a framework for collecting and documenting location identification data. It does not include a requirement that a particular level of precision or accuracy be achieved; managers of individual data collection efforts determine the levels precision and accuracy necessary to support their mission. However, this policy does serve as a starting point for acquiring these critical data.

c. To implement this policy, program data managers must collect and document the following:

1. Latitude/longitude coordinates in accordance with Federal Interagency Coordinating Committee for Digital Cartography (FICCDC) recommendations. The coordinates may be present singly or multiple times, to define a point, line or area, according to the most appropriate data type for the entry being represented.

This format for representing this information is:

+/-DD MN SS.SSSS (latitude)
+/-DDD MM SS.SSSS (longitude)

where:

- Latitude is always presented before longitude,

- DD represents degrees of latitude; a digit decimal number ranging from 00 through 90,

- DDD represents degrees of longitude; a three digit decimal number ranging from 000 through 180,

- MM represents minutes of latitude or longitude, a two-digit decimal number ranging from 00 through 60,

- SS.SSSS represents seconds of latitude or longitude, with a format allowing possible precisions to the ten-thousandths of seconds actual accuracy to be program and case specific.

- + specifies latitudes north of the equator and longitudes east of the prime meridian, and

- - specifies latitudes south of the equator and longitudes west of the prime meridian.

2. Specific method used to determine the lat/long coordinates (e.g., remote sensing techniques, map interpolation, cadastral survey);

3. Textual description of the entity to which the latitude/longitude coordinates refer (e.g., north-east corner of site, entrance to facility, point of discharge, drainage ditch);

4. Estimate of accuracy in terms of the most precise units of measurements used (e.g., if the coordinates are given to tenths-of-seconds precision, the accuracy estimate should be expressed the terms of the range of tenths of-seconds within which the true value should fall, such as "+/- 0.5 seconds").

d. Recommended labeling of the above information is as follows:

- "Latitude"
- "Longitude"
- "Method"
- "Description"
- "Accuracy"

e. This policy does not preclude or rescind more stringent regional or program-specific policy and guidance .

f. Formats, standards, coding conventions or other specifications for the method, description and accuracy information shall be as specified by the Regional Program as appropriate.

6. RESPONSIBILITY FOR IMPLEMENTATION. Assistant Administrators, Associate Administrators, Regional Administrators, Laboratory Directors and the General Counsel shall establish procedures within their respective organizations to ensure information collection and reporting systems under their direction are in compliance with this policy

Interchange File Format for
Electronic Data Reports

This document establishes, for EPA Region Iv, the required format for electronic reporting of monitoring data.

Data will be transported as a set of four ASCII files:

STATION.DAT - contains basic information about monitoring station location and type. Detailed description of the structure is contained in Appendix A.

WELL.DAT - contains detailed information about construction and characteristics of groundwater monitoring stations. See Appendix B.

SAMPLE.DAT - contains basic information about the collection and characteristics of samples. See Appendix C.

PARM.DAT - contains measured values and reporting units for specific parameters. See Appendix D.

The first line of EACH of the four files MUST contain the following text starting in position one: 19901001

These files are to be transmitted in ASCII format using 5.25 inch flexible disk, nine-track magnetic tape (1600 or 6250 bpi) or, in the future, via communications channels yet to be defined. Hardcopy reporting requirements will continue as currently required until further notice. Additional files may be defined in the future for non-groundwater station types should the need arise.

Several of these files will contain data that is usually static in nature. For example, the basic information contained in STATION.DAT will not normally change for any single station, therefore once the data has been submitted for a particular station, it will not be required to resubmit that information. If, however, the station record is updated or corrected the record would have to be resubmitted. After the initial report then, STATION.DAT would be submitted only when new stations are created, or when an old station record is modified, and need only contain the new or modified records. The same is true of file WELL.DAT. SAMPLE.DAT would, of course, be submitted each time one or more new samples were to be reported, or any sample record required updating. Again, the file need only contain the new or updated records. PARM.DAT is expected to be submitted at each required reporting interval, since it will contain the analytical results needed to determine compliance. It must contain all new results for the reporting interval, and may contain corrections and updates to older records. As may be observed, the format allows for asynchronous reporting, provided that no sample may be reported before the station with which it is associated, and no parametric record before its sample record.

For each file described in the appendices, all fields must be reported. The null, or "no data", value for all fields is the pound sign (#), and must appear in the first column position of its field. Field values may be listed one per line in the export file, or multiple values may be reported on a single line, provided that field values are reported in the specified order, and each value is terminated by a comma (,). Lines containing multiple values may not exceed 80 characters in length, including the delimiters. Since the comma is used as a delimiter for data values, the values themselves may not contain any comma, even though the value may be a text stream.

Attachment A

Datafile STATION.DAT

Field No.	Field Name	Field Description
1	STATION_KEY *	Unique station identifier. Consists of a twenty-seven character alphanumeric field, left justified, containing:

Column:	Description:
1 - 12	Unique site identifier as assigned by EPA. Must be alphanumeric.
13 - 17	Unique solid waste management unit designator. Must be alphanumeric.
18	Media status indicator. Must contain one of the following: C - compliance monitoring station B - baseline monitoring station A - other ambient monitoring station.
19 - 27	Unique station identifier. Must be alphanumeric.

If this data is to be used with the Region IV Query menu, the naming convention recommended for stations is as follows. Monitoring wells should contain 'MW',test pits 'TP',boreholes 'BH', surface soil 'SS'.

2	TYPE	*	Type of monitoring station. Consists of a four character alphanumeric field, left justified, containing one of the following: AIR, SWTR, GWTR, SOIL, SED, and SLDG. The meanings of these abbreviations are as follows: AIR - Air sampling station SWTR - Surface water sampling station GWTR - ground water sampling station SOIL - soil sampling station SED - Stream bed sediment SLDG - process sludge sampling
3	LATITUDE	*	Geographic position of the station in degrees north of the equator. Must be in the format DDMMSS.xxxx, where DD represents degrees, MM represents minutes, and SS.xxxx represents seconds, with available precision to four decimal places.

* = required field

4 LONGITUDE * Geographic position of the station in degrees west of the Prime Meridian. Must be in the format DDDMMSS.xxxx, where DDD represents degrees, MM represents minutes, and SS.xxxx represents seconds, with available precision to four decimal places.

5 LSDAT * Elevation in feet (MSL) of land surface at the location of the monitoring station. Must be a DECIMAL NUMERIC field with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point.

6 RFDAT * Elevation in feet (MSL) of the point from which height above ground, water level and sampling depth measurements are taken. DECIMAL NUMERIC field with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point.

7 CONDT Date construction of the station was completed. Eight character integer field consisting of:

Columns	Content
1-4	year including century, e.g. 1989
5-6	numeric month
7-8	numeric day of month

Column numbers are relative to the beginning of the CONDT Field. Each subfield described above must be right justified, and may contain leading zeros.

8 ACCUR * Estimated accuracy for the reported latitude and longitude, in meters. DECIMAL NUMERIC field with a maximum of six characters (including the decimal point) and may have up to two digits after the decimal point.

9 LLMETH * One character alphanumeric field which indicates the method used to determine the latitude and longitude. Contains one of the following:

C - Calculated from map
D - Digitized from a map
G - Global Positioning System
L - Loran-C
U - Unknown

* = required field

10	OMETH	Any method for which there is no code. This field consists of 32 character ALPHANUMERIC field, left justified.
11	COMMENT	Any additional information the user feels necessary, required field which may not be accommodated in a defined field. Must be ALPHANUMERIC consisting of up to 40 characters.

Attachment B

Datafile WELL.DAT

Field No.	Field Name	Field Description
1	STATION KEY *	Unique station identifier. Consists of a twenty-seven character alphanumeric field, left justified, consisting:

Column:	Description:
1 - 12	Unique site identifier as assigned by EPA. Must be alphanumeric.
13 - 17	Unique solid waste management unit designator. Must be alphanumeric.
18	Media status indicator. Must contain one of the following: C - compliance monitoring station B - baseline monitoring station A - other ambient monitoring station.
19 - 27	Unique station identifier. Must be alphanumeric.

2	AQNAM *	USGS Aquifer Code for aquifer from which samples are obtained. Alphanumeric field with up to eight characters.
3	TOTDP	Total depth to which the hole was drilled, bored or dug in feet below land surface datum. DECIMAL NUMERIC field with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point.
4	DRMTH	Method by which well was constructed. Must be ALPHANUMERIC, consisting of a single character. The character must be one of the followings:

H - hollow stem auger	S - solid stem auger
C - cable tool	R - rotary
V - reverse rotary	D - dug
J - water jet	A - air percussion
O - other	

* = required field

5 DRPLD

Fluid used to lubricate cutting tool and/or remove materials from hole. Must be ALPHANUMERIC, consisting of a single character. The character must be one of the followings:

A - air	M - other mud
B - bentonite	N - none
W - water	O - other fluid

6 DVMTH

Method by which well wag developed. Must be ALPHANUMERIC, consisting of a single character. The character must be one of the following:

A - air lift pump	B - bailed
C - compressed air	J - jetted
P - other pump	S - surged
Z - other method	N - none

7 DVHRS

Time in hours during which well was developed. Must be INTEGER NUMERIC, consisting of up to 5 digits.

8 SPLTRT

Any special treatment that was applied during the well development process. Must be ALPHANUMERIC, consisting of a single character, which must be one of the following:

C - chemicals	D - dry ice
E - explosives	F - deflocculant
H - hydrofracturing	M - mechanical
Z - other	N - none

9 LIFT

Type of lift indicator. Must be Alphanumeric, consisting of a single character. The character must be one of the followings:

A - air lift	R - rotary pump
B - bucket	S - submersible pump
C - centrifugal pump	T - turbine
J - jet pump	U - unknown
P - Piston pump	Z - other

10 NOSEG

Number of bore hole sections. A bore hole section is defined as a length of bore hole of constant diameter. Bore hole sections are designated numerically from top to bottom of bore hole. INTEGER NUMERIC field containing a value of one or two.

11 SGDIA1

Diameter of first bore hole section, in inches.

12 SGDIA2

Diameter of second bore hole section, in inches.

13	SGDIA3	Diameter of third bore hole section, in inches.
		Each of the SGDIAx fields is DECIMAL NUMERIC, containing up to twelve characters (including the decimal point), and may have up to two digits following the decimal point.
14	STELV1	The depth to the top of the first bore hole section.
15	STELV2	The depth to the top of the second bore hole section.
16	STELV3	The depth to the top of the third bore hole section.
		Each of the STELYx fields is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. These depths are measured relative to land surface datum.
17	SBELV1	The depth to the bottom of the first bore hole section.
18	SBELV2	The depth to the bottom of the second bore hole section.
19	SBELV3	The depth to the bottom of the third bore hole section.
		Each of the SBELVx fields is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. These depths are measured relative to land surface datum.
20	NOCAS	Number of casing sections. A casing section is defined as a length of casing of constant diameter and uniform material. Casing sections are designated numerically from top to bottom of well. INTEGER NUMERIC field containing a value of one or two.
21	TCELV1	The depth to the top of the first section of casing (in feet).
22	TCELV2	The depth to the top of the second section of casing (in feet).
23	TCELV3	The depth to the top of the third section of casing (in feet).
		The TCELVx fields are DECIMAL NUMERIC, each with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. These depths are measured relative to land surface datum.
24	BCELV1	The depth to the bottom of the first section of casing, in feet.

25	BCELV7	The depth to the bottom of the second section of casing,in feet.
26	BCELV3	The depth to the bottom of the third section of casing,in feet.
		The BCELVx fields are DECIMAL NUMERIC,each with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. These depths are measured relative to land surface datum.
27	CIDIA1	Inside diameter of the first section of casing, in inches.
28	CIDIA2	Inside diameter of the second section of casing, in inches.
29	CIDIA3	Inside diameter of the third section of casing, in inches.
		The CIDIAx fields are DECIMAL NUMERIC, each with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point.
30	CODIA1	Outside diameter of the first section of casing, in inches.
31	CODIA2	Outside diameter of the second section of casing, in inches.
32	CODIA3	Outside diameter of the third section of casing, in inches.
		The CODIAx fields are DECIMAL NUMERIC, each with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point.
33	CMATR1	Description or name of casing material from which the first section of casing is made.
34	CMATR2	Description or name of casing material from which the second section of casing is made.
35	CMATR3	Description or name of casing material from which the third section of casing is made.
		The CMATRx fields are ALPHANUMERIC, each with a maximum of eight characters.
		OPEN INTERVAL - any portion of the well in which the interior of the well is not isolated from the surrounding soil and rock by unbreached casing.

36 OPTYP — Indicator of the type of opening in the open interval. The field is ALPHANUMERIC, consisting of a single character. The character must be one of the following:

O - open end
S - screened
W - walled
Z - other
P - perforated or slotted
T - sand point
X - open hole

37 TOELV — The depth to the top of the open interval. The TOELV field is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. Measured relative to land surface.

38 BOELV — The depth to the bottom of the open interval. The BOELV field is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. Measured relative to land surface.

39 OMATR — Description or name of material used to screen the open interval. The OMATR field is ALPHANUMERIC with a maximum of eight characters.

40 OWIDT — Width or short dimension of slot or mesh of screen material for the open interval, in inches. The OWIDT field is DECIMAL NUMERIC with up to twelve characters (including the decimal), and may have up to 3 digits following the decimal point.

41 OLENG — Length or long dimension of slot or mesh of screen material for the open interval, in inches. The OLENG field is DECIMAL NUMERIC with up to twelve characters (including the decimal), and may have up to 3 digits following the decimal point.

FILTER PACK - material placed in the annulus of the well between the borehole wall and the well screen to prevent formation material from entering through the well screen.

42 FPMTH — Indicator for method of filter pack placement. Must be ALPHANUMERIC consisting of a single character. The character must be one of the following:

A - dropping material down the hole and tamping
B - dropping material down hollow-stem auger
T - tremie pipe
O - other

43 FPMAT — Description or name of the material which forms the filter pack. Must be ALPHANUMERIC, consisting of up to eight (8) characters.

44 FPGRN Grain size of the material which forms the filter pack, in mesh gauge. Must be INTEGER NUMERIC, with up to four characters.

45 TFELV The depth to the top of the filter pack. The TFELV field is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. Measured relative to land surface.

46 BFELV The depth to the bottom of the filter pack. The BFELV field is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. Measured relative to land surface.

ANNULAR SEALANT - material used to seal the space between the borehole and the casing of the well. The annular sealant is placed directly above the filter pack to prevent the migration of contaminants to the sampling zone from the surface or intermediate zones and prevent cross contamination between strata.

47 SLMTH Indicator for method of sealant placement. Must be ALPHANUMERIC consisting of a single character. The character must be one of the following:

A - dropping material down the hole and tamping
B - dropping material down hollow-stem auger
T - tremie pipe
O - other

48 SLMATR Description or name of the material which forms the seal above the filter pack against entry of surface water. Must be ALPHANUMERIC, consisting of a single character. The character must be one of the following:

B - bentonite
G - cement
N - none
C - other clay
Z - other

49 TSLELV The depth to the top of the annular seal. The TSLELV field is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point) and may have up to two digits after the decimal point. Measured relative to land surface.

50	BSLELV	The depth to the bottom of the annular seal. The BSLELV field is DECIMAL NUMERIC with a maximum of twelve characters (including the decimal point and may have up to two digits after the decimal point. Measured relative to land surface.
51	SRFSL	Surface seal Indicator. Indicates whether or not the upper portion of the borehole is sealed to prevent inflow of surface water. Single character ALPHANUMERIC, containing "Y" if well is sealed. Otherwise contains "Nn".
52	DNGRAD	Downgradient indicator. Indicates whether or not, the well has been installed hydraulically downgradient of the source of potential groundwater pollution, and is capable of detecting the migration of contaminants. Single character ALPHANUMERIC, containing "y" if well is downgradient from waste disposal site. Otherwise contains "N".
53	DRLOG	Drillers log indicator. Indicates availability of drillers log. Single character ALPHANUMERIC, containing "Y if log is available. Otherwise contains "N".
54	LTHLG	Lithologic log indicator. Lithologic log shows distribution of lithology with depth in the bore hole. Single character ALPHANUMERIC, containing "Y" if log is available. Otherwise contains "N".
55	WLUSE *	Well use indicator. Must be ALPHANUMERIC, consisting of a single character. The character must be one of the followings D - domestic (private) water supply I - industrial water supply M - monitoring well P - public water supply O - other
56	COMMENT	Supplemental information as needed. May contain up to 80 alphanumeric characters.

* = required field

Attachment C
Datafile SAMPLE.DAT

Field No.	Field Name	Field Description
1	SAMPLE_KEY *	Unique sample identifier. Consists of a forty-two character field, left justified, containing:

Columns:	Description:
1 - 12	Unique site identifier as assigned by EPA. Must be alphanumeric.
13 - 17	Unique solid waste management unit designator. Must be alphanumeric.
18	Media status indicator. Must contain one of the following: C - compliance monitoring station B - baseline monitoring station A - other ambient monitoring station.
19 - 27	Unique station identifier. Must be alphanumeric.
28 - 42	Unique sample identifier. Must be alphanumeric.

2 DELTH * Vertical displacement of sample from the reference elevation (in feet) of the sampling station. For surface water, soils, and groundwater stations this would be the depth of the sample and for air monitoring stations, the height above ground. Must be DECIMAL NUMERIC consisting of a maximum of 8iX characters (including the decimal) and may have up to two digits after the decimal point.

3 DATE * Date of sample collection. Eight character integer field consisting of:

Columns	Content
1 - 4	year including century, e.g. 1989
5 - 6	numeric month
7 - 8	numeric day of month

* = required field

Column numbers are relative to the beginning of the DATE Field. Each subfield described above must be right justified, and may contain leading zeros.

4	TIME	*	Time (in military format) of sample collection. INTEGER NUMERIC consisting of four characters.
5	SSTAT	*	Station status or condition. Used primarily for groundwater monitoring stations. ALPHANUMERIC consisting of one character. The character must be one of the following: D - Dry O - obstructed W - Destroyed Z - other F - Flowing P - Pumping X - Surficial inflow
			FIELD MEASUREMENTS
6	TEMP		Sample temperature in degrees Celsius. DECIMAL NUMERIC consisting of six characters (including the decimal) and may have up to two digits after the decimal point.
7	PH		Sample pH in standard units. DECIMAL NUMERIC consisting of four characters (including the decimal) and may have one digit after the decimal point.
8	COND		Specific Conductance in uMhos. INTEGER NUMERIC consisting of a maximum of six characters.
9	TURB		Turbidity. INTEGER NUMERIC consisting of a maximum of eight characters. May be reported in JTU or NTU, as required by program.
10	WLEVEL		Well water level, or stream gage height, in feet. Measured relative to the reference datum. Item is DECIMAL NUMERIC consisting of a maximum of six characters (including the decimal) and may have up to two digits following the decimal point.
11	WINDSP		Wind speed in km/h. DECIMAL NUMERIC consisting of a maximum of six characters (including the decimal), and may have up to two digits after the decimal point.
12	WINDIR		Wind direction in degrees. INTEGER NUMERIC consisting of a maximum of four characters.
13	SAMMETH		Method used to collect sample. ALPHANUMERIC field, left justified, consisting of up to 20 characters.

* = required field

14	SAMPLER	Name of Agency of Organization that collected the sample. Must be ALPHANUMERIC consisting of up to 20 characters.
15	COMMENT	Any additional information the user feels necessary, which may not be accommodated in a defined field. Must be ALPHANUMERIC consisting of up to 40 characters.

* = required field

Attachment D

Datafile PARM.DAT

Field No.	Field Name	Field Description
1	PARAM_KEY *	Unique data record identifier. Consists of a fifty-four character field, left justified, containing:

Columns	Description
1 - 12	Unique site identifier as assigned by EPA. Must be alphanumeric.
13 - 17	Unique solid waste management unit designator. Must be alphanumeric.
18	Media status indicator. Must contain one of the following: C - compliance monitoring station B - baseline monitoring station A - other ambient monitoring station.
19 - 27	Unique station identifier. Must be alphanumeric.
28 - 42	Unique sample identifier. Must be alphanumeric.
43 - 54	Parameter identifier. For chemical constituents for which CAS number exist, the CAS number will be the identifier. For other constituents, the identifier will be determined on an as-needed basis.
55 - 58	Replicate number. Identifies the value as one of two or more analytical results for the same parameter on the same sample. INTEGER NUMERIC, right justified, up to four characters. Not used unless replicate results are reported.

2	QUALF	Qualifier field. ALPHANUMERIC, may contain up to four STORET qualifier codes.

* = required field

3	VALUE	*	The reported analytical result for the chemical. Must be DECIMAL NUMERIC, consisting of up to twelve character (including the decimal), and may have up to four digits after the decimal point.
4	UNITS	*	The units of measurement in which analytical results are reported. ALPHANUMERIC, consisting of up to six characters.
5	METHOD		The name or code of the analytical method or technique used to obtain the reported value. ALPHANUMERIC, containing up to fourteen characters.
6	DATE	*	Date of analysis. Eight character integer field consisting of:

Columns	Content
1 - 4	year including century, e.g. 1989
5 - 6	numeric month
7 - 8	numeric day of month

Column numbers are relative to the beginning of the DATE Field. Each subfield described above must be right justified, and may contain leading zeros.

7	DETLIM	Detection limit. Must be in same units as the reported value. Must be DECIMAL NUMERIC, consisting of up to twelve characters (including the decimal), and may have up to four digits after the decimal point.
8	LAB	Name of Lab that performed the analysis. ALPHANUMERIC field containing up to 28 characters.
9	COMMENT	Any additional information the user feels necessary, which may not be accommodated in a defined field. Must be ALPHANUMERIC consisting of up to 40 characters.

* = required field

APPENDIX C

ARARS CHECKLIST

Chemical-Specific ARARs Checklist
Federal Requirements

RI/FS Workplan
OLF Barin, Foley, Alabama

Requirements	Is this an ARAR? Yes	Is this an ARAR? No	Comments
1. SDWA - Maximum Contaminant Levels (MCLs) (40 CFR 141)	✓		Final or proposed MCLs exist for groundwater contaminants at MCLB facility.
2. CAA - National Ambient Air Quality Standards (NAAQS) (40 CFR 50)	✓		NAAQS for particulate matter may be considered during assessment of soil removal options.
3. RCRA - Alternative Concentration Levels (ACLs)		✓	MCLs and risk-based levels will be used as target levels instead of ACLs. ACLs are not applicable.

Chemical-Specific ARARs Checklist--continued
Federal Criteria, Advisories, and Guidance (FCAG)

RI/FS Workplan
OLF Barin, Foley, Alabama

FCAG	Is this an FCAG? Yes	Is this an FCAG? No	Comments
1. Maximum Contaminant Level Goals (MCLGs)	✓		MCLs are the relevant and appropriate clean-up levels. MCLGs are ARARs unless MCLG is zero.
2. Federal Ambient Water Quality Criteria (AWQC)	✓		AWQC exist for groundwater (which may recharge in the wetland) and surface water contaminants at the MCLB facility.
3. TSCA Section 8D Health and Safety Data	✓		Will be evaluated during risk assessment for the MCLB sites.
4. Health Advisories (EPA Office of Drinking Water)	✓		Will be considered for drinking water exposures.
5. TSCA Chemical Advisories/Fact Sheets		✓	Provide qualitative toxicological information on chemical; not applicable here.
6. EPA Risk Reference Doses (RfD)	✓		Intended for use in quantitative public health evaluation of remedial alternatives, if adequate data exist.
7. EPA Carcinogen Assessment Group Potency Factors	✓		Potency factors may be used to develop target soil cleanup levels.
8. Acceptable Intake - Chronic (AIC) and Subchronic (AIS) - EPA Health Assessment Documents		✓	Intended for use in quantitative public health evaluation of remedial alternatives, if adequate data exist.
9. Pesticide Registration Data	✓		Will be reviewed, where available.
10. EPA Office of Water Guidance - Water-Related Environmental Fate of 129 Priority Pollutants (1979)	✓		Transport and fate of pollutants will be assessed.
11. TSCA - Polychlorinated Biphenyls Spill Cleanup Policy (40 CFR 761, Subpart G; 761.120 - 761.135)	✓		Not usually applicable to CERCLA sites, but standard may be considered relevant and appropriate or used as guideline for the MCLB.

Location-Specific ARARs Checklist
Federal Requirements

RI/FS Workplan
OLF Barin, Foley, Alabama

Requirements	Does this ARAR apply to existing site conditions? Yes	No	Comments
1. CWA - 40 CFR Part 404	✓		Will be considered for alternatives that affect wetlands.
2. NEPA - 40 CFR Part 6		✓	Preparation of RI/FS incorporates the requirements of NEPA.
3. Endangered Species Act (16 U.S.C. 1531, 50 CFR Parts 81, 225, 402)	tbd		Presence of threatened or endangered species will be evaluated during the RI.
4. Wild and Scenic Rivers Act (16 U.S.C. 1271)		✓	Not applicable.
5. Fish and Wildlife Coordination Act (16 U.S.C. 661 note)	tbd		Applicability to be determined during the RI.
6. Fish and Wildlife Conservation Act (16 U.S.C. 2901, 50 CFR Part 83)	tbd		Applicability to be determined during the RI.
7. Coastal Zone Management Act (16 U.s.C. 1451, 15 CFR Part 930, 923.45)		✓	Not applicable.
8. Historic Sites, Buildings, and Antiquities Act (16 U.S.C. 461)	tbd		Applicability to be determined during the RI.
9. National historic Preservation Act (16 U.S.C. 470)	tbd		Applicability to be determined during the RI.
10. Protection of Archeological Resources (32 CFR Part 229, 229.4; 43 CFR Parts 107, 107.1 - 171.500)	tbd		Will be considered during the excavation activities.

Note: tbd = to be determined.

Location-Specific ARARs Checklist–continued
State Requirements

RI/FS Workplan
OLF Barin, Foley, Alabama

FCAG	Do these FCAGs apply to existing site conditions? Yes	No	Comments
1. FWS, NWFS Advisories (Under Fish and Wildlife Coordination Act)	✓	—	Requirements addressed in CWA Section 404.
2. Floodplains Executive Order (11988)	tbd	—	Requirements will also be addressed in CWA Section 404.
3. Wetlands Executive Order (11990)	tbd	—	Requirements will also be addressed in CWA Section 404.
4. Federal Sole-Source Aquifer Requirements	—	✓	Not applicable.

Note: tbd = to be determined.

Action-Specific ARARs Checklist--continued
Federal Requirements

RI/FS Workplan
OLF Barin, Foley, Alabama

Requirement	Is this an ARAR? Yes	Is this an ARAR? No	Comments
1. RCRA - Standards for Owners and Operations of Permitted Hazardous Waste Facilities (40 CFR 264.10 - 264.18)	✓		Applicable or relevant and appropriate RCRA Requirements will be identified and considered during the evaluation of remedial alternatives.
2. RCRA - Preparedness and Prevention (40 CFR 264.30 - 264.37)	✓		
3. RCRA - Contingency Plan and Emergency Procedures (40 CFR 264.50 - 264.56)	✓		
4. RCRA - Manifesting, Recordkeeping, and Reporting (40 CFR 264.70 - 264.77)	✓		
5. RCRA - Groundwater Protection (40 CFR 264.90 - 264.109)	✓		
6. RCRA - Closure and Post-Closure (40 CFR 264.110 - 264.120)	✓		Applicable to site closure.
7. RCRA - Surface Impoundments (40 CFR 264.220 - 264.249)	tbd		Applicability will be determined during the development of remedial alternatives.
8. RCRA - Waste Piles (40 CFR 264.250 - 264.269)	tbd		Applicability will be determined during the development of remedial alternatives.
9. RCRA - Land Treatment (40 CFR 264.270 - 264.299)	tbd		Applicability will be determined during the development of remedial alternatives.
10. RCRA - Landfills (40 CFR 264.300 - 264.339)	tbd		Applicability will be determined during the development of remedial alternatives.
11. RCRA - Incinerators (40 CFR 264.340 - 264.999)	tbd		Applicable to alternatives involving incineration.
12. CWA - 40 CFR Parts 122, 125, 403, and 404	tbd		Will be considered when remedial alternatives include discharges to surface water.
13. TSCA - Manufacturing, Processing, Distribution in Commerce, Use of PCBs and PCB Items (40 CFR 761.60 - 761.79)	✓		Will be considered during remediation of PCB-contaminated areas.
14. TSCA - Markings of PCBs and PCB Items (40 CFR 761.40 - 761.79)	✓		Will be considered during remediation of PCB-contaminated areas.
15. TSCA - Storage and Disposal (40CFR 761.60 - 761.79)	✓		Governs responses to soil contaminated with PCBs at 50 ppm or greater. Will be considered during evaluation of soil remedial alternatives.
16. TSCA - Records and Reports (40 CFR 761.180 - 761.185, also 40 CFR 129.105, 750)	✓		Will be considered during remediation of PCB-contaminated areas.

Note: tbd = to be determined.

Action-Specific ARARs Checklist–continued
Federal Requirements

RI/FS Workplan
OLF Barin, Foley, Alabama

Requirement	Is this an ARAR? Yes	Is this an ARAR? No	Comments
17. CAA - National Air Quality Standards for Particulate Matter (40 CFR 50)	✓	—	Will be considered for soil removal options.
18. OSHA - General Industry Standards (29 CFR Part 1910)	✓	—	OSHA requirements will be complied with during implementation of onsite remedial alternatives.
19. OSHA - Safety and Health Standards for Federal Service Contracts (29 CFR Part 1926)	✓	—	
20. OSHA - Recordkeeping, Reporting, and Related Regulations	✓	—	
21. DOT Rules for the Transportation of Hazardous Materials (49 CFR Parts 107, 171.1 - 171.500)	✓	—	Will be complied with the remedial alternatives requiring transportation of hazardous materials off-site.
22. Rivers and Harbors Act (33 CFR Parts 320-329)	—	✓	Not applicable.
23. Guidelines for Specifications of Disposal Sites for Dredged or Fill Material (40 CFR 230)	—	✓	Not applicable.
24. Denial or Restriction of Disposal Sites (40 CFR 231)	—	✓	Not applicable.
25. Ocean Dumping Regulations (40 CFR 220-229)	—	✓	Not applicable.
26. Disposal of Waste Material Containing TCDD (40 CFR 775.180 - 775.197)	—	✓	Not applicable.
27. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Regulations (40 CFR Part 165)	✓	—	Applicable or relevant and appropriate to pesticides located at MCLB Albany.

Note: tbd = to be determined.

Action-Specific ARARs Checklist–continued
Federal Criteria, Advisories, and Guidance (FCAG)

RI/FS Workplan
OLF Barin, Foley, Alabama

Requirement	Is this an FCAG? Yes	Is this an FCAG? No	Comments
1. EPA's Groundwater Protection Strategy	✓		To be considered during remedial design.
2. TSCA Compliance Policy	✓		To be considered during remedial design.
3. Waste Load Allocation Procedures (EPA Office of Water)			Not applicable.
U.S. EPA RCRA Design Guidelines			
A. EPA's RCRA Design Guidelines			
1. Surface Impoundments, Liner Systems, Final Cover and Freeboard Control	tbd		These RCRA design guidelines will be considered if these types of facilities will be constructed.
2. Waste Pile Design - Liner Systems	tbd		
3. Land Treatment Units	tbd		
4. Landfill Design - Liner Systems and Final Cover	tbd		
B. Permitting Guidance Manuals			
1. Permit Applicants' Guidance Manual for Hazardous Waste Land Treatment, Storage and Disposal Facilities		✓	These permit guidance manuals are not applicable to the MCLB site because permits are not required for onsite actions. For remedial actions taken off-site and discharges occurring off-site (e.g., discharges to surface water from groundwater treatment remedial actions) must comply with all requirements, including obtaining proper federal and state permits. In addition, the contents of the Subpart F Guidance Manual will be reviewed during the development of any proposed groundwater monitoring program.
2. Permit Writers' Guidance Manual for Hazardous Waste Land Treatment, Storage and Disposal Facilities		✓	
3. Permit Writer's Guidance Manual for Subpart F	✓	✓	
4. Permit Applicants' Guidance Manual for General Facility Standards		✓	
5. Waste Analysis Plan Guidance Manual		✓	
6. Permit Writers' Guidance Manual for Hazardous Waste Tanks		✓	
7. Model Permit Application for Existing Incinerators		✓	
8. Guidance Manual for Evaluating Permit Applications for the Operation of Hazardous Waste Incinerator Units		✓	
9. A Guide for Preparing RCRA Permit Applications for Existing Storage Facilities		✓	
10. Guidance Manual on Closure and Post-Closure Interim Status Standards		✓	

Note: tbd = to be determined.

Action-Specific ARARs Checklist--continued
Federal Criteria, Advisories, and Guidance (FCAG)

RI/FS Workplan
OLF Barin, Foley, Alabama

Requirement	Is this an FCAG? Yes	Is this an FCAG? No	Comments
C. Technical Resource Documents			
1. Evaluating Cover Systems for Solid and Hazardous Waste	tbd		Technical resource and guidance documents are not considered directly applicable; however, their content may be used as guidance for some alternatives.
2. Hydrologic Simulation of Solid Waste Disposal Sites	tbd		
3. Landfill and Surface Impoundment Performance Evaluation	tbd		
4. Lining of Water Impoundments and Disposal Facilities	tbd		
5. Test methods for Evaluating Solid Wastes	tbd		
6. A Method for Determining the Compatibility of Hazardous Wastes	tbd		
7. Guidance Manual on Hazardous Waste Compatibility	tbd		
EPA Office of Water Guidance Documents			
A. Pretreatment Guidance Documents			
1. 304(G) Guidance Document Revised Pretreatment Guidelines	tbd		
B. NPDES Guidance Documents	tbd		
1. NPDES Best Management Practices Guidance Manual (6/81)	tbd		
2. Case Studies on Toxicity Reduction Evaluation (5/83)	tbd		
C. Groundwater/UIC Guidance Document			
USEPA Manuals from the Office of Research and Development			
1. EW 846 Methods - Laboratory Analytical Methods	✓		Established lab methods and protocols will be followed during all chemical analysis.
2. Lab Protocols Developed Pursuant to Clean Water Act 304(h)	✓		

Note: tbd = to be determined.

APPENDIX D

STATE AND FEDERAL ACTION LEVELS

Applicable Alabama Water Quality Standards

Surface Water Quality [1]

1. All waters free from substances attributable to sewage, industrial wastes, or other wastes in concentrations that are toxic or harmful to humans or aquatic life to the extent commensurate with the designated usage.

2. Specific criteria use classes "S", and "F&W."

   pH - no deviation > 1.0 pH unit or to cause a pH < 6.0 or >8.5.
   Dissolved oxygen - not less than 5.0 mg/ℓ.
   Toxic substances - not to exceed 1/10 of the 96-hour median tolerance limit for fish and aquatic life.
   Bacteria - the fecal coliform contamination shall not exceed a geometric mean value of 200 per 100 milliliters.

Alabama Primary Drinking Water Standards [2]

Maximum Contaminant Levels

Contaminant	mg/ℓ
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium	0.05
Fluoride	4.0
Lead	0.020
Mercury	0.002
Nitrate	10.0
Selenium	0.01
Silver	0.05
Endrin	0.002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-Dichlorophenoxy acetic acid	0.1
2,4,5-Trichlorophenoxy acetic acid (Silvex)	0.01
Total trihalomethane	0.10
Benzene	0.005
Carbon tetrachloride	0.005
1,2-Dichloroethane	0.005
Trichloroethylene	0.005
p-Dichlorobenzene	0.075
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
Vinyl chloride	0.002

Applicable Alabama Water Quality Standards (Continued)

Alabama Secondary Drinking Water Standards [2]

Contaminant	mg/ℓ
Chloride	250
Color	15 units
Copper	1
Corrosivity	non corrosive
Foaming agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 threshold odor number
Sulfate	250
Total dissolved solids	500
Zinc	5

NOTES: (1) Wolf Creek is classified as "F&W", suitable for protection of Fish and Wildlife; Sandy Creek is classified "S", "F&W", suitable for swimming and other whole body contact recreation and protection of Fish and Wildlife under Alabama Water Quality Criteria and Use Classification Regulations Title II, Section II, April 1982.

(2) Alabama Administrative Code Chapter 335-7-2, January 4, 1989

(3) Alabama Administrative Code Chapter 335-7-3, January 4, 1989

mg/ℓ = milligram per liter

Federal and State Water Quality Standards and Criteria, U.S. Environmental Protection Agency Target Compound List

RI/FS Workplan
OLF Barin, Foley, Alabama

	Federal Primary Drinking Water MCL[1] (µg/ℓ)	Federal Primary Drinking Water MCLG[1] (µg/ℓ)	Federal AWQC Aquatic Organisms[2] (µg/ℓ)	Federal AWQC Human Health[3] (µg/ℓ)	Federal Secondary Drinking Water MCL[4] (µg/ℓ)
Volatile organic compounds					
Chloromethane				0(0.19)	
Bromomethane				0(0.19)	
Vinyl chloride	2	0		0(2.0)	
Chloroethane			IND	IND	
Methylene chloride			[5]11,000	0(0.19)	
Acetone					
Carbon disulfide					
1,1-Dichloroethene	7	7	[5]11,600	0(0.003)	
1,1-Dichloroethane					
cis-1,2-Dichloroethene	[6]70	70	IND	IND	
trans-1,2-Dichloroethene	[6]100	100			
Chloroform	[7]100		[8]1,240	0(0.19)	
1,2-Dichloroethane	5	0	[8]20,000	0(0.94)	
2-Butanone					
1,1,1-Trichloroethane	200	200	18,000	18,400	
Carbon tetrachloride	5	0	[5]35,200	0(0.4)	
Vinyl acetate					
Bromodichloromethane	[7]100		[5]11,000		
1,2-Dichloropropane	5	0	[8]5,700	IND	
trans-1,3-Dichloropropene			[8]244	87	
Trichloroethene	5	0	[8]21,900	0(2.78)	
Dibromochloromethane	100		[5]11,000	0(0.19)	
1,1,2-Trichloroethane			[8]9,400	0(0.6)	
Benzene	5	0	[5]5,300	0(0.66)	
cis-1,3-Dichloropropene			[8]244	87	
2-Chloroethylvinyl ether					
Bromoform	[7]100		[5]11,000		
4-Methyl-2-pentanone					
2-Hexanone					
Tetrachloroethene	[7]5	0	[8]840	0(0.80)	
1,1,2,2-Tetrachloroethane			[8]2,400	0(0.17)	
Toluene	[6]1,000	1,000	[5]17,500	[8]18,400	

See notes at end of table.

Federal and State Water Quality Standards and Criteria, U.S. Environmental Protection Agency Target Compound List--continued

RI/FS Workplan
OLF Barin, Foley, Alabama

	Federal Primary Drinking Water MCL[1] (µg/ℓ)	Federal Primary Drinking Water MCLG[1] (µg/ℓ)	Federal AWQC Aquatic Organisms[2] (µg/ℓ)	Federal AWQC Human Health[3] (µg/ℓ)	Federal Secondary Drinking Water MCL[4] (µg/ℓ)
Inorganic compounds--continued					
Silver	50		[9]0.12	50	100
Sodium					
Thallium			[8]40	13	
Vanadium					
Zinc			[11]110	[13]5,000	5,000
Semivolatile organic compounds					
3-Nitroaniline				0.0028	
Acenaphthene			[8]520	70	
2,4-Dinitrophenol				70	
4-Nitrophenol					
Dibenzofuran					
2,4-Dinitrotoluene			[8]230	0(0.11)	
Diethylphthalate				350,000	
4-Chlorophenyl-phenylether					
Fluorene				0.0028	
4-Nitroaniline					
4,6-Dinitro-2-methylphenol					
N-Nitrosodiphenylamine				0(4.9)	
4-Bromophenyl-phenylether					
Hexachlorobenzene			[8]3.68	0.00072	
Pentachlorophenol	1	0	[9]13	1,010	
Phenanthrene			[8]6.3	0.0031	
Anthracene			[13]6.3	0.0031	
Di-n-butylphthalate				34,000	
Fluoranthene			[5]3,980	42	
Pyrene				0.0028	
Butylbenzylphthalate					
3,3'-Dichlorobenzidine				0.0103	
Benzo(a)anthracene				0.0028	
Chrysene				0.0028	
bis(2-Ethylhexyl)phthalate			[8]3		
Di-n-octylphthalate					
Benzo(b)fluoranthene				0(0.0028)	

See notes at end of table.

Federal and State Water Quality Standards and Criteria, U.S. Environmental Protection Agency Target Compound List--continued

RI/FS Workplan
OLF Barin, Foley, Alabama

	Federal Primary Drinking Water MCL[1] (µg/ℓ)	Federal Primary Drinking Water MCLG[1] (µg/ℓ)	Federal AWQC Aquatic Organisms[2] (µg/ℓ)	Federal AWQC Human Health[3] (µg/ℓ)	Federal Secondary Drinking Water MCL[4] (µg/ℓ)
Semivolatile organic compounds--continued					
Benzo(k)fluoranthene				0(0.0028)	
Benzo(a)pyrene				0(0.0028)	
Indeno(1,2,3-cd)pyrene				0(0.0028)	
Dibenzo(a,h)anthracene				0(0.0028)	
Benzo(g,h,i)perylene				0(0.0028)	
Phenol			[8]2,560	3,500	
bis(2-Chloroethyl)ether				0(30 ng/ℓ)	
2-Chlorophenol			[5]4,380	[13]0.1	
1,3-Dichlorobenzene	[6]600	600	[8]50	400	
1,2-Dichlorobenzene	[6]600	600	[8]50	400	
1,4-Dichlorobenzene	[6]75	75	[8]50	400	
Benzyl alcohol					
2-Methylphenol					
bis(2-Chloroisopropyl)ether				34.7	
4-Methylphenol					
N-Nitroso-di-n-propylamine					
Hexachloroethane			[8]540	0(1.9)	
Nitrobenzene			[5]27,000	19,800	
Isophorone			[5]117,000	5,200	
2-Nitrophenol					
2,4-Dimethylphenol			[5]2,120	400[f]	
Benzoic acid					
bis(2-Chloroethoxy)methane					
2,4-Dichlorobenzene			[8]763	3,090	
Naphthalene			[8]620	IND	
4-Chloroaniline					
Hexacholorobutadiene			[8]9.3	0(0.45)	
4-Chloro-3-methylphenol			[5]30	3,000	
2-Methylnaphthalene				0.0028	
Hexachlorocyclopentadiene			[8]5.2	206	
2,4,6-Trichlorophenol			[8]970	0(1.2)	
2,4,5-Trichlorophenol			[8]63	2,600	

See notes at end of table.

Federal and State Water Quality Standards and Criteria, U.S. Environmental Protection Agency Target Compound List--continued

RI/FS Workplan
OLF Barin, Foley, Alabama

	Federal Primary Drinking Water MCL[1] (µg/ℓ)	Federal Primary Drinking Water MCLG[1] (µg/ℓ)	Federal AWQC Aquatic Organisms[2] (µg/ℓ)	Federal AWQC Human Health[3] (µg/ℓ)	Federal Secondary Drinking Water MCL[4] (µg/ℓ)
Semivolatile organic compounds--continued					
2-Chloronaphthalene			[5]1,600	IND	
2-Nitroaniline					
Dimethylphthalate				313,000	
Acenaphthylene				0.0028	
2,6-Dinitrotoluene					
Pesticides/PCB compounds					
Alachlor	[6]2	0			
Atrazine	[6]3	3			
Carbofuran	[6]40	40			
Dibromochloropropane	[6]0.2	0			
2,4-D	[6]70	70		100	
Ethylene dibromide	[6]0.05	0			
2,4,5-TP	[6]50	50		10	
alpha-BHC			[5]100	0.073	
beta-BHC			[5]100	0.0233	
delta-BHC	0.2	0	IND	IND	
gamma-BHC (lindane)	[6]0.2	0.2		0.0174	
Heptachlor	[6]0.4	0	[9]0.0038	0.00028	
Aldrin			[14]3.0	0.000074	
Heptachlor epoxide	[6]0.2	0	0.0038		
Endosulfan I			[14]0.056		
Dieldrin			[14]0.0019	0.000071	
4,4'-DDE			[5]1,050		
Endrin	0.2		[14]0.0023	1	
Endosulfan II			0.056		
4,4'-DDD					
Endrin aldehyde		[14]0.001			
Endosulfan sulfate					
4,4'-DDT			[9]0.001	0.000024	
Methoxychlor	40	40		100	
Endrin ketone					
Chlordane	[6]2	0	[14]0.0043	0(0.00046)	
Silvex					

See notes at end of table.

Federal and State Water Quality Standards and Criteria, U.S. Environmental Protection Agency Target Compound List--continued

RI/FS Workplan
OLF Barin, Foley, Alabama

	Federal Primary Drinking Water MCL[1] (µg/ℓ)	Federal Primary Drinking Water MCLG[1] (µg/ℓ)	Federal AWQC Aquatic Organisms[2] (µg/ℓ)	Federal AWQC Human Health[3] (µg/ℓ)	Federal Secondary Drinking Water MCL[4] (µg/ℓ)
Pesticides/PCB compounds--continued					
Toxaphene	[6]3	0	[8]0.0002	0(0.00071)	
Aroclor-1016				0(>0.0126)	
Aroclor-1221				0(>0.0126)	
Aroclor-1232				0(>0.0126)	
Aroclor-1242				0(>0.0126)	
Aroclor-1248				0(>0.0126)	
Aroclor-1254				0(>0.0126)	
Aroclor-1260				0(>0.0126)	
PCBs (total)	[6]0.5	0	[9]0.014	(0.000079)	

[1] From 40 Code of Federal Regulations (CFR) 161, revised by 56 Federal Register 3578, January 30, 1991.
[2] Ambient water quality criteria (AWQC) for the protection of aquatic life lowest available number is presented (USEPA, May 1986).
[3] AWQC for the protection of human health, from effects through ingestion of contaminated aquatic organisms (USEPA, May 1986).
[4] Secondary MCLs from 40 CFR 143, revised by 56 Federal Register 3595, January 30, 1991. Secondary MCLs are not federally enforceable, they are guidelines to control aesthetic qualities of drinking water.
[5] Acute lowest observed effect level (LOEL).
[6] Effective July 30, 1992.
[7] Maximum contaminant limit (MCL) for total trihalomethanes (sum of concentrations of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform), and trichloromethane) = 100 micrograms per liter (ug/ℓ).
[8] Chronic LOEL.
[9] Chronic criteria.
[10] Units for asbestos MCLs are million fibers per liter for fibers longer than 10 micrometer.
[11] Hardness based criteria (based on 100 milligrams per liter [mg/ℓ] as $CaCO_3$).
[12] Secondary Alabama maximum contaminant levels (MCLs).
[13] Organoleptic, criteria based on odor and taste, not health. No health-based criteria available.
[14] Acute criteria.

Notes: MCLs = maximum contaminant levels.
µg/ℓ = microgram per liter.
MCLG = maximum contaminant level goal.
AWQC = Ambient Water Quality Criteria.
IND = insufficient data.
PCB = polychlorinated biphenyls.
f/ℓ = fibers per liter.
ng/ℓ = nanogram per liter.

APPENDIX E

REMEDIAL TECHNOLOGY DATA NEEDS

Media	Data Needs	Remedial Technologies
Groundwater	Accessibility of Materials (soils)	Containment Technologies
	Topography of Site	Containment Technologies
	Soil Characteristics (physical and chemical) *In-situ* Technologies Reinjection Disposal	Containment Technologies Extraction Technologies
	Groundwater Flow Rate and Direction *In-situ* Technologies Disposal Technologies	Containment Technologies Extraction Technologies
	Groundwater Characteristics (e.g., chemistry, transmissivity storativity, and conductivity)	Containment Technologies Extraction Technologies In-situ Technologies
	Area of Contamination Extraction Technologies *In-situ* Technologies Treatment Technologies	Containment Technologies
	Climate	Containment
	Land Use	Containment
	Specific Contaminants (types and concentrations) Disposal Technologies	*In-situ* Technologies Treatment Technologies
	Discharge Locations	Treatment Technologies
	Accessible Area for Set-up Treatment Technologies	*In-situ* Treatment
	Proximity to Utilities	Treatment Technologies
	Distance/Accessibility to Base Sewers	Treatment Technologies
	VOCs, SVOCs, Pesticides, PCBs, TOC, BOD, COD, and Ammonia as N Disposal Technologies	*In-situ* Treatment Treatment Technologies
	Metals, Total Suspended Solids (TSS), pH	Treatment Technologies Disposal Technologies

Media	Data Needs	Remedial Technologies
Soil and Sediments (continued)	Hardness as CaC03 Resin Adsorption	Precipitation/Flocculation
	Availability of Materials (soils)	Containment Technologies
	Soil Types and Characteristics	Containment Technologies Excavation *In-situ* Treatment Treatment Technologies Vacuum Extraction
	Climate	Containment Excavation *In-situ* Biological Treatment
	Land Use	Containment *In-situ* Treatment Disposal
	Topography	Containment Technologies Excavation Technologies Land Farming Disposal
	Geologic Characteristics	Excavation Onsite Landfill
	Depth to Groundwater	Containment Technologies *In-situ* Treatment Land Farming Disposal
	Proximity of neighbors (i.e., need for air monitoring)	Treatment Technologies
	Available Land Area	Treatment Technologies Onsite Landfill
	Site Access	Treatment Technologies
	Availability of Electrical Power	*In-situ* Vitrification Solvent Extraction

Media	Data Needs	Remedial Technologies
Soil and Sediments (continued)	Specific Contaminants (e.g., VOCs, SVOCs, Metals, Pesticides, and PCBs)	Excavation *In-situ* Treatment Treatment Technologies Disposal
	Area of Contamination	Excavation *In-situ* Treatment Treatment Technologies
	Contaminant Vapor Pressures/Boiling Points	Vacuum Extraction Thermal Aeration
	Soil Gas Survey Information	Vacuum Extraction
	Ammonia as N	*In-situ* Biological
Treatment		
	Presence of underground tanks, pipelines, buried drums, large rocks or other metal debris	*In-situ* Vitrification Solvent Extraction Incineration

APPENDIX F

SUMMARY DATA NEEDS

Groundwater Remedial Technologies	Data Needs
Containment	
Slurry Walls	• Accessibility of site materials(soils) • Topography • Depth to impermeable strata • Heterogeneity of subsurface formation • Soil conditions • Groundwater depth, flow rate, and direction of flow • Soil chemistry • Chemistry of groundwater
Cap	• Area of contamination • Depth to groundwater table • Availability of cover materials • Soil characteristics; gradation, Atterberg limits, percent moisture, compaction, permeability and strength • Climate (precipitation) • Land use
Extraction Technologies	
Pumping	• Depth to aquifer • Depth to impermeable strata • Aquifer transmissivity • Aquifer storativity • Hydraulic conductivity • Water solubility of contaminants • Soil type • Soil grain size distribution
Drains	• Depth to aquifer • Depth to impermeable strata • Aquifer transmissivity • Aquifer storativity • Hydraulic conductivity • Water solubility of contaminants • Soil type • Soil grain size distribution

Groundwater Remedial Technologies	Data Needs
In-situ Treatment Technologies	
In-situ Bioremediation	• Gross organic components (BOD, COD) • Ammonia • pH • VOCs, SVOCs, Metals concentration
Treatment Technologies	
Air Stripping	• Presence of: VOCs Trihalomethanes Ammonia (Nitrogen) SVOCs Metals Oil & Grease Total Suspended Solids Alkalinity pH Temperature COD BOD • Presence of large volumes of contaminated water • Discharge locations • Accessible area for set-up • Proximity to utilities
Carbon Adsorption	• Presence of: VOCs Total Petroleum Hydrocarbons BOD COD TSS Ammonia Metals • Effluent discharge locations • Access to area for trucks, equipment and removal of spent carbon

Groundwater Remedial Technologies	Data Needs
Treatment Technologies	
Precipitation/Flocculation	• Concentrations of metals in aqueous stream • Presence of compounds that could inhibit the P/F process • Expected variability of the contaminated stream • Area to set up stationary or mobile plant • Distance/accessibility to Base Sewers • Suitable area for discharge of treated water • Contaminants of concern: COD TSS Alkalinity Hardness as CaC03 Metals pH
Ultraviolet Radiation/Ozonation	• Aquifer characteristics that may affect pumping rates • Distribution of contaminants • Distance/accessibility of Base sewers • Availability of discharge locations • Accessible onsite buildings to house $U/0_3$ unit, or the space to construct buildings of adequate size • Contaminant concentration organics, petroleum hydrocarbons, suspended solids, pH of water, metals
Biological Treatment	• Gross organic components (BOD, COD) • Influent pH • VOCs, SVOCs, Metals Concentrations • Flowrate

Groundwater Remedial Technologies	Data Needs
Treatment Technologies	
Resin Adsorption	• Concentrations of metals in aqueous stream • Presence of compounds that couldinhibit the Resin Adsorption Process • Expected variability of the contaminated stream • Area to set up stationary or mobile plant • Distance/accessibility to nearest Base Sewers • Suitable area for discharge of treated water • Contaminants of Concern: COD TSS Alkalinity Hardness as CaC03 pH Metals
Disposal	
Reinjection	• Depth to aquifer • Depth to bedrock or impermeable strata • Aquifer transmissivity • Aquifer storativity • Hydraulic conductivity • Water solubility of contaminants • Soil type • Soil grain size distribution
Sewage Treatment Plant (onsite)	• Gross Organic Components (BOD, COD) • Specific Organic constituents • Influent pH • Effluent requirements • Metals
Discharge to Surface Water	• Surface Water Classification • State and Federal Standards • Discharge Contaminant Concentrations

Soil and Sediment Remedial Technologies	Data Needs
Containment	
Cap	• Extent of contamination • Depth to groundwater table • Availability of cover materials • Soil types and characteristics • Climate (precipitation) • Land use
Excavation	
Excavation of Soils	• Waste characteristics • Nature and area of contamination • Topography • Geologic characteristics • Climate
***In-situ* Treatment Technologies**	
Biological Treatment	• Area of contamination • Gross organic components (BOD, COD) • VOCs, SVOCs • Microbiology cell enumerations • Dissolved oxygen • pH • Ammonia as N
Vacuum Extraction	• Area of contamination • Concentration profile for contaminants • Soil types and characteristics • Soil permeability • Depth to groundwater • Vapor pressures for contaminants • Results of soil gas surveys
***In-situ* Treatment Technologies**	
In-situ Vitrification	• Depth to groundwater • Presence of high levels of organic and inorganic compounds • Location of contamination in top 20 feet • Volume of contaminated soils • Silica content of soils • Presence of underground tanks, pipe lines, buried drums, or other metal debris • Availability of electrical power of sufficient capacity (3000-4000kw)

Soil and Sediment Remedial Technologies	Data Needs
Treatment Technologies	
Thermal Aeration	• Type of soils (fines content, presence of cobbles, presence of high levels of organics) • Contaminant vapor pressure and boiling points • Extent of contamination, depth of contamination • Metals levels • Open area of 200' by 200' for process equipment • Proximity of neighbors (to determine needs for air monitoring and operating hours)
Land Farming (Bioreclamation)	• Specific organic constituents and concentrations • Soil types and characteristics • Available land area (size) • Access • Depth to groundwater • Site topography
Solvent Extraction	• Electrical power availability • Grain size distribution • Total organics present in soil (for volume extract) • Presence of large gravel/rocks/debris • Access to site (for risk assessment of treated soil) • Distance to neighbors (for evaluation of volatile solvent air impacts) • Open area to set up treatment system • Moisture content of soils
Incineration (Rotary Kiln)	• Presence of drummed organic liquids • Presence of soil areas which are highly contaminated with organics • Types of contaminants • Metals levels • Open area to set up mobile incinerator • Proximity of neighbors (for air modeling purposes) • Presence of large unincinerable material (rock, metal, debris, etc.)

SOIL AND SEDIMENT REMEDIAL TECHNOLOGIES	Data Needs
Disposal	
Onsite Landfill	• Waste characteristics • Property survey • Local geology • Waste volume • SVOCs, VOCs, metals concentration
Off-Site Landfill	• Waste characteristics • Property survey • Local geology • Waste volume