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FINAL RCRA FACILITY INVESTIGATION FOR PARCEL D AND BACKGROUND STUDY
WORK PLAN NAS FORT WORTH TX
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NAVAL AIR STATION FORT WORTH JRB CARSWELL FIELD TEXAS

ADMINISTRATIVE RECORD COVER SHEET

AR File Number 383

United States Air Force
Air Force Base Conversion Agency

FINAL

NAS Fort Worth JRB, Texas
(Formerly Carswell AFB, Texas)

RCRA FACILITY INVESTIGATION FOR PARCEL D AND BACKGROUND STUDY

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RCRA FACILITY INVESTIGATION FOR PARCEL D AND BACKGROUND STUDY

WORK PLAN

SEPTEMBER 1996

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFBCA	Air Force Base Conversion Activity
Air Force	U.S. Air Force
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeters per second
CSM	conceptual site model
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	U.S. Department of Defense
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FSP	Field Sampling Plan
ft	feet
ft/day	feet per day
ft/ft	feet per foot
FWS	U.S. Fish and Wildlife Service
HSP	Health and Safety Plan
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
I-30	Interstate Highway I-30
Jacobs	Jacobs Engineering Group Inc.
JEMS	Jacobs Environmental Management System
JRB	Joint Reserve Base
MDL	method detection limit
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRHP	National Register of Historic Places
PA	Preliminary Assessment

ACRONYMS AND ABBREVIATIONS

PQL	practical quantitation limit
PR	Preliminary Review
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
Radian	Radian Corporation
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCE	trichloroethene
TDPW	Texas Department of Parks and Wildlife
TEPH	total extractable petroleum hydrocarbons
TNRCC	Texas Natural Resource Conservation Commission
USGS	U.S. Geological Survey
UTL	upper threshold limit
VOC	volatile organic compound
VSI	visual site inspection
WSA	Weapons Storage Area
°	degrees

1.0 INTRODUCTION

This Work Plan, prepared by Jacobs Engineering Group Inc. (Jacobs), provides information on proposed activities associated with a Preliminary Assessment (PA)/Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at Parcel D, a basewide background study, and a background study at the Weapons Storage Area (WSA) at Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB), Carswell Field, Texas (referred to in this plan as NAS Fort Worth). The Work Plan provides the rationale for the proposed environmental sampling program, the data needs and uses, and the overall objectives for the project. The plan is based on identifying potentially contaminated areas through previous studies, as well as literature reviews conducted as part of the Work Plan preparation. The plan was based on guidance found in the *Handbook to Support Installation Restoration Program Remedial Investigations and Feasibility Studies* (U.S. Air Force [Air Force] 1993).

This investigation is part of a larger program, known as the Installation Restoration Program (IRP), which is designed to evaluate potential hazardous waste contamination at Air Force facilities. Because of its primary mission in national defense, the Air Force has long been engaged in a wide variety of operations that involve the use, storage, and disposal of hazardous materials. In 1980, the U.S. Department of Defense (DOD) developed the IRP to investigate hazardous material disposal sites on DOD facilities. The IRP is discussed further in Section 1.1.

This Work Plan has six sections:

- Section 1.0 provides background information on the Air Force IRP and its objectives, previous work performed at NAS Fort Worth, and the objectives of the current investigation.
- Section 2.0 provides a summary of the environmental setting, the current knowledge of NAS Fort Worth, and the data needs for this project.

- Section 3.0 describes the purpose, objectives, and rationale for the field investigation approach.
- Section 4.0 presents reporting and data management requirements.
- Section 5.0 is the anticipated project schedule.
- Section 6.0 presents the references used to prepare the Work Plan.

1.1 THE AIR FORCE INSTALLATION RESTORATION PROGRAM

The objectives of the Air Force IRP are to assess past hazardous waste disposal and spill sites at Air Force installations and develop remedial action consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for those sites that pose a threat to human health and welfare or the environment. The following sections present information on the program origins, objectives, and organization.

1.1.1 Program Origins

RCRA of 1976, as amended, is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require that federal agencies comply with local and state environmental regulations and provide information to the U.S. Environmental Protection Agency (EPA) concerning past disposal practices at federal sites. Section 3012 of RCRA requires state agencies to inventory past hazardous waste disposal sites and provide information to EPA concerning those sites.

The IRP was implemented to identify potentially contaminated sites, investigate those sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP in June 1980. The NCP was issued in 1980 to provide guidance on a process by which contaminant releases could be identified and quantified and remedial actions selected. The NCP describes the responsibilities of federal and state governments and the parties responsible for contaminant releases.

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA, also known as Superfund, outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. CERCLA legislation identifies EPA as the primary policy and enforcement agency regarding contaminated sites.

Executive Order 12372, which was adopted in 1981, gave various federal agencies, including DOD, the responsibility to act as lead agencies to conduct investigations and implement remediation efforts when they are the sole contributor to contamination on or off their properties.

DOD formally revised and expanded the existing IRP directives, and amplified all previous directives and memoranda concerning the IRP, through DEQPPM 81-5, dated 11 December 1981. This memorandum was implemented by an Air Force message dated 21 January 1982.

The Superfund Amendments and Reauthorization Act (SARA), enacted in 1986, extends the requirements of CERCLA and modifies CERCLA with respect to goals for remediation and the process leading to the selection of a remedial action. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of applicable or relevant and appropriate requirements (ARARs) is required, and consideration of potential remediation alternatives is recommended at the beginning of an investigation. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

1.1.2 Program Objectives

The objectives of the IRP include the following:

- Identify and evaluate sites where contamination may be present on DOD property as a result of past hazardous waste disposal practices, spills, leaks, or other activities.
- Control the migration of hazardous contaminants.
- Control health hazards or hazards to the environment that may result from past DOD disposal operations.

The IRP was developed so that these objectives could be met in accordance with the NCP, CERCLA, and SARA. Solutions that are developed must protect public health and the environment, meet ARARs, and be technically feasible to implement at the evaluated site.

To meet these objectives, the following program tasks will be completed:

- Develop a project database through literature search, field investigation, laboratory analysis, and data evaluation.
- Develop and implement a quality assurance (QA)/quality control (QC) program to ensure meaningful and defensible data.
- Develop and follow site and laboratory safety plans to protect the health and safety of personnel and to prevent the release of contaminants.
- Identify data gaps and recommend and implement appropriate, additional or supplemental studies during the course of performing the IRP.
- Use a rigorous procedure to identify, evaluate, and select appropriate solutions.
- Conduct the IRP in compliance with applicable federal, state, and local regulations and guidances.
- Provide information regarding the nature of identified contamination, the effects of contamination on the community, the progress of the IRP, and the selected remedial alternative and its impacts on human health and the environment.

1.1.3 Program Organization

Originally, IRP studies were organized into four phases:

1. Phase I – Installation Assessment/Records Search;
2. Phase II – Confirmation/Quantification;
3. Phase III – Technology Base Development; and
4. Phase IV – Remedial Actions.

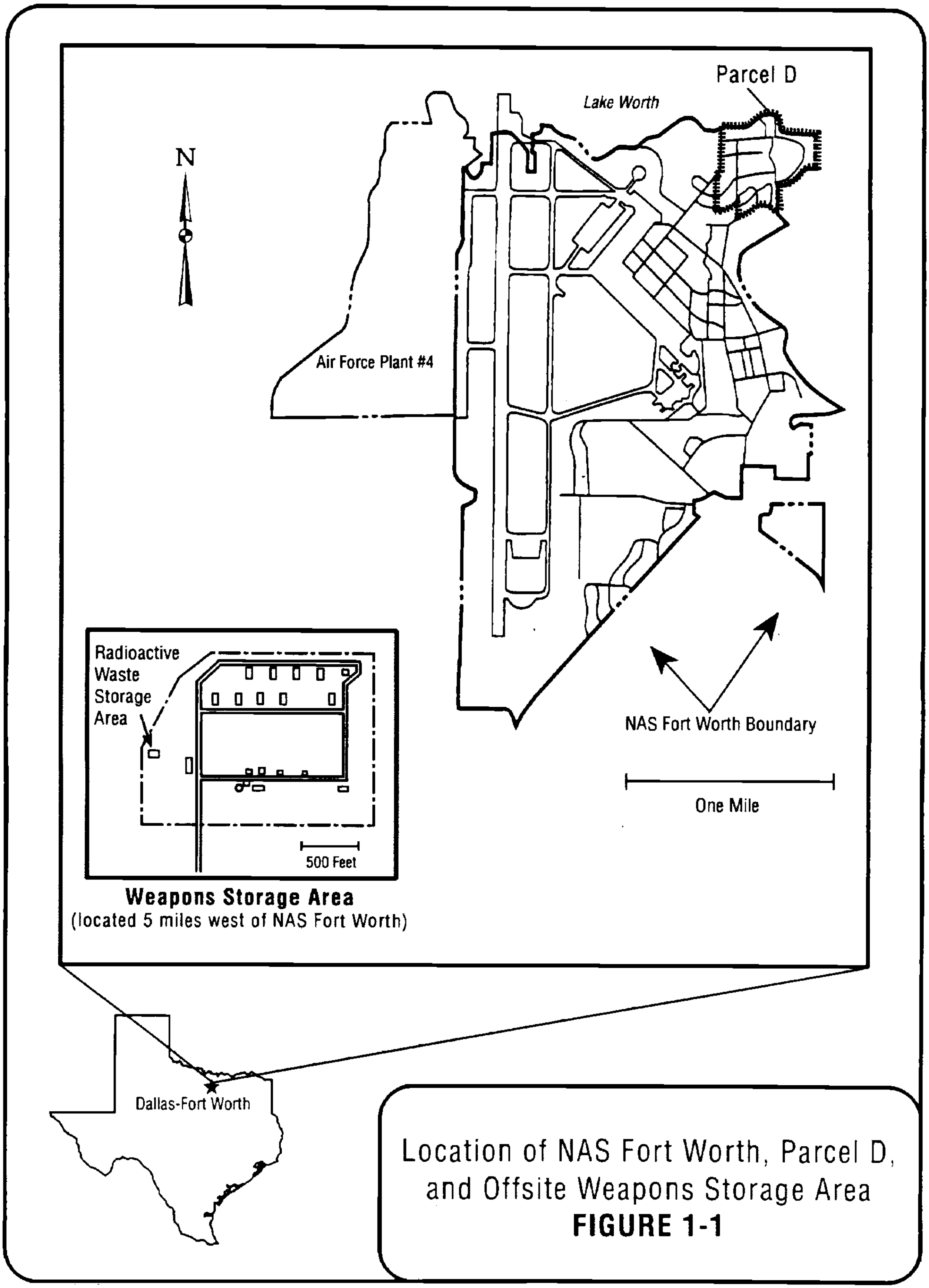
The phases of the Air Force IRP were sequential steps as compared with the steps of the Superfund remedial process, which can occur simultaneously. Although the procedures were different, the targets of the two programs were the same. In response to SARA and for the Air Force program to parallel the Superfund process, DOD directed the Air Force to implement the Superfund methodology of conducting the IRP and to abandon the phased approach.

1.2 HISTORY OF WORK AT NAS FORT WORTH

Because of the volume of IRP work conducted at NAS Fort Worth, this section will focus only on past work that was directly used to prepare this Work Plan.

1.2.1 Installation Description

NAS Fort Worth is located in north-central Texas in Tarrant County, 8 miles west of downtown Fort Worth (Figure 1-1). The area surrounding the station is mostly suburban, including the residential areas of the cities of Fort Worth, Westworth Village, and White Settlement. The main station totals 2,264 acres and is bordered on the north by Lake Worth, on the east by the Trinity River and Westworth Village, on the northeast and southeast by Fort Worth, on the west and southwest by White Settlement, and on the west by Air Force Plant 4 (Lockheed). The offsite WSA is bordered by primarily rural property, with some ranches and farms nearby.



Location of NAS Fort Worth, Parcel D, and Offsite Weapons Storage Area
FIGURE 1-1

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The existing land uses in the immediate vicinity of the station include industrial, commercial, residential, and recreational. The land uses west of the station are primarily industrial as a result of industrial complexes at Air Force Plant 4 and in White Settlement. Additional uses to the west include residential and some supporting commercial. South of the station are commercial areas at the interchange of Interstate Highway I-30 (I-30) and State Highway 183. This area includes a regional shopping mall, a discount shopping center, and a small convenience center. Both single-family and multifamily residential developments dominate the area southeast of the station and north of I-30 and the area east of the station. The area north of the station is predominantly composed of recreational and public facilities. The south shore of Lake Worth is restricted to public access because of the presence of NAS Fort Worth and Air Force Plant 4, but the lake is open for recreation. A fish hatchery, a YMCA camp, and private recreational land are along the West Fork of the Trinity River northeast of the station. The area surrounding the offsite WSA is primarily rural, although a residential development is located south of White Settlement Road.

NAS Fort Worth was originally a modest dirt runway built to service the aircraft manufacturing plant now called Air Force Plant 4. The installation was established in 1942 as was referred to as the Tarrant Field Airdrome. Its mission was to provide training for B-24 bomber pilots. The Strategic Air Command assumed control of the installation in 1946. In 1948, the base was renamed Carswell Air Force Base (AFB) in honor of Fort Worth native Major Horace S. Carswell. Carswell AFB became host base for its first B-52s and KC-135s in 1956.

Pursuant to the Base Closure and Realignment Act of 1990, Carswell AFB was selected for closure and associated property disposal during Round II Base Closure Commission deliberations. This announcement initiated the closure and disposal and reuse planning process. Drawdown activities were initiated in 1992, and all aircraft were relocated by January 1993. The base officially closed on 30 September 1993. On 01 October 1994, the U.S. Navy assumed control of Carswell AFB; the base was renamed NAS Fort Worth.

The base is under the regulatory oversight of the Texas Natural Resource Commission Conservation (TNRCC) through permit HW-50289 issued in 1991.

1.2.2 Previous Investigative Activities and Documentation

In 1984, the IRP was initiated at NAS Fort Worth with a records search by CH2M Hill, Inc. that identified 15 sites requiring further evaluation (CH2M Hill 1984).

Several other IRP studies have been conducted, including a 1989 RCRA Facility Assessment (RFA) by A.T. Kearney, Inc. (A.T. Kearney, Inc. 1989). The RFA identified three solid waste management units (SWMUs) at Parcel D (former base hospital). All three were determined to require no further action and are currently considered closed by the TNRCC. Two SWMUs were identified at the WSA: SWMU 60, the radium burial site and SWMU 65, the waste disposal site. Radian Corporation (Radian) collected soil and groundwater samples at the WSA in 1986 and in 1988 (Radian 1986, 1988). Based on these investigations, SWMU 65 was approved for no further action by the TNRCC in 1991. Additional work at SWMU 60 will include removal of the radioactive material by Metcalf and Eddy in the summer of 1996.

1.3 DESCRIPTION OF CURRENT STUDY

The following sections describe the project objectives and scoping documents to be prepared for this effort.

1.3.1 Project Objectives

The activities described in this plan will be performed to fulfill the requirements set forth in the Statement of Work for this project. Three primary tasks will be completed:

- PA/RFI for Parcel D;
- basewide background study; and
- background study at the WSA.

The PA/RFI will be conducted to assess the environmental conditions at Parcel D, and identify any areas of concern that require further investigation in the RFI. If required, the RFI will consist of field sampling activities designed to confirm whether contamination is present in the area included in Parcel D. The PA will correspond to the Preliminary Review (PR) portion of a RCRA investigation. This will enable the entire activity (PA[PR]/RFI) to follow EPA guidance (EPA 1986, 1987).

The basewide background study will be conducted to determine naturally occurring metals concentrations in soils and groundwater. Sampling will be conducted of surface and subsurface soil, groundwater, surface water, and sediment to obtain a statistically significant data set for background calculations. Only the Terrace Alluvium aquifer will be addressed as part of the groundwater background study because to date, evidence of potential contamination in the Paluxy as a result of activities related to Carswell AFB or NAS Fort Worth JRB has not been encountered

The background study at the WSA will focus on the previously detected radionuclides in groundwater. Existing wells will be sampled, and additional wells will be installed to determine whether the radionuclides are naturally occurring or the result of disposal practices at the WSA. Surface and subsurface soils will also be sampled for this effort.

1.3.2 Scoping Documents

In addition to this Work Plan, a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HSP) have been prepared as companion documents.

The SAP includes two main sections: a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP). The FSP is an attachment to the QAPP. The QAPP outlines the following quality requirements for this project:

- data quality objectives for data collection;
- analytical procedures;
- sample handling and custody procedures;
- calibration procedures;
- data reduction, validation, and reporting procedures;
- internal QC checks for field and laboratory operations;
- performance and system audits;
- procedures to assess data precision, accuracy, and completeness;
- corrective actions; and
- QA reports.

The FSP details all sample collection procedures including sampling for surface water, groundwater, surface soil, subsurface soil, and sediment. Also described are procedures for site reconnaissance, geologic mapping, borehole drilling, installation of monitoring wells, surveying, and waste handling. The FSP includes a discussion of the field QC program, record keeping procedures for field activities, and site management.

The HSP includes all procedures to be followed in the field to ensure the health and safety of all field personnel and to prevent the inadvertent release of contaminants into the environment. A description of possible contaminants of concern along with their respective health risks is included. Accident reporting procedures and medical evacuation procedures are components of the HSP.

2.0 SUMMARY OF EXISTING INFORMATION

The following sections describe the environmental setting of NAS Fort Worth and the data needs and uses for this investigation.

2.1 INSTALLATION ENVIRONMENTAL SETTING

Both NAS Fort Worth and the WSA are located in the Grand Prairie Section of the Central Lowlands Physiographic Province. The area is characterized by broad, gently to moderately sloping terraces of sedimentary rock mantled by a variable thickness of light brown to black loamy soil. The soil layer is thin to virtually nonexistent in some areas of the WSA. The Grand Prairie Section is typically grass-covered with isolated stands of upland timber.

Topography at NAS Fort Worth is generally flat except in areas along Farmers Branch, West Fork of the Trinity River, and Lake Worth. Elevations at NAS Fort Worth range from approximately 590 feet above mean sea level along the shore of Lake Worth to approximately 660 feet above mean sea level in the southwest corner of the site.

In general, topography within the fenced area of the WSA consists of a gently eastward sloping surface with elevations ranging from approximately 720 feet above mean sea level along the east fence to approximately 770 feet above mean sea level near the western fence boundary of the site. The topography is more variable outside the fenced area. The stream valleys of Live Oak Creek and a tributary are found to the north and southeast of the WSA fenced area but within the WSA property boundary.

2.1.1 Demography

Both NAS Fort Worth and the WSA are located in Tarrant County. Based on the 1990 census, the population of Tarrant County (which encompasses most of the Fort Worth metropolitan area) is approximately 1.17 million; approximately 447,600 live in the City of Fort Worth. Numerous smaller communities represent the balance of the population. The communities of White Settlement, Lake Worth Village, Westworth Village, River Oaks, and Sansom Park Village all lie within a 3-mile radius of NAS Fort Worth. Most of the land surrounding NAS Fort Worth is zoned for residential use, but also includes areas zoned for recreational, commercial, and industrial uses.

Land in the vicinity of the WSA is primarily rural and characterized by grazing and agriculture use. Currently, the area surrounding the WSA is relatively undeveloped; however, several small residential communities have recently or are currently being built in the area.

2.1.2 Geology

The following sections discuss the regional geology for NAS Fort Worth and the site-specific geology of the WSA. The regional geologic descriptions will apply to the basewide background study and the PA/RFI for Parcel D.

2.1.2.1 Regional Geology

The geology of west-central Tarrant County consists of Early Cretaceous age marine sedimentary rocks underlain by undifferentiated Paleozoic age rocks. Unconsolidated thin alluvial deposits of the Quaternary period overly bedrock along major stream and river valleys.

Sediments were deposited in the area during most of the Paleozoic era. Late in the Paleozoic era the area was uplifted, and extensive erosion during the Jurassic period produced a surface upon which early Cretaceous marine sediments were deposited as part of an oscillating shoreline. These marine sediments now exist as a southeast-thickening wedge extending into the East Texas basin. From the late Cretaceous period through the Tertiary period, the sea withdrew toward the Gulf of Mexico, and the land surface was eroded and shaped by streams. During the Quaternary period, the streams deposited alluvial sediments. The older sediments are represented by terrace deposits cut by the alluvial valleys of present streams.

Major structural features in the vicinity of Tarrant County include the Mexia-Talco fault system about 80 miles to the east, the leading edge of the Ouachita overthrust about 30 miles to the east, and the south end of the of the axis of the Fort Worth basin, located just to the east of the site.

The generalized regional stratigraphic units in the vicinity of Tarrant County are presented in Table 2-1. The units are briefly described in the following paragraphs.

TABLE 2-1

Stratigraphic Units of Interest in the Vicinity of NAS Fort Worth and the WSA

Era	System	Series	Group	Stratgraphic Units
Cenozoic	Quaternary	Holocene		Fill Material Alluvium
		Pleistocene		Fluvial Terrace Deposits
Mesozoic	Cretaceous	Comanche	Washita	Duck Creek Limestone Kiamichi Formation
			Fredericksburg	Goodland Limestone Walnut Formation
			Trinity	Paluxy Formation Glen Rose Formation Twin Mountains Formation
Paleozoic				Paleozoic Undifferentiated

The fill materials consist of clay, silt, sand, gravel, and organic material occasionally mixed with general refuse and construction debris. The alluvial deposits fill present-day stream and river valleys and consist of sand, silt, clay, and gravel. The Terrace Alluvium, consisting of gravel, sand, silt, and clay, represent older floodplain sediments and occur above and are generally cut by the present stream valleys.

The Cretaceous rocks of the Comanche Series (the Washita, Fredericksburg, and Trinity Groups) all dip gently to the east-southeast at a rate of approximately 37 feet per mile (Leggat 1957). Units of the Washita Group (the Duck Creek Limestone and Kiamichi) do not occur at the sites, but do occur to the south and east of NAS Fort Worth (McGowen and others 1988).

The Fredericksburg Group, which consists of the Goodland Limestone and the Walnut Formation, underlie most of the area and occasionally outcrop. The Goodland Limestone is composed of white, chalky, fossiliferous, dense, thinly to massively bedded limestone interbedded with gray to yellow-brown stiff clay and marl (Hargis + Associates 1989a). The formation is extensively jointed and ranges from 0 to 130 feet thick in Tarrant County. The Walnut Formation, which averages 300 feet in thickness, is a fossiliferous limestone and shell coquinite, and consists of interbedded brown sandy clay, thinly bedded fossiliferous clay, fissile clay, and iron-stained limestone (Leggat 1957).

Rocks of the Trinity Group, consisting of the Paluxy, Glen Rose, and Twin Mountains Formations, underlie NAS Fort Worth, and underlie and often outcrop at the WSA. The Paluxy Formation consists of sandstone and siltstone interbedded with sandy to silty, calcareous, waxy clay, and shale (Nordstrom 1982). The sandstone is composed of fine- to coarse-grained, well-sorted, poorly consolidated, and cross-bedded white quartz. The thickness of the Paluxy Formation in Tarrant County is approximately 140 to 190 feet (Leggat 1957). Underlying the Paluxy Formation is the Glen Rose Formation consisting of sandstone, claystone, limestone, and anhydrite. In the vicinity of the Lake Worth, the Glen Rose Formation is approximately 250 feet thick.

Underlying the Glen Rose Formation is the Twin Mountains Formation. The Twin Mountains Formation grades upward from a chert and quartz conglomerate to a fine- to coarse-grained sandstone interbedded with shale and clay, and is approximately 250 feet thick in the vicinity of Lake Worth. Undifferentiated Paleozoic deposits underlie the Twin Mountains Formation and consist of shales, sandstones, and limestones 6,000 to 7,000 feet thick.

2.1.2.2 Geology of NAS Fort Worth

The geologic units of concern at NAS Fort Worth include, in descending order, the following:

- fill materials;
- alluvium;
- terrace deposits;
- Goodland Limestone;
- Walnut Formation; and
- Paluxy Formation.

No major faults or fracture zones have been mapped near the site. The following sections describe the physical characteristics, location and thickness of each unit found at the site.

Fill. Fill material at NAS Fort Worth consists of variable mixtures of clay, silt, sand, and gravel, sometimes mixed with general refuse, chemical sludge, and construction debris. The fill occurs in landfills, waste pits, excavated areas and other areas where the land surface has been altered for construction of buildings, roads, or runways.

Alluvium. Terrace alluvial material deposited by the Trinity River underlies the fill material or is found at the surface and consists of heterogeneous interbedded clay, silt, and poorly to moderately sorted sand, gravel, and occasional cobbles. Individual beds are continuous only over very short distances. The clastic materials in these sediments consist primarily of limestone and shell fragments, while quartz sand grains are a minor constituent.

Vertically, the Terrace Alluvium can be divided into two general lithologies: (1) a shallower unit composed of varying amounts of clayey sand, sandy clay, and gravelly clay; and (2) a deeper sand or gravel unit, usually saturated, that immediately overlies the bedrock. The upper part of the shallower unit (from the surface to a depth of 2 to 4 feet) has been discolored to a dark gray from the accumulation of organic matter, and for the purposes of the background studies, will be considered as a separate soil horizon.

The fill and alluvial deposits are found in nearly all areas of NAS Fort Worth; the thickness of these deposits varies considerably around the site. The thickest accumulations correspond to erosional depressions in the bedrock. One of these erosional depressions, or paleochannels, extends northeast from the southern end of the Plant 4 Assembly Building to the Plant 4 East Parking Lot and is approximately 60 feet thick. A secondary channel appears to extend to the southeast under the flightline. A cross section presented in the *Summary of Interim Remedial Investigation* (Hargis + Associates 1989a) indicates that this channel has cut down through nearly the entire thickness of the Walnut Formation.

Coarse sand and gravel deposits occur immediately above bedrock in several areas at NAS Fort Worth. The greatest thickness of these coarse deposits is in the paleochannels where the gravels were deposited as channel lag on the scoured bedrock surface. Basal sand and gravel in the paleochannel in the Plant 4 East Parking Lot area reaches a thickness of at least 15 feet (Hargis + Associates 1989a).

Basal sand and gravel in the southeastward extension of this paleochannel under the runways at NAS Fort Worth range up to at least 35 feet thick. Sand and gravel greater than 20 feet thick also occur in an area that trends eastward approximately aligned with White Settlement Road. These deposits probably coincide with the location of a former channel of what is now Farmers Branch Creek (Radian 1990).

Goodland Limestone. The Goodland Limestone is present in the subsurface throughout Plant 4 and NAS Fort Worth, except (1) where erosion has removed it in the northwest part of Plant 4, (2) the northern portion of NAS Fort Worth, and (3) in deeply eroded meander bends cut by former courses of the West Fork of the Trinity River beneath both Plant 4 and NAS Fort Worth. The top of the formation is highly weathered in places because it was exposed for a long period before overlying alluvium was deposited. The thickness of the formation on the site is variable, depending on the amount of erosion that has occurred. The thickest Goodland Limestone encountered near the site (just west of Plant 4 at well EPA-4) is 47 feet.

The Goodland Limestone consists of chalky white, fossiliferous, dense, thinly to massively bedded limestone interbedded with gray to yellow-brown stiff clay and marl. Extensive jointing is common in weathered portions of the formation; however, core samples from the Goodland Limestone indicate that joints are rare when unweathered. No faults are known to occur in the Goodland Limestone in the vicinity of Plant 4 (Hargis + Associates 1989b).

Walnut Formation. The Walnut Formation underlies most of Plant 4 and NAS Fort Worth. Where erosional channels have not been cut into the top of the Walnut Formation, the thickness of the formation is fairly constant at between 25 and 35 feet. Except for the deep paleochannel cut into the Walnut Formation in the East Parking Lot, the top of the Walnut Formation shows few abrupt changes in elevation.

The Walnut Formation, is mainly a coquinite that contains abundant *Gryphaea marcoui* and *Exogyra texana* shell fossils (Leggat 1957). The coquinite often has a matrix of calcareous shale and clay. Interbeds of calcareous shale and clay also occur. Black, fissile shale was encountered in several boreholes from the upper part of the formation just above the coquinite. Dense sandy limestone, silty shale, and minor pyrite also occur in the lower part of the formation.

A disconformity separates the base of the Walnut Formation from the top of the Paluxy Formation. No faults are known to occur in the Walnut Formation in the vicinity of NAS Fort Worth.

Paluxy Formation. The Paluxy Formation, commonly called the Palùxy Sand, is the upper member of the Lower Cretaceous period Trinity Group. The Paluxy Formation underlies all of NAS Fort Worth and Plant 4, and its uppermost part outcrops along the Lake Worth shoreline.

The thickness of the Paluxy Formation ranges from 133 to 175 feet in the NAS Fort Worth and Plant 4 area (Hargis + Associates 1989b). The formation predominantly consists of several thick sandstone layers (cumulatively, about 120 feet thick in this area) separated by thin, discontinuous shale and claystone layers. The lower part of the Paluxy Formation is generally coarser grained than the upper part. This intercalated sandstone and shale sequence was deposited as a shifting complex of near-shore (littoral) environments on the western margin of the East Texas embayment. The top of the underlying Glen Rose Formation is defined as the first occurrence of a limestone unit.

Sandstones in the Paluxy Formation are porous, fine- to very fine-grained, and composed of moderately to well sorted, subangular to subrounded white quartz sand. The sandstones are poorly cemented (friable) to slightly indurated with sparry calcite cement (Caughey 1977). Traces of pyrite, iron oxides (limonite concretions), and glauconite occur in the sandstone, and these can be locally abundant. Thinner sandstone beds may contain pyrite nodules, traces of lignite, silicified wood, and carbonized plant fragments. Low-angle cross-bedding has been observed in core from the Paluxy Formation and in outcrop along the Lake Worth shoreline northwest of Plant 4 where horizontal fossiliferous limestone beds of the Walnut Formation truncate cross-bedded yellow-brown sandstone of the upper Paluxy Formation.

Bedding in the gray to green-gray or olive-green shales (mudrocks) and silty claystones of the Paluxy Formation may be horizontally laminated, massive, or burrowed (churned or bioturbated). The mudstones commonly contain carbonized plant fragments and thin beds of lignite.

The thicknesses of individual sandstone and shaley units in the Paluxy Formation vary across the site. In the upper part of the Paluxy Formation, differences in the individual sandy and clayey units can be subtle (i.e., silty claystone compared with very fine-grained sandstone) and facies changes occur across the site (claystone may grade into very fine-grained sandstone).

2.1.2.3 Geology of the Weapons Storage Area

The stratigraphy of the WSA consists of, in descending order, the following:

- Goodland Limestone;
- Walnut Formation;
- Paluxy Formation; and
- Glen Rose Formation.

The surficial materials at the WSA consist mostly of moderately to highly weathered outcrops of Goodland Limestone and Walnut Formation; very little, if any, fill or soil exists at the site. Alluvial materials are found only along the stream channels of Live Oak Creek and its tributary, which are located outside the boundary fence of the site.

Goodland Limestone outcrops to the west of the WSA property boundary, while weathered Walnut Formation outcrops over most of the area inside the fenced boundary of the WSA (Barnes 1972). This unit is composed of shell-agglomerate limestone with varying amounts of clay and shale. The limestone is usually fractured and contains considerable jointing and flaking. Previous investigations do not report any Terrace Alluvium at the WSA.

Underlying the Walnut Formation, reported to be approximately 45 feet thick in the area, is the Paluxy Formation. The Paluxy is exposed only along Live Oak Creek and tributary, and in a quarry south of the WSA. The Paluxy is principally composed of sand with lesser amounts of clay, sandy clay, shale, and lignite. The Paluxy may range in thickness from 140 to 190 feet (Leggett 1957).

2.1.3 Hydrogeology

The following sections describe the regional hydrogeology of NAS Fort Worth for the basewide background study and the PA/RFI at Parcel D, and the hydrogeology of the WSA.

2.1.3.1 Hydrogeology of NAS Fort Worth

The hydrogeology in the vicinity of NAS Fort Worth consists of three main units:

1. a shallow (or water table) aquifer within the fill, alluvium, and weathered Goodland Limestone;
2. an aquitard composed of competent bedrock of the Goodland Limestone and Walnut Formation; and
3. the Paluxy Aquifer, which is a source of municipal water supply for the city of White Settlement.

Discussions of each of these hydrogeologic units are presented in the following sections.

Shallow Aquifer. Shallow groundwater occurs in unconsolidated fill, alluvium, and weathered Goodland Limestone, all of which overlie competent bedrock. Lithology of the shallow groundwater system consists primarily of silt and clay material, with silty sand and gravel deposits often present in paleochannels incised into bedrock. The direction of groundwater flow is generally controlled by bedrock topography of the Goodland Formation. Groundwater flow in the shallow aquifer is generally to the east toward the West Fork of the Trinity, with some localized flow to the north toward Lake Worth, and in various directions toward Farmers Branch in the southern end of NAS Fort Worth.

The shallow groundwater system is underlain by competent Goodland Limestone and Walnut Formation. These two formations form an aquitard that restricts the flow of groundwater between the shallow aquifer and the underlying Paluxy Formation. In many areas the Goodland Limestone is located at or very near the land surface, and the shallow groundwater is essentially absent in these areas. Elsewhere, the Goodland Limestone and Walnut Formation are incised by paleochannels filled with alluvium. The Goodland Limestone is often entirely absent in these areas. Locally, for example at the Plant 4 East Parking Lot "window area," the Walnut Formation has been eroded almost completely by a paleochannel.

Groundwater recharge to the fill and alluvium is from local rainfall and infiltration from streams and drainage ditches. Extensive paved areas and buildings restrict the natural infiltration of precipitation over much of NAS Fort Worth and Plant 4. However, precipitation does infiltrate through several large grassy areas that include portions of the flightline area, the radar range, and Landfills No. 2, 3, and 4. Additional recharge also occurs as leakage from water-supply lines, fire-fighting pipe systems, cooling-water systems, sanitary sewers, and storm sewers.

Discharge from the shallow aquifer occurs primarily as seeps to Meandering Road Creek, baseflow to Farmers Branch, and discharge to the West Fork of the Trinity River. Discharge from the shallow groundwater also occurs as vertical leakage into the Paluxy Aquifer. Most of the vertical leakage occurs in the paleochannels where considerable portions of the Goodland Limestone and Walnut Formation are absent.

Slug tests completed during the Plant 4 RI PA/SI to obtain estimates of hydraulic conductivity in easterly flowing upper zone groundwater, averaged 0.5×10^{-4} centimeters per second (cm/sec). This included 13 wells, some of which were screened in the weathered portions of the Goodland Limestone (Rust Geotech 1995).

Hydraulic conductivities determined from slug tests ranged from 4.1×10^{-4} cm/sec to 7.98×10^{-3} cm/sec, while pump tests conducted in groundwater monitoring wells LF04-02 and LF04-03 averaged 2.8×10^{-1} cm/sec (Radian 1991). This value is within the typical range for clean sand and gravel deposits (U.S. Geological Survey 1989).

Goodland Limestone and Walnut Formation Aquitard. These two formations form an aquitard that restricts the vertical flow of groundwater between the shallow aquifer system and the Paluxy Aquifer. The entire section of Walnut Formation and at least a portion of the Goodland Limestone are present throughout most of NAS Fort Worth and the Plant 4 area. In the vicinity of NAS Fort Worth and Plant 4, the maximum thickness of the aquitard is approximately 30 feet, but is considerably thinner or absent in areas where paleochannels have incised into the Goodland Limestone and Walnut Formation. In highly incised areas, such as the window area, there is a potential for groundwater flow into the Paluxy Formation.

Vertical hydraulic conductivity of the competent Walnut Formation was measured on several drilling core samples collected during the Plant 4 RI PA/SI. The logarithmic mean of the measured hydraulic conductivity values is 7.0×10^{-10} cm/sec, based on a sampling of six cores. Additionally, hydrographs for paired Terrace Alluvium and Paluxy Formation monitoring wells also indicate that there is relatively little flow from the Terrace Alluvium to the Paluxy Formation (Rust Geotech 1995).

These estimates of vertical flow velocity through the Walnut Formation suggest that as long as the Walnut Formation is present, the downward flow of groundwater is very limited. The distribution of contamination in the Paluxy Formation over most of Plant 4 confirms that there is very little flow of shallow groundwater through the aquitard.

The Paluxy Aquifer. The Paluxy Aquifer is an unconfined to semiconfined sandstone aquifer that underlies the Walnut Formation aquitard. The bottom of the Paluxy Aquifer is defined as the first occurrence of limestone beneath the Paluxy Formation. Limestone is the dominant component of the Glen Rose Formation, which underlies the Paluxy Formation.

In Tarrant and Dallas Counties, the Paluxy Aquifer is widely used as a source of water for domestic, municipal, and industrial water supplies. Development of the Paluxy Aquifer began in the early 1900s, with total production in the Tarrant and Dallas County areas reaching a peak in the late 1960s (Nordstrom 1982). The decline in production since the late 1960s resulted from large declines in hydraulic head caused by heavy pumping in eastern Tarrant County and central Dallas County. The declining water levels led to the abandonment of inefficient wells (Nordstrom 1982), which were then replaced by the development of other sources, such as the Twin Mountains Aquifer. In the immediate vicinity of Plant 4, seven city of White Settlement water supply wells obtain water from the Paluxy Aquifer.

The Paluxy Aquifer has been characterized in previous site reports as a stratified aquifer consisting of three distinct flow systems separated by continuous aquitards composed of siltstone, claystone, and/or shale. However, in most instances individual shale and siltstone/claystone units cannot be correlated over large distances because of the variable distribution of the units and the uncertainty associated with the lithologic logs prepared on the basis of drill cuttings. On the basis of these observations, the Paluxy Aquifer is regarded as a single unconfined to semiconfined flow system consisting of a largely sandstone matrix with abundant layers of interbedded shale, siltstone, and claystone.

Recharge to the Paluxy Aquifer occurs largely as infiltration of precipitation falling on the outcrop in Wise, Parker, Hood, and Tarrant Counties. Recharge also occurs as infiltration from Lake Worth and Eagle Mountain Lake, both of which lie at least partially within the boundary of the outcrop. Additional minor amounts of recharge also occur as infiltration from streams that cross the outcrop. In the immediate vicinity of Plant 4, it is evident that small amounts of recharge are also derived from leakage of upper-zone groundwater through the window area (where the Walnut Formation has been severely eroded) and leakage of surface water through the lower reaches of Meandering Road Creek. In both of these areas, most if not all of the Walnut Formation has been eroded reducing the capacity of this aquitard to impede the vertically downward flow of upper-zone groundwater and surface water.

Mean hydraulic conductivity values from slug tests and pumping tests is 6.4×10^{-3} cm/sec. Using 0.00294 feet per foot (ft/ft) to 0.01 ft/ft for average hydraulic gradients and 0.27 as average effective porosity of the Paluxy, average linear velocities range from 0.20 feet per day (ft/day) to 0.68 ft/day, with a regional direction of groundwater flow to the east-southeast.

2.1.3.2 Hydrogeology of the Weapons Storage Area

The hydrogeology of the WSA consists of three primary units:

1. the Walnut Formation aquitard, consisting primarily of dry limestone with some locally perched groundwater in shallow weathered zones;
2. the Paluxy Aquifer; and
3. the Glen Rose Formation aquitard.

Walnut Formation Aquitard. The Walnut Formation Aquitard is composed of varying amounts of clay and shale layers interbedded with shell-agglomerate limestone strata. The Walnut Formation is typically dry and is not a source of groundwater in the area. However, previous investigations report groundwater at the interface between weathered and unweathered Walnut Formation. Previous investigations also report that small amounts of groundwater enter the borehole while drilling through the otherwise dry Walnut Formation, suggesting that limited amounts of groundwater may occur in the Walnut along bedding planes and fractures (Hargis + Associates

1985). The Walnut Formation is estimated to be approximately 45 feet thick in the vicinity of the WSA.

Paluxy Aquifer. The Paluxy Aquifer is the principal source of groundwater in the vicinity of the Weapons Storage Area. The Paluxy Formation consists predominantly of sands separated by thin, discontinuous shale and claystone layers. The lower part of the Paluxy Formation is generally coarser grained than the upper part. The Paluxy is believed to exist under unconfined or semiconfined conditions, depending on depth of encounter and the local stratigraphic sequence. Most of the water wells in the area are completed in the lower, coarser grained and higher permeability, section of the Paluxy Aquifer.

Most recharge to the Paluxy occurs where the formation crops out west and north of the WSA along the Clear Fork of the Trinity River and along tributaries to the West Fork and South Fork of the Trinity River. The amount of recharge via outcrops along Live Oak Creek is not known. Regional groundwater flow in the Paluxy is southeastward in the direction of the regional dip.

The Paluxy Aquifer is an important source of potable groundwater for the Fort Worth area. Many of the communities surrounding Plant 4 and NAS Fort Worth develop their municipal water supplies from the Paluxy Aquifer. Groundwater is also used by many of the surrounding farms and ranches for agricultural and livestock purposes.

Glen Rose Aquitard. Below the Paluxy are the fine-grained limestone, shale, marl, and sandstone beds of the Glen Rose Formation. Although the sands in the Glen Rose yield small amounts of water to wells in Fort Worth and western Tarrant County, the relatively impermeable limestone is an aquitard, and restricts water movement between the Paluxy Aquifer above and the Twin Mountains Aquifer below.

2.1.4 Surface Water

The primary surface-water features in the vicinity of NAS Fort Worth include Lake Worth, Farmers Branch, and the West Fork of the Trinity River. Lake Worth is located along the northern boundary of the site, Farmers Branch flows eastward near the southern end of the site discharging into the West Fork of the Trinity River, and the West Fork of the Trinity River flows southeasterly from Lake Worth and borders the site on the east. Lake Worth was created by damming the West Fork of the Trinity River. Portions of NAS Fort Worth fall within the 100-year floodplain. These areas occur along portions of the West Fork of the Trinity River, Lake Worth, Farmers Branch, and Kings Branch. Portions of the WSA also fall within the 100-year floodplain of Live Oak Creek.

The primary surface-water features in the vicinity of the WSA are Live Oak Creek, located approximately 400 feet south of the WSA boundary, and an unnamed ephemeral tributary to Live Oak Creek located immediately outside the boundary north of the WSA. Live Oak Creek flows northeast from the WSA, entering Lake Worth approximately 3 miles west of NAS Fort Worth.

2.1.5 Climatology/Meteorology

NAS Fort Worth and the WSA are located at approximately 32 degrees north latitude and 97 degrees west longitude, in north-central Texas. The climate of the sites is typified by hot summers and cool, relatively dry winters.

2.1.5.1 Precipitation

Mean annual precipitation is 31.6 inches, with the highest mean precipitation occurring in April and May (3.8 and 4.4 inches), and in September and October (3.2 and 3.6 inches). Mean monthly precipitation amounts are lowest from November through February (1.8 inches or less), and during August (1.9 inches). Most precipitation occurs as rain; snowfall accounts for appreciable amounts of precipitation only during the months of January and February.

2.1.5.2 Temperature

Historical meteorological data from NAS Fort Worth during the years 1942 through 1990 indicate the mean annual temperature is 66 degrees Fahrenheit (° F). Mean monthly temperatures range from a high of 86° F (July) to a low of 45° F (January). High and low extreme temperatures were 110 and 0° F, respectively, during the record keeping period.

2.1.5.3 Wind

During most of the year, the predominant wind direction is from the south at a speed of 6 to 8 knots. Typically, the wind blows from the north only during the months of December through February, at a speed of 7 to 8 knots.

2.1.6 Biological Resources

The following sections describe the biological resources at NAS Fort Worth, including the WSA.

2.1.6.1 Flora and Fauna

Because of the urban environmental setting, few natural terrestrial and aquatic communities exist at NAS Fort Worth. The richest ecological community in the immediate area exists in the riparian corridor along Meandering Road Creek, west of Plant 4. At NAS Fort Worth, a limited complex of terrestrial and aquatic communities exist along the shores of Lake Worth, the West Fork of the Trinity River, Kings Branch and Farmers Branch.

Aquatic species observed in the West Fork of the Trinity include catfish, sunfish, and numerous varieties of bass. Common birds observed in the area include herons, kestrels, kingfishers, seagulls, mourning doves, meadowlarks, grackles, and starlings.

A ecological study has not been completed at the WSA, however, because it is less developed than the area around NAS Fort Worth. In addition, because of the proximity to Live Oak Creek, a wide variety of species would be expected to inhabit the buffer zone. Animals expected to inhabit this area include mice, gophers, squirrels, rabbits, granivorous and insectivorous birds, lizards, snakes, skunks, and higher predators such as hawks, owls, and foxes.

2.1.6.2 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (FWS) and the Texas Department of Parks and Wildlife (TDPW) have identified 12 bird, two reptile, and one sensitive plant species that are threatened and endangered species potentially occurring in Tarrant County. The two federal-listed candidate reptile species that could also inhabit Tarrant County are the Texas horned lizard, which lives on grassy hillsides, and the Texas garter snake, which inhabits prairie seeps and wet grassy swales.

However, no state- or federal-listed threatened or endangered species are known to live on NAS Fort Worth or the WSA property. The closest sensitive habitat to the sites are the great blue heron rookeries to the north of NAS Fort Worth, across Lake Worth.

2.1.7 Cultural/Archaeological Resources

One historical structure listed in the National Register of Historic Places (NRHP) exists within the boundaries of NAS Fort Worth. No significant archaeological or prehistoric sites have been identified within the boundary of NAS Fort Worth.

Fossils are present in outcrops at both NAS Fort Worth and the WSA, but have not been identified as a significant paleontological resource.

2.2 SOURCE DESCRIPTION AND SITE-SPECIFIC ENVIRONMENTAL SETTING

The following sections provide descriptions of Parcel D and the WSA. For the basewide background study, the regional information presented in Section 2.1 will be used as the source description and environmental setting.

2.2.1 Parcel D

Parcel D covers approximately 150 acres and is located in the northeast portion of the AFB. Parcel D contains base housing and the former Robert L. Thompson Hospital that contained 140 beds and offered medical services to active and retired military personnel and their dependents (Carswell 1995). The hospital was located in the eastern portion of Parcel D. Former hospital services included general surgery, maternity, and radiology departments, and a pharmacy.

Approximately 14,000 pounds of medical waste were generated annually by the hospital and other on-base clinics. Before 1991, all medical waste was destroyed using an on-base incinerator at the hospital; the ash was then disposed of as municipal refuse. These disposal areas were identified as SWMUs (1, 2, and 3 located in Parcel D, and SWMU 4 located outside Parcel D) during the RFA conducted in 1989 (A.T. Kearney 1989). Beginning in 1991, the medical waste generated was picked up twice weekly and disposed of in an off-base permitted facility in accordance with state regulations. The SWMUs were later determined to require no further action and are currently considered closed by the TNRCC (Carswell 1995). The hospital is currently operated by the Federal Bureau of Prisons as a federal medical center complex with a minimum security work camp.

Lake Worth runs along a portion of the northern west edge of Parcel D. The shore of Lake Worth is considered sensitive habitat because of its importance to migratory birds, including state- and federal-listed species. The great blue heron rookeries are sensitive nesting areas along the northern banks of Lake Worth near the Fort Worth Nature Center. The birds are especially vulnerable to human intrusion during the nesting season. These rookeries are protected as sensitive wildlife areas by the TDPW (A.T. Kearney 1989). The West Fork, a tributary of Trinity River is located to the south of Parcel D. One stormwater discharge point (outfall 002) located within Parcel D is subject to the National Pollutant Discharge Elimination System (NPDES) permitting. The outfall is located in a small stormwater ditch that flows southwest from the hospital area, through the YMCA Camp Center, to the west fork of the Trinity River (CH2M Hill 1984).

2.2.2 Weapons Storage Area

The WSA is a 247-acre site surrounded by a 264-acre buffer zone easement. It is an off-base facility located approximately 5 miles west of NAS Fort Worth on White Settlement Road in the western portion of Tarrant County. The WSA is surrounded by mostly undeveloped land characterized by pasture land grazed by beef cattle and by oak woodlands. The WSA is located between two forks of Live Oak Creek, which flows east and north to discharge into Lake Worth. Elevations at the site range from approximately 720 feet above mean sea level along the east fence to approximately 770 feet above mean sea level near the western fence boundary of the site.

Opened in 1956, the site was historically used for munitions inspection, storage, and disposal. The facility includes two munitions inspection shops, 16 ordnance storage buildings, one entry-control building, an emergency power plant, an Explosive Ordnance Disposal range, a radioactive waste storage facility, a water storage tank, and two water wells. The radioactive waste storage facility consists of three waste burial wells, which were reportedly used for disposal of luminous instruments from dismantled or refurbished warplanes.

Contamination identified in previous investigations includes trichloroethene (TCE) in soil west of the Inspection Shop (Building 8503), and total radium in excess of the federal drinking water standards in the onsite potable water supply well.

The total radium detected in the onsite water supply well is the basis for the background study at the WSA. The background study will establish the naturally occurring concentrations of radium-226 and -228 and determine the presence of total extractable petroleum hydrocarbons (TEPH) in groundwater and soil. Details of the WSA background study are outlined in Section 3.0 of this Work Plan.

2.3 PARCEL D CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a representative drawing of the physical and chemical characteristics of an area. It incorporates physical information on the site such as geological, hydrological, hydrogeological, and surficial characteristics of the site; chemical information of potential constituents of concern; and physical, chemical, and biological characteristics such as migration pathways, affected media, potential exposure points, and receptors of concern. The CSM usually starts as a preliminary sketch and develops into a more detailed drawing as additional information of the site characteristics becomes known. Therefore, the CSM changes and evolves with time as additional information on the chemical-physical characteristics of the area is gathered.

The five elements of the CSM are as follows:

1. Identification of constituents of concern.
2. Characterization of the source of constituent concentrations.

3. Delineation of potential migration pathways considering atmospheric, geologic, and hydrologic conditions.
4. Identification and characterization of both human and ecological receptors.
5. Determination of the concentrations of constituents in environmental media at the point of exposure to receptors (Air Force 1993).

A CSM will be developed for each of the SWMUs or potential areas of concern found in Parcel D during the PA/RFI. The CSM will incorporate all available information obtained through the literature search, visual observations made during the field investigation, and analytical laboratory results. The CSMs that are developed will be used to evaluate migration pathways so that preliminary recommendations for future actions, if needed, can be made. These models are not intended to provide a detailed evaluation of risk to human health and the environmental because the data collected during the RFI are not extensive enough to be evaluated in this context, nor is it the purpose of the RFI to fully evaluate these risks. If chemical constituents have been released to the environment, the CSMs will be further developed during subsequent investigations.

2.4 REMEDIAL ACTIONS - NOT APPLICABLE

2.5 ARARS

ARARs will be determined for any chemicals of concern identified during the PA. The ARARs will be further developed using the results of laboratory analysis of samples collected during the RFI, if an RFI is required. ARARs are not required for the background studies.

2.6 DATA NEEDS AND USES

The data needs to be satisfied by the NAS Fort Worth and WSA field investigations are determined by the overall and specific objectives and purposes of the PA/RFI at Parcel D, background study at the WSA, and basewide background study. The general purpose is to provide data to allow a decision of further action to be reached at each of the sites. The broad objectives of the IRP include the following:

- Identify and evaluate sources where contamination may be present on DOD property because of past hazardous waste disposal practices, spills, leaks, or other occurrence.
- Control the migration of hazardous contaminants.
- Control the human health hazards or hazards to the environment that may result from past DOD disposal operations.

Specific objectives of the investigations have been developed through discussions between the Air Force and Jacobs. These objectives have been refined during the planning process leading to this Work Plan and the companion SAP. The objectives of the Parcel D PA/RFI, the background study at the WSA, and the basewide background study are described in the following sections.

2.6.1 Objectives of the Parcel D PA/RFI

The objectives of the PA/RFI at Parcel D are as follows:

- Determine if past hazardous waste disposal practices, spills, leaks, or other occurrences have resulted in contamination of surface soil, subsurface soil, or groundwater.
- Determine if an RFI is warranted.
- Determine if any contamination levels exceed ARARs or other criteria.
- Determine if further action is warranted.
- Recommend further action as needed.

2.6.1.1 Data Applications

The data collected during the investigation at Parcel D will be applied to the following uses:

- Determine if past uses present the potential for releases to site soil or groundwater.
- Determine the presence or absence of contamination from potential releases from the site to soil or groundwater.
- Determine concentrations of contaminants, if releases are identified.
- Identify potential pathways and targets of concem for releases.

2.6.1.2 Data Types

Data will be collected for the uses listed above. Initially, for the PA, the only data collected will be from literature searches and interviews with base personnel. If the investigation includes an RFI, data collected will include both physical parameters and chemical constituents, as well as spatial measurements of sampling locations.

If necessary, chemical constituents that will be determined vary depending on the medium being sampled and the objectives of the analyses. The samples collected will be transported to an offsite, fixed laboratory for analyses. Specific compounds and analytical methods are discussed in the QAPP. The laboratory analyses will be the principal source of information regarding the nature and extent of contamination at source areas.

Additional data that will be collected include the locations of the sampling points. Both geographic position and elevation of sampling points will be recorded. Data will also include water levels in monitoring wells, and lithologies of surface soil and subsurface soil. Field measurements will be made of various parameters in groundwater samples, including pH, specific conductance, temperature, and turbidity.

2.6.2 Objectives of Weapons Storage Area Background Study

The objectives of the WSA background study are as follows:

- Establish background concentrations of radium-226 and -228 and TEPH in groundwater immediately upgradient of the WSA.
- Establish background concentrations of radium-226 and -228 and TEPH in surface and subsurface soils surrounding the WSA.
- Determine if concentrations of radium previously detected in WSA well can be attributed to off-base human sources or to natural background sources.

2.6.2.1 Data Applications

The data collected during the WSA background investigation will be applied to the following uses:

- Determine concentrations and spatial distribution of radium-226 and -228 and TEPH in surface soil and subsurface soil in the vicinity of the radioactive waste storage site.
- Determine if shallow groundwater exists at the site.
- Determine the concentrations of radium-226 and -228 and TEPH in shallow and deep groundwater.
- Determine the degree of connection between surface soil and the vadose zone.
- Determine the degree of connection between shallow and deep groundwater.

2.6.2.2 Data Types

Data will be collected for the uses listed above. Data collected will include both physical parameters and chemical constituents, as well as spatial measurements of sampling locations.

The samples collected will be transported to an offsite, fixed laboratory for analyses. Specific compounds and analytical methods are discussed in the QAPP. The laboratory analyses will be the principal source of information regarding the nature and extent of contamination and background concentrations at the WSA.

Additional data that will be collected include the locations of the sampling points. Both geographic position and elevation of sampling points will be recorded. Data will also include water levels in monitoring wells, and lithologies of surface soil, subsurface soil, rock, and sediment. Field measurements will be made of various parameters in surface water and groundwater samples, including pH, specific conductance, temperature, and turbidity.

2.6.3 Objectives of Basewide Background Study

The objectives of the basewide background study include the following:

- Obtain samples that are representative, to the degree possible, of background concentrations. This may be difficult in the highly urban setting of NAS Fort Worth and because NAS Fort Worth is bounded on the west by Plant 4.
- Establish background levels of metals in Terrace Alluvium groundwater, surface water, sediment, and soil.

2.6.3.1 Data Applications

The data collected during the basewide background investigation will applied to the following uses:

- Determine metals concentrations in surface water, sediment, surface and subsurface soil from locations upgradient from NAS Fort Worth.
- Determine metals concentrations in shallow groundwater from locations upgradient and cross-gradient from NAS Fort Worth.

2.6.3.2 Data Types

Data will be collected for the uses listed above. Data collected will include both physical parameters and chemical constituents as well as spatial measurements of sampling locations.

The samples collected will be transported to an offsite, fixed laboratory for analyses. Specific compounds and analytical methods are discussed in the QAPP. The laboratory analyses will be the principal source of information regarding the background concentrations.

Additional data that will be collected include the locations of the sampling points. Both geographic position and elevation of sampling points will be recorded. Data will also include water levels in monitoring wells, and lithologies of surface soil, subsurface soil, rock, and sediment. Field measurements will be made of various parameters in surface-water and groundwater samples, including pH, specific conductance, temperature, and turbidity. Information on the cultural setting of each sampling location, i.e., commercial, residential, farmland, etc., will be included in the data collection.

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3.0 WORK TASKS

The following sections describe the tasks that will be conducted during the field investigation at NAS Fort Worth and the WSA. The investigation objectives for the three main tasks (a PA/RFI at Parcel D, a background study at the WSA, and a basewide background study) are presented in Section 3.1. Section 3.2 describes the investigative activities for Parcel D. Sections 3.3 and 3.4 describe specific investigations and sampling to be conducted for the background studies at the WSA and for basewide, respectively.

3.1 INVESTIGATION OBJECTIVES

Objectives for the basewide background study, the background study at the WSA, and the PA/RFI for Parcel D were presented in Section 2.6 of this Work Plan, and are discussed in more detail in the following sections.

3.2 PA/RFI FOR PARCEL D

The goal of the preliminary assessment (or preliminary review) (PR)/RFI at Parcel D is to determine any past or present releases to the environment from SWMUs or potential areas of concern (EPA 1987). The goal will be accomplished by conducting (1) a preliminary review of pertinent state and federal records, (2) a site visit, and (3) sampling during the course of an RFI, if this step is determined to be necessary. The following paragraphs describe the past RFA conducted at Carswell in 1989, which includes Parcel D, and the tasks to be conducted during this project as part of the PA/RFI at Parcel D.

Previous RCRA Investigations. A preliminary review and visual site inspection (VSI) was conducted at Carswell AFB in 1989. The following information was taken from the RFA report (A.T. Kearney 1989). The principal sources of information used in conducting the PR included the facility's IRP reports and its correspondence with the EPA, as well as internal Air Force correspondence. These documents were obtained during a search of relevant files at the EPA Region VI office in Dallas and at the office of the Texas Bureau of Solid Waste Management in Austin. This search included relevant files from RCRA, CERCLA, NPDES, and Air Quality Division. The VSI for Carswell was conducted on 13 through 16 February 1989. As a result of the PR/VSI, the following three SWMUs located in Parcel D were identified in the RFA Report (A.T. Kearney 1989):

- SWMU No. 1 - Pathological Waste Incinerator;
- SWMU No. 2 - Pathological Waste Storage Shed; and
- SWMU No. 3 - Metal Cans.

SWMU No. 1 – Pathological Waste Incinerator. The incinerator was operated from 1985 to 1993 and managed pathological solid waste such as syringes, clothing, linens, and surgical masks. The incinerator burned approximately 350 pounds of solid waste per week. There is no history of a documented release associated with this unit. The construction of the unit appeared adequate to prevent inadvertent releases. The unit appeared to be well managed, with no visible signs of release observed during the VSI.

The potential for releases to soil/groundwater, surface water, and subsurface gas was determined to be low. The potential release to air was rated as moderate because the unit was designed to release to the atmosphere; however, it was required to be in compliance with the Rules and Regulations of the Texas Air Control Board.

SWMU No. 2 – Pathological Waste Storage Shed. The unit was operated from 1985 to 1993. It was used to store plastic bags containing pathological waste (such as syringes, clothing, linens, and surgical masks) generated from hospital activities before incineration. The shed was a four-sided, roofed, wooden structure located next to the waste incinerator. The floor of the shed was wood and was situated on a concrete pad approximately 10 feet long by 8 feet wide. The shed was approximately

7 feet high. Waste was stored in the shed for a maximum of 48 hours before incineration. There is no history of documented releases associated with this unit. The unit appeared to be well managed, with no visible signs of release observed during the VSI. The potential for releases to soil/groundwater, surface water, air, and subsurface gas was determined to be low.

SWMU No. 3 – Metal Cans. Three metal cans were used to store the ash and other debris such as small vials and bottles removed form the waste incinerator before disposal in a facility dumpster (SWMU No. 4, located outside Parcel D). The capacity of each metal can was approximately 35 gallons. The unit was operated from 1985 to 1993. There is no history of a documented release associated with this unit. There was no evidence of release during the VSI. The potential for releases to soil was found to be moderate because one of the cans rested directly on the ground; however, the condition of the can appeared adequate to prevent a release of waste to the soil. The potential for releases to groundwater, surface water, air, and subsurface gas was determined to be low.

All three SWMUs were determined to require no further action and are currently considered closed by the TNRCC (Carswell 1995).

3.2.1 Investigation Approach

A PA (PR) and site visit will be conducted as the initial tasks, and RFI will be conducted, if necessary, based on the results of the PA (PR) and site visit. These tasks are explained in the following sections.

3.2.2 Preliminary Assessment

The PA (PR) will consist of a file review at EPA, the state, and the AFB, and interviews with former and current base personnel to identify potential SWMUs or potential areas of concern within Parcel D. The PA (PR) will be conducted in accordance with EPA guidance document No. 530-86-053 (EPA 1986). As part of the PA (PR), records that verify the closure of SWMUs 1, 2, and 3, will be documented and copied. The results of the records review and interviews will be documented in an PA (PR) report. A draft report will be submitted for review. Comments on the draft will be addressed and a final report that incorporates the comments will be submitted. The records search is discussed further under Section 3.5, Literature Review.

Site Visit. In addition to the PA (PR), a one-day site visit will be conducted to verify the results of the record search and to gather information needed to develop a sampling plan, if necessary. During the site visit, any existing SWMUs and potential areas of concern will be visually evaluated for potential releases to the environment. In addition, closure of SWMUs 1, 2, and 3 will be physically verified. The site visit task will be included under the health and safety plan for the background studies. No sampling will be conducted during the site visit. Photographs will be taken of each SWMU or potential area of concern. The following information will be evaluated and summarized in the PA (PR) report:

- unit description;
- dates of operation;
- wastes managed;
- release controls;
- history of releases;
- release potential into the following:
  - soil/groundwater;
  - surface water;
  - air; and
  - subsurface gas.

The findings of the PA (PR) and recommendations for further action will be made in the PA (PR) report. The report will recommend one of the following courses of action:

- No further action is required because no evidence of release or suspected release was identified.
- An RFI is required because a release or suspected release was identified.
- An interim corrective measure is required because an expedited action should be taken to protect human health of the environment.
- Problems associated with permitted releases were identified and referred to the appropriate permitting authorities.

3.2.3 RCRA Facility Inspection

If the results of the PA (PR) indicate the potential for releases, an RFI work plan will be prepared for inclusion in the PA (PR) report and an RFI will be conducted to sample potential releases determined in the PA (PR) report. Sampling of surface soil, subsurface soil, and groundwater will be conducted. It is assumed that no surface water, soil gas, or sediment samples will be required. The subsurface soil and groundwater will be collected using GeoProbes or equivalent direct-push technology. Monitoring wells will be installed for sampling to confirm the results of direct-push sampling. A maximum of 18 samples (six samples of each medium) will be collected in addition to QC field samples. Samples will be analyzed for modified Appendix IX constituents as described in the FSP in accordance with the Part B permit. Any boreholes advanced during GeoProbe sampling will be surveyed by a licensed Texas land surveyor.

It is anticipated that soil cuttings and liquid decontamination wastes will be generated and drummed and stored for disposition by the Base Conversion Activity. The RFI will be conducted in accordance with EPA guidance document No. 530/SW87-001 (EPA 1987). The results of the RFI will be documented in a report. A draft report will be submitted to the Air Force and regulatory agencies for review. Comments on the draft will be addressed and a final report that incorporates the comments will be submitted.

3.3 BACKGROUND STUDY AT WEAPONS STORAGE AREA

The following sections describe the field investigation approach and field activities to be conducted during the background study at the WSA.

3.3.1 Field Investigation Approach

The investigation at the WSA is to determine if the concentrations of total radium detected in the onsite well are attributable to the radioactive waste storage site or are naturally occurring background concentrations. Section 3.7 describes the statistical approach to establishing background concentrations.

3.3.2 Data Collection and Analysis

The investigation at the WSA will include conducting a presurvey and a presampling site visit, and collecting 10 surface-soil samples, 20 subsurface-soil samples, and 17 groundwater samples. The following sections describe these tasks in greater detail.

3.3.2.1 Presurvey

The presurvey will be conducted immediately following delivery order award. The purpose of the presurvey will be to (1) collect documents from the Air Force Base Conversion Activity (AFBCA) office that will be used to prepare the planning documents, (2) visit the offsite WSA, and (3) identify potential sampling locations to be included in the planning documents. Any special arrangements for access to the WSA will also be reviewed at this time.

3.3.2.2 Presampling Site Visit

To save time during the field operation, it will be necessary to visit all locations where sampling will take place during the fieldwork, and to address any access limitations or other situations that may delay fieldwork. Activities to be conducted during this visit include staking sampling locations, coordinating with the surveyor, determining utility locations and obtaining clearances, preparing drilling permits, and possibly conducting a site walk with potential drilling subcontractors. It is assumed that this visit will occur after comments are received on the planning documents and before the final plans are prepared.

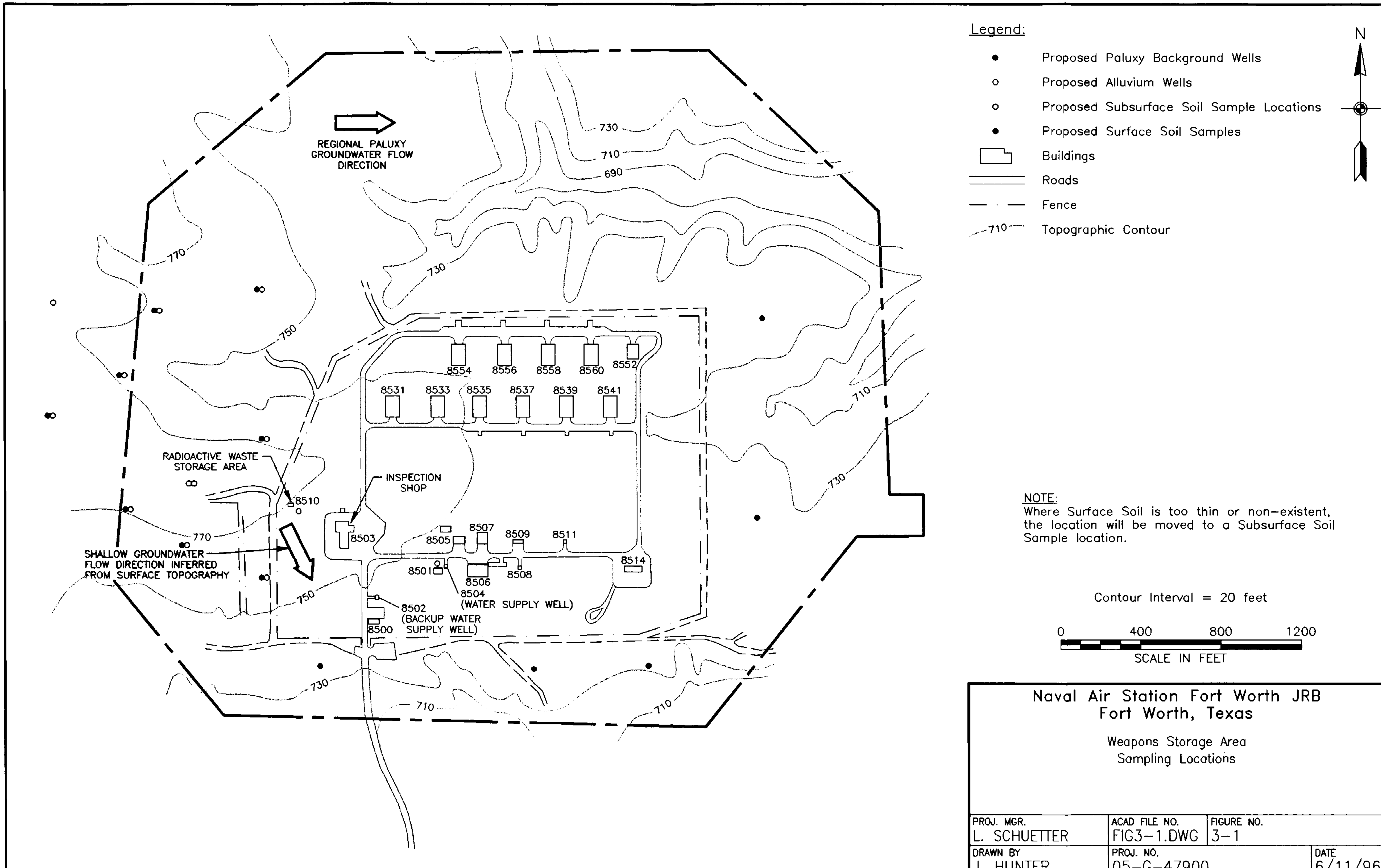
3.3.2.3 Surface Soil Sampling

The purpose of collecting surface-soil samples is to establish windblown or fall-out constituent background concentrations. Approximately 10 surface-soil samples will be collected from 0 to 2 feet below ground surface (bgs) during the WSA background investigation; in addition, QC field samples will also be collected. If possible, the samples will be collected from the buffer zone surrounding the WSA. The surface-soil samples will also be co-located with the subsurface-soil samples, if possible. Surface-soil samples may need to be located primarily to the west of the WSA because surface soil appears thin to absent in the eastern portion of the WSA. The proposed locations shown in Figure 3-1 will be evaluated in the field during the presampling site visit. Each location will be inspected for consistency of soil type, available amount of surface soil for sampling, and evidence of potential artificial soil disturbance such as grading or contamination. Any changes made to the proposed sampling locations will be coordinated with AFCEE and TNRCC. All samples will be collected in accordance with the September 1993 Handbook (Air Force 1993) and as described in the SAP. The samples will be analyzed for radium-226, radium-228, and TEPH by Method E418.1.

Sample locations will be staked and hand plotted on a map. Location information will be estimated from the map for entry into the Installation Restoration Program Information Management System (IRPIMS) database.

3.3.2.4 Subsurface-Soil Sampling

The purpose of collecting subsurface soil samples is to detect any contaminants that have leached from the surface into the vadose zone via infiltration. Approximately 20 subsurface-soil samples will be collected in addition to QC field samples. Ten of the samples will be co-located with the surface-soil samples, while another 10 samples will be collected from soil boreholes completed for monitoring well construction. It is anticipated that the subsurface-soil samples will be collected at depths of 4 to 10 feet, though the exact locations and depths will be determined during the presampling site visit and in the field. The proposed locations illustrated in Figure 3-1 will be evaluated in the field during the presampling site visit. Each location will be examined for consistency in soil types of clayey sand/sandy clay with varying amounts of fine to medium gravel, potential utility conflicts, vehicle access, signs of soil disturbance, obvious contamination, and stressed vegetation. If significant changes are made to the proposed sampling locations, AFCEE and the TNRCC will be consulted. The general interval of 4 to 10 feet bgs was chosen to intersect the soil type of clayey sand/sandy clay with varying amounts of fine to medium gravel that has been observed on the base at this interval. This soil horizon may not always be encountered at these depths or at all at some locations. The onsite geologist will determine if the target soil type is present at a location or sampling depth. If the target soil is not present, then an alternate location will be sampled. GeoProbe or other direct-push methods will be used to complete the soil boreholes and to collect the samples for laboratory analysis. All samples will be collected in accordance with the 1993 Handbook (Air Force 1993) and as described in the SAP. Samples will be analyzed for radium-226, radium-228, and TEPH.



Naval Air Station Fort Worth JRB
Fort Worth, Texas

Weapons Storage Area
Sampling Locations

PROJ. MGR.	ACAD FILE NO.	FIGURE NO.	
L. SCHUETTER	FIG3-1.DWG	3-1	
DRAWN BY	PROJ. NO.		DATE
J. HUNTER	05-G-47900		6/11/96

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All sample locations will be surveyed by a licensed Texas land surveyor to obtain state plane coordinates and elevations of sampling locations for entry into the IRPIMS database.

3.3.2.5 Groundwater Sampling

Two deep and three shallow monitoring wells will be installed at the WSA. A private water supply well located approximately 1,400 feet west (cross-gradient) of the radioactive waste storage area will also be sampled as a background well. Approximately 17 unfiltered groundwater samples and two field duplicates will be collected. The two deep monitoring wells will be installed in upgradient locations within the buffer zone. The monitoring wells will establish background concentrations of radium-226 and -228. The wells will be completed in the deep Paluxy Aquifer at the same depth as the existing onsite wells (approximately 220 feet below ground surface), and will be screened at the same intervals.

The three shallow monitoring wells will be installed within the fenced area of the WSA. One well will be installed upgradient of the radioactive waste storage site to evaluate background conditions. One well will be installed downgradient from the radioactive waste storage site at a depth approximately equal to the depth of the storage casings. The remaining well will be installed immediately upgradient of the primary water supply well. Because significant shallow groundwater is not anticipated at the WSA, it is likely that it will be necessary to drill five borings to construct three wells. In previous studies, shallow groundwater was identified at a depth of 5 feet below ground surface (Radian 1986).

After the monitoring wells are installed, they will be developed, and groundwater sampling will be conducted in accordance with the 1993 Handbook (Air Force 1993) and the methods described in the SAP. The three shallow monitoring wells will be sampled soon after completion. The three deep monitoring wells will be sampled four times each over a two- to three-month period. The exact time interval between samples will be determined based on the average linear velocity of the groundwater, reported in published data. The two existing water supply wells will also be sampled following removal of the submersible pumps.

Purge and development water will be disposed of as outlined in the SAP. All new sample locations will be surveyed by a licensed surveyor so that location information can be entered into the IRPIMS database.

3.4 BASEWIDE BACKGROUND STUDY

The following sections describe the field investigation approach and field activities to be performed during the basewide background study.

3.4.1 Field Investigation Approach

The basewide background study will be conducted to determine whether the contamination found at NAS Fort Worth can be attributed to offsite sources. To accomplish this objective, Jacobs proposes establishing background concentrations for surface soil, subsurface soil, surface water, sediment, and groundwater. Section 3.7 describes the statistical approach to establishing background concentrations.

3.4.2 Data Collection and Analysis

The basewide background investigation will include conducting a presurvey and a presampling site visit, and collecting 30 surface-soil samples, 30 subsurface-soil samples, 12 groundwater samples, seven surface water samples, and seven sediment samples. The following sections describe these tasks in greater detail.

3.4.2.1 Presurvey

The presurvey will be conducted immediately following delivery order award. The purpose of the presurvey will be to collect documents from the AFBCA office that will be used to prepare the planning documents, and to identify potential sampling locations to be included in the planning documents. Any special arrangements for access to areas planned for sampling will also be reviewed at this time.

3.4.2.2 Presampling Site Visit

To save time during the field operation, it will be necessary to visit all locations where sampling will take place during the fieldwork, and to address any access limitations or other situations that may delay fieldwork. Activities to be conducted during this visit include staking sampling locations, coordinating with the surveyor, determining utility locations and obtaining clearances, preparing drilling permits, determining if the clayey sand/sandy clay soil horizon may be present for sampling, and possibly conducting a site walk with potential drilling subcontractors. It is assumed that this visit will occur after comments are received on the planning documents and before the final plans are prepared.

3.4.2.3 Surface-Soil Sampling

Approximately 30 surface-soil samples and three field duplicates will be collected during the basewide background investigation to establish surface-soil background concentrations from areas near the boundaries of NAS Fort Worth. The exact location of surface-soil samples will be determined during the presampling site visit, and during the field investigation. The proposed locations shown on Plate 1 will be evaluated in the field during the presampling site visit. To minimize the potential for contamination by wind-borne contaminants such as lead-paint chips, surface-soil samples will not be collected (1) within 100 feet of large structures such as buildings and houses or (2) with 50 feet of smaller painted features such as fire hydrants and painted curbs. Each location will be inspected for consistency of soil type, available amount of surface soil for sampling, and evidence of potential artificial soil disturbance such as grading or contamination. Any significant changes made to the proposed sampling locations will be coordinated with AFCEE and TNRCC. Surface-soil samples will be co-located with subsurface-soil samples whenever possible and will be collected in accordance with the 1993 Handbook (Air Force 1993) and as described in the SAP. The samples will be analyzed for metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) as described in the FSP.

Sample locations will be staked and hand plotted on a map. Location information will be estimated from the map for entry into the IRPIMS database.

3.4.2.4 Subsurface-Soil Sampling

Subsurface-soil sampling will establish background concentrations for the clayey sand/sandy clay that has been observed as the dominant, unsaturated subsurface soil type at NAS Fort Worth. Approximately 30 subsurface-soil samples and three field duplicates will be collected, and will be co-located with surface-soil samples whenever possible. It is anticipated that shallow bedrock or the proximity to surface structures may preclude co-locating samples in some cases.

The proposed locations illustrated on Plate 1 will be evaluated in the field during the presampling site visit and examined for consistency in soil types, potential utility conflicts, vehicle access, signs of soil disturbance, obvious contamination, and stressed vegetation. If significant changes are made to proposed sampling locations, AFCEE and the TNRCC will be consulted. Soil borings will be completed and soil samples will be collected using GeoProbe or other direct-push technology. All samples will be collected in accordance with the 1993 Handbook (Air Force 1993) and as described in the SAP. The samples will be analyzed for metals, VOCs, and SVOCs as described in the FSP.

Sample locations will be staked and hand plotted on a map. Location information will be estimated from the map for entry into the IRPIMS database.

3.4.2.5 Groundwater Sampling

To establish background concentrations in the shallow alluvium, 12 groundwater samples will be collected; in addition, QC field samples will also be collected. Existing wells will be used as much as possible for these samples, but up to four additional Terrace Alluvium wells will be installed to fill data gaps on the south side of the base. The wells sampled will be from locations upgradient and crossgradient of NAS Fort Worth. The proposed new well locations are shown on Plate 2. These wells are located to collect water samples from the groundwater migrating onto the base from the south in the vicinity of the Carswell Golf Course and southern single family residences. Unfiltered samples will be collected and analyzed for metals, VOCs, and SVOCs as described in the FSP. A filtered sample will be collected and analyzed for metals only.

Any new wells will be developed and groundwater sampling will be conducted in accordance with the 1993 Handbook (Air Force 1993), and as described in the SAP. Purge and development water will be disposed of as outlined in the SAP. Any new well locations will be surveyed by a licensed surveyor so that location information can be entered into the IRPIMS database.

Analytical results from the October 1996 quarterly sampling round for Air Force Plant 4, as well as any other data collected at approximately the same time by other contractors, will be used to supplement the data collected for the background project. Any previously collected data used for the background study will meet the following criteria:

- The purging techniques are identical.
- The analysis is identical. The entire analyte suite does not need to be identical, but individual tests for constituents must be.
- Sampling methodology is similar.
- QA/QC protocols are similar.

3.4.2.6 Surface-Water and Sediment Sampling

Surface-water and sediment samples will be collected from selected locations along Farmers Branch or Kings Branch to determine background concentrations of metals upstream from NAS Fort Worth. It is anticipated that approximately eight samples of each medium will be collected. The exact location and number of surface-water and sediment samples to be collected will be determined during the presampling site visit and in the field. Each location will be selected based on the available sediment for sampling, accessibility, and the spatial proximity to other sampling locations. Each location shall be a minimum of 1,000 feet apart. The surface-water and sediment samples will be collected primarily as co-located samples; however, specific conditions at a sample location may require separate sample locations.

All sampling will be conducted in accordance with the 1993 Handbook (Air Force 1993), and as described in the SAP. Sample locations will be staked and hand plotted on a map. Location information will be estimated from the map for entry into the IRPIMS database.

3.5 LITERATURE SEARCH

Literature searches will be conducted as part of the presurvey for the background studies, and as part of the PA. The following sections describe the activities associated with these literature searches.

3.5.1 Weapons Storage Area and Basewide

The literature search is conducted to identify and evaluate existing information pertaining to the WSA and the basewide background study. Information obtained through the search is used to identify potential contamination caused by past waste disposal practices and to identify potential migration pathways. The following resources have been identified for the literature search:

- previous environmental investigation reports;
- contractor reports;
- aerial photographs;
- facility drawings and figures;
- U.S. Geological Survey (USGS) reports; and
- soil borehole logs.

Documents obtained from the literature search are compiled and maintained in the document control file at the Jacobs Denver office.

3.5.2 Parcel D

The literature search will be conducted during the PA (PR). The goals of the PR are to (1) gather and evaluate existing information of Parcel D to identify and characterize potential releases (for SWMUs and potential areas of concern) and (2) focus activities to be conducted during the site visit and potentially an RFI, if needed. During the PR, existing documents and state and federal records will be evaluated and interviews will be conducted with appropriate base personnel. Source of documents and information to be reviewed will be based on the RCRA guidance for conducting an RFA (EPA 1986).

Information collected during the PR will be evaluated to determine (1) waste generation processes at Parcel D, (2) SWMUs and other potential release of concern, and (3) the release potential of the SWMUs or potential areas of concern. The findings of the PR will be reported as described in Section 3.3.

3.6 RECORD KEEPING

All field personnel will be responsible for keeping accurate records of each field task performed. Field records will contain sufficient detail to relocate all sampling locations and measurement activities and to meet the IRPIMS data requirements. The field coordinator will be responsible for ensuring that all pertinent paperwork is filled out before each field task and sampling event is completed. Field books will be permanently bound with sequentially numbered pages. Copies of field documentation will be kept in the document control file for Air Force projects located in the Jacobs Denver office. Field documentation will be attached to the technical reports (Section 4.0). For all field activities, the following information will be included in field logbooks:

- location;
- date and time;
- identity of field personnel;
- field equipment and calibration information;
- sample type and collection method;
- sample preservation;
- detailed sample location and sample depths ;
- sample volume;
- chain-of-custody and sample numbers;
- QA/QC samples; and
- conditions that could affect sample integrity or representativeness.

Documentation of sampling activities will also be recorded in the field, in tabular form, and/or on personal computers, as data become available. This information will be used to monitor field activity progress and analytical laboratory sample tracking.

3.7 DERIVATION OF BACKGROUND CONCENTRATIONS

The analytical data sets for background samples from surficial and subsurface soils, groundwater, and Farmers Branch surface water and sediments will be used to estimate statistically significant background concentrations for each environmental medium. This statistical analysis will be conducted by subjecting the data set for a given analyte in a specified environmental medium to the following steps as outlined in the EPA guidance (EPA 1989, 1992):

1. Determine the population distribution of the data set as normal, lognormal, or other by generating probability plots and calculating the Shapiro-Wilk test statistic (W) using the following formulae:

   $$W = \left[\frac{b}{s\sqrt{n-1}} \right]^2$$

   where:

   $$b = \sum_{i=1}^{k} a_{n-i+1}\left(x_{(n-i+1)} - x_{(i)}\right) = \sum_{i=1}^{k} b_i$$

   x_i is the ith smallest ordered value;

   a_i is a coefficient dependent on the sample size (n);

   s is the standard deviation;

   n is the number of samples; and

   k is the greatest integer less than or equal to $\frac{n}{2}$

   The calculated test statistic (W) is compared to a critical value ($W_{crit.}$) which is a function of the sample size and the acceptable Type I (false positive) error rate (α) which has been set at 5 percent (i.e. an acceptable rate of five percent of having a false positive measurement). If W is less than W_{crit}, there is significant evidence of the non-normality of the distribution of the population.

2. Those data sets that are normally or lognormally distributed will be subjected to parametric statistical analyses. The mean $(\bar{x})$ and standard deviation (s) of the raw or log transformed data will be calculated and a 95 percent coverage, 95 percent confidence upper tolerance limit (UTL) will be calculated:

$$UTL_{95/95} = \bar{x} + \kappa_{(n-1,1-\alpha)} s_x$$

or, for lognormally distributed data ($y_i = \ln x_i$):

$$UTL_{95/95} = \exp\left(\bar{y} + \kappa_{(n-1,1-\alpha)} s_y\right)$$

where κ is the tolerance factor for a one-sided normal (or lognormal) tolerance interval with an average of 95 percent coverage and a 95 percent probability and n background observations. By definition, this calculation specifies one has a 95 percent confidence that only 5 percent of the time (one in 20) will the $UTL_{95/95}$ concentration be exceeded by analyses of groundwater samples from wells that have not been affected by contamination.

3. For those constituents that are not parametrically distributed, the UTL_{95}, i.e. 95 percent coverage, is taken as the maximum concentration measured. The confidence is calculated based on the number of background measurements (n) and the number of comparisons (k) that will be made to the UTL:

$$(1-\alpha) = \frac{n}{(n+k)}$$

For example, if one has 15 background analyses (n) and four downgradient analyses (k), the confidence that the maximum value measured in the background wells will only be exceeded by a noncontaminated, downgradient well one in 20 times is 79 percent:

$$(1-\alpha) = \frac{15}{(15+4)} = 0.789$$

A common problem with environmental media data sets is the presence of large numbers of constituents that are present in concentrations below the practical quantitation limits (PQL) or method detection limits (MDL) for the various analytical methods. The way that the "nondetects" are handled within the individual data sets is a function of their frequency. The EPA guidance (EPA 1989) recommends that when the number of nondetects are fewer than 15 percent, one substitutes one-half of the PQL and conducts the same series of statistical tests. For data sets with between 15 and 50 percent nondetects, one can use either Cohen's or Aitchison's adjustment to generate values for the data set nondetect concentrations. The difference between these two methods is that Cohen's adjustment is based on the assumption that all of the data, measured concentrations and nondetections, are from the same population distribution, i.e., normal or lognormal. Aitchison's adjustment assumes that the nondetectable concentrations are either zero or follow different probability distributions. Both of the adjustment methods require a single PQL or MDL for all analyses in the data set. Gibbons (1994) recommends the use of Cohen's adjustment and this will be the preferred method unless there is a compelling reason to use Aitchison's method. The decision on which adjustment to use will be based on the shape of the probability plot curve. Cohen's adjustment is calculated in the following manner (EPA 1989):

1. Calculate the mean of the measured concentrations (m) (detections):

$$\bar{x}_d = \frac{1}{m}\sum_{i=1}^{m} x_i$$

2. Calculate the variance of the measured concentrations:

$$s_d^2 = \frac{\sum_{i=1}^{m}(x_i - \bar{x}_d)^2}{(m-1)}$$

3. Calculate two parameters, h and γ:

$$h = \frac{(n-m)}{n} \; and \; \gamma = \frac{s_d^2}{(\bar{x}_d - DL)^2}$$

n = total number of samples
DL = detection limit

4. From a table use h and γ to determine $\hat{\lambda}$.

5. Use $\hat{\lambda}$ and the DL to calculate the mean:

$$\bar{x} = \bar{x}_d - \hat{\lambda}(\bar{x}_d - DL)$$

6. And standard deviation:

$$s = (s_d^2 + \hat{\lambda}(\bar{x}_d - DL)^2)^{\frac{1}{2}}$$

7. Use the adjusted mean and standard deviation to calculate an upper tolerance limit.

For data sets with greater than 50 percent nondetects, the nonparametric method described above is used.

The report associated with this investigation will contain a series of tables containing the $UTL_{95/95}$ for the various environmental media and their supporting statistical parameters. These data can then be used for statistical comparisons with downgradient data sets for the determination of the presence or absence of base-added contamination. All of the data and calculations will be compiled in appendices that will accompany the report.

4.0 REPORTING REQUIREMENTS

Reports will be prepared for all aspects of the work to be performed for this project. The following sections describe the data management requirements, technical reports, and miscellaneous letter reports.

4.1 DATA MANAGEMENT

Jacobs will enter all information from the field effort into the Jacobs Environmental Management System (JEMS). This database will allow preparation of IRPIMS data submittals to the Air Force as specified in the Statement of Work. All data will be entered as soon as possible after collection or after analytical results are received and validated. Data entries will be checked for accuracy and completeness before the IRPIMS submittal is prepared.

The JEMS data management system will also allow for data manipulation as well as interpretation. The data interpretation programs will generate summary tables, borehole logs, cross sections, contour maps, etc., as required, to assist in the preparation of the technical reports.

4.2 TECHNICAL REPORTS

Several technical reports will be prepared as part of this project. The first report to be prepared will be the PA report. This report will summarize the results of the PA for Parcel D, and will make recommendations for further investigation as part of the RFI, or for no further action. The PA report will include a sampling plan if an RFI is required. The HSP for this project will be updated as necessary to include field activities for the RFI.

Technical reports will also be prepared for the basewide background study and the background study at the WSA. These reports will include a description of all project activities, including field activities, waste management, field QA/QC, laboratory analysis, data evaluation, and statistical analysis of background concentrations.

If an RFI is required, an RFI report will be prepared after the fieldwork is completed. This report will include a description of all field activities, analytical results, data evaluation, CSMs, and hazard ranking scoring for any areas of concern identified, and recommendations for further action or closure.

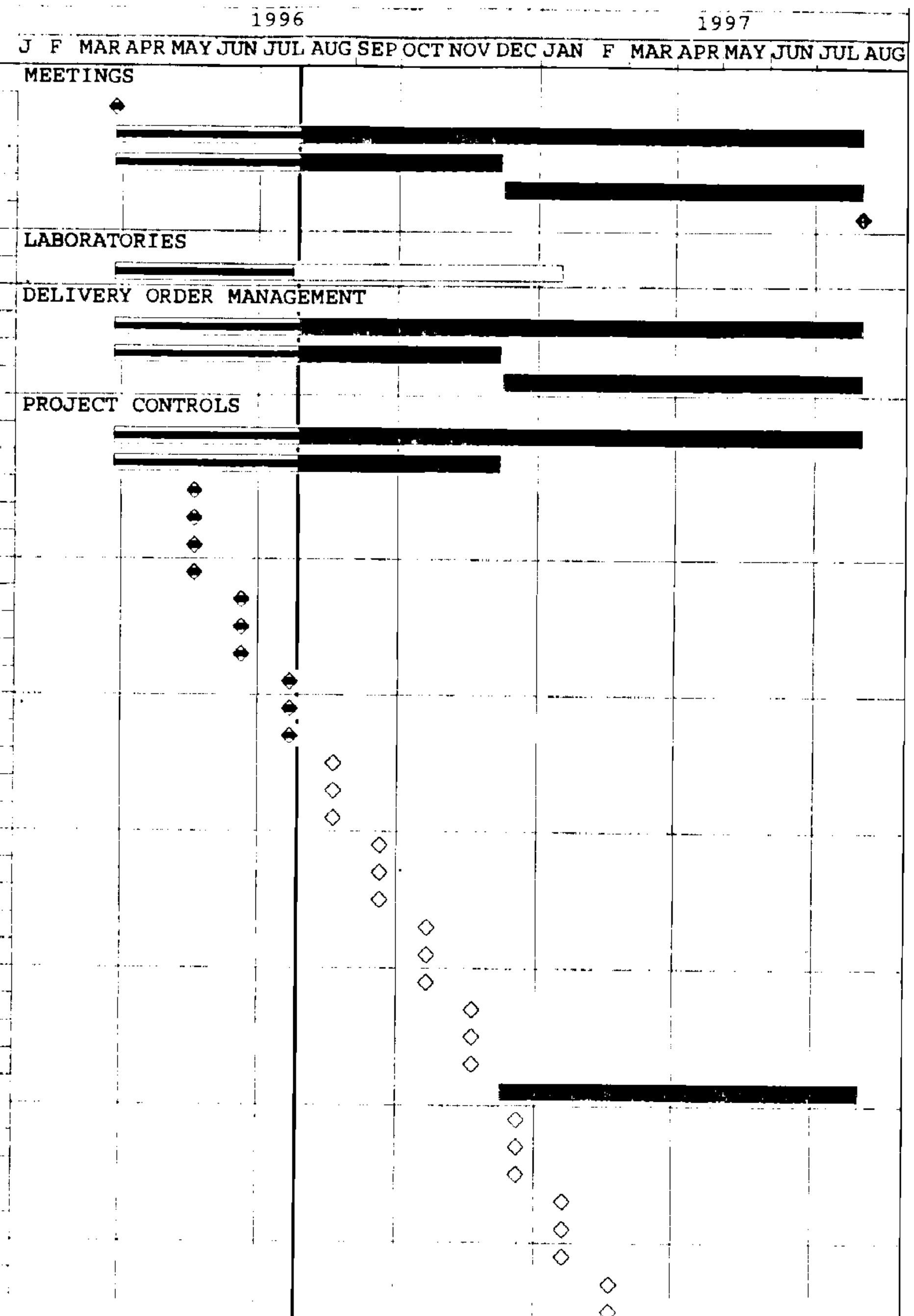
4.3 MISCELLANEOUS LETTER REPORTS

Miscellaneous letter reports will be submitted to the Air Force as requested.

5.0 PROJECT SCHEDULE

Figure 5-1 is the project schedule.

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
500-00	Project Start	27MAR96A		0
500-01	MEETINGS, PRESENTATION MATLS, MINUTES	27MAR96A	31JUL97	344
500-01A	Meetings, Presentation Matls, Minutes-Year 3	27MAR96A	6DEC96	179
500-01B	Meetings, Presentation Matls, Minutes-Year 4	9DEC96	31JUL97	165
2000-00	Project Finish		31JUL97	0
500-02	Laboratories	27MAR96A	16JAN97	200
500-91	DELIVERY ORDER MANAGEMENT	27MAR96A	31JUL97	344
500-91A	Delivery Order Management-Year 3	27MAR96A	6DEC96	179
500-91B	Delivery Order Management-Year 4	9DEC96	31JUL97	165
500-92	PROJECT CONTROLS	27MAR96A	31JUL97	344
500-92A	Project Controls-Year 3	27MAR96A	6DEC96	179
500-92AA	Submit Initial P&C Report-May96 (CDRL B006)	20MAY96A		0
500-92AB	Submit Manhour Expenditure Rpt-May96 (CDRL B007)	20MAY96A		0
500-92AC	Submit Status Report-May96 (CDRL A001)	20MAY96A		0
500-92AD	Submit MIP Schedule (CDRL B001)	20MAY96A		0
500-92BA	Submit P&C Report-Jun96 (CDRL B006)	20JUN96A		0
500-92BB	Submit Manhour Expenditure Rpt-Jun96 (CDRL B007)	20JUN96A		0
500-92BC	Submit Status Report-Jun96 (CDRL A001)	20JUN96A		0
500-92CA	Submit P&C Report-Jul96 (CDRL B006)	22JUL96A		0
500-92CB	Submit Manhour Expenditure Rpt-Jul96 (CDRL B007)	22JUL96A		0
500-92CC	Submit Status Report-Jul96 (CDRL A001)	22JUL96A		0
500-92DA	Submit P&C Report-Aug96 (CDRL B006)	20AUG96		0
500-92DB	Submit Manhour Expenditure Rpt-Aug96 (CDRL B007)	20AUG96		0
500-92DC	Submit Status Report-Aug96 (CDRL A001)	20AUG96		0
500-92EA	Submit P&C Report-Sep96 (CDRL B006)	20SEP96		0
500-92EB	Submit Manhour Expenditure Rpt-Sep96 (CDRL B007)	20SEP96		0
500-92EC	Submit Status Report-Sep96 (CDRL A001)	20SEP96		0
500-92FA	Submit P&C Report-Oct96 (CDRL B006)	21OCT96		0
500-92FB	Submit Manhour Expenditure Rpt-Oct96 (CDRL B007)	21OCT96		0
500-92FC	Submit Status Report-Oct96 (CDRL A001)	21OCT96		0
500-92GA	Submit P&C Report-Nov96 (CDRL B006)	20NOV96		0
500-92GB	Submit Manhour Expenditure Rpt-Nov96 (CDRL B007)	20NOV96		0
500-92GC	Submit Status Report-Nov96 (CDRL A001)	20NOV96		0
500-92B	Project Controls-Year 4	9DEC96	31JUL97	165
500-92HA	Submit P&C Report-Dec96 (CDRL B006)	20DEC96		0
500-92HB	Submit Manhour Expenditure Rpt-Dec96 (CDRL B007)	20DEC96		0
500-92HC	Submit Status Report-Dec96 (CDRL A001)	20DEC96		0
500-92IA	Submit P&C Report-Jan97 (CDRL B006)	20JAN97		0
500-92IB	Submit Manhour Expenditure Rpt-Jan97 (CDRL B007)	20JAN97		0
500-92IC	Submit Status Report-Jan97 (CDRL A001)	20JAN97		0
500-92JA	Submit P&C Report-Feb97 (CDRL B006)	20FEB97		0
500-92JB	Submit Manhour Expenditure Rpt-Feb97 (CDRL B007)	20FEB97		0



Plot Date 24SEP96
Data Date 27JUL96
Project Start 1FEB96
Project Finish 31JUL97

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

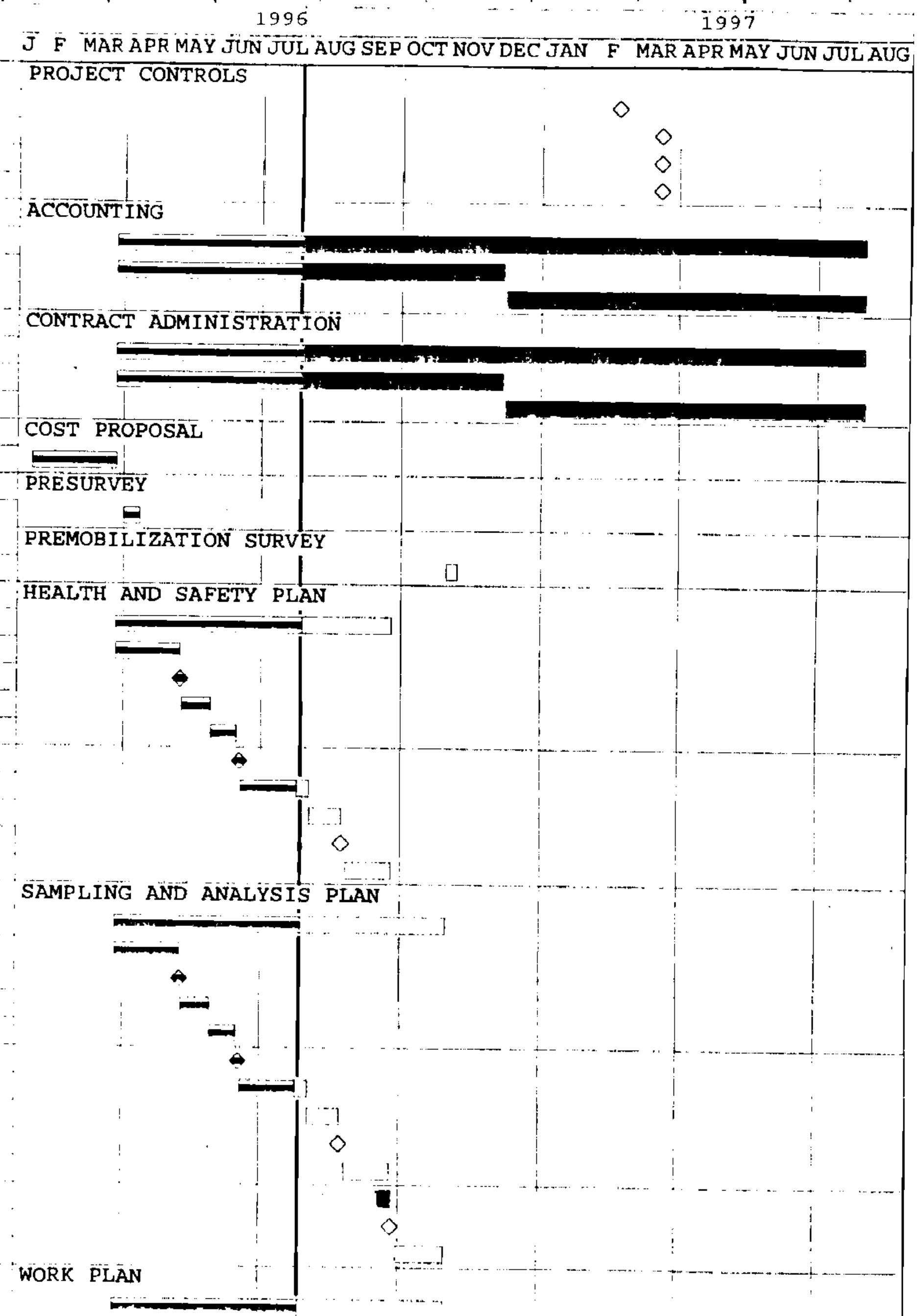
Sheet 1 of 4

CARSWELL NAS, FT WORTH
PA/RFI FOR PARCEL D
CDRL A001AA, APPENDIX A

IRP II D.O. 0021

Date	Revision	Checked	Approved

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
500-92JC	Submit Status Report-Feb97 (CDRL A001)	20FEB97		0
500-92KA	Submit P&C Report-Mar97 (CDRL B006)	20MAR97		0
500-92KB	Submit Manhour Expenditure Rpt-Mar97 (CDRL B007)	20MAR97		0
500-92KC	Submit Status Report-Mar97 (CDRL A001)	20MAR97		0
500-93	ACCOUNTING	27MAR96A	31JUL97	344
500-93A	Accounting-Year 3	27MAR96A	6DEC96	179
500-93B	Accounting-Year 4	9DEC96	31JUL97	165
500-94	CONTRACT ADMINISTRATION	27MAR96A	31JUL97	344
500-94A	Contract Administration-Year 3	27MAR96A	6DEC96	179
500-94B	Contract Administration-Year 4	9DEC96	31JUL97	165
500-99	Cost Proposal	1FEB96A	26MAR96A	12
501-01	Presurvey	1APR96A	11APR96A	9
501-02	Premobilization Survey	31OCT96	6NOV96	5
501-03	HEALTH AND SAFETY PLAN (CDRL A002)	27MAR96A	24SEP96	127
501-03A	Prepare Advance Draft HASP (CDRL A002)	27MAR96A	8MAY96A	31
501-03B	Submit Advance Draft HASP (CDRL A002)	9MAY96A		0
501-03C	AFCEE Review Advance Draft HASP (CDRL A002)	10MAY96A	28MAY96A	22
501-03D	Prepare Draft HASP (CDRL A002)	29MAY96A	14JUN96A	13
501-03E	Submit Draft HASP (CDRL A002)	17JUN96A		0
501-03F	TNRCC Review Draft HASP (CDRL A002)	18JUN96A	1AUG96	22
501-03G	Prepare Final HASP (CDRL A002)	2AUG96	22AUG96	15
501-03H	Submit Final HASP (CDRL A002)	23AUG96		0
501-03I	AFCEE Review Final HASP (CDRL A002)	26AUG96	24SEP96	21
501-04	SAMPLING AND ANALYSIS PLAN (CDRL A003)	27MAR96A	30OCT96	153
501-04A	Prepare Advance Draft SAP (CDRL A003)	27MAR96A	8MAY96A	31
501-04B	Submit Advance Draft SAP (CDRL A003)	9MAY96A		0
501-04C	AFCEE Review Advance Draft SAP (CDRL A003)	10MAY96A	28MAY96A	22
501-04D	Prepare Draft SAP (CDRL A003)	29MAY96A	14JUN96A	13
501-04E	Submit Draft SAP (CDRL A003)	17JUN96A		0
501-04F	TNRCC Review Draft SAP (CDRL A003)	18JUN96A	1AUG96	22
501-04G	Prepare Final SAP (CDRL A003)	2AUG96	22AUG96	15
501-04H	Submit Final SAP (CDRL A003)	23AUG96		0
501-04I	AFCEE Review Final SAP (CDRL A003)	26AUG96	24SEP96	21
501-04J	Prepare Revised Final SAP	17SEP96	25SEP96	7
501-04K	Submit Revised Final SAP	26SEP96		0
501-04L	AFCEE Review Revised Final SAP	30SEP96	30OCT96	23
501-05	WORK PLAN (CDRL A004)	27MAR96A	30OCT96	153



Plot Date 24SEP96
Data Date 27JUL96
Project Start 1FEB96
Project Finish 31JUL97

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

2102

Sheet 2 of 4

CARSWELL NAS, FT WORTH
PA/RFI FOR PARCEL D
CDRL A001AA, APPENDIX A

IRP II D.O. 0021

Date	Revision	Checked	Approved

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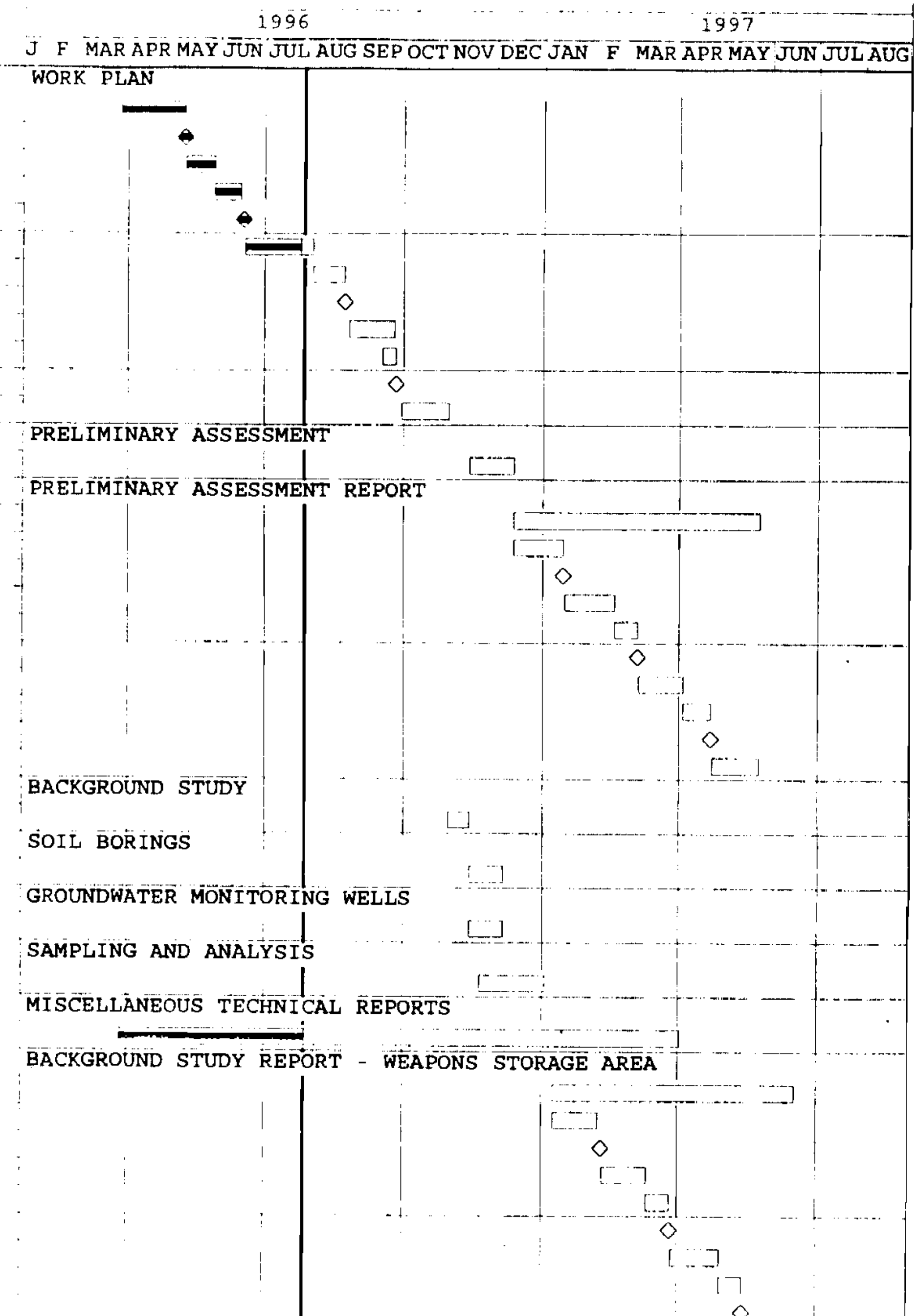
ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
501-05A	Prepare Advance Draft WP (CDRL A004)	27MAR96A	8MAY96A	31
501-05B	Submit Advance Draft WP (CDRL A004)	9MAY96A		0
501-05C	AFCEE Review Advance Draft WP (CDRL A004)	10MAY96A	28MAY96A	22
501-05D	Prepare Draft WP (CDRL A004)	29MAY96A	14JUN96A	13
501-05E	Submit Draft WP (CDRL A004)	17JUN96A		0
501-05F	TNRCC Review Draft WP (CDRL A004)	18JUN96A	1AUG96	22
501-05G	Prepare Final WP (CDRL A004)	2AUG96	22AUG96	15
501-05H	Submit Final WP (CDRL A004)	23AUG96		0
501-05I	AFCEE Review Final WP (CDRL A004)	26AUG96	24SEP96	21
501-05J	Prepare Revised Final WP	17SEP96	25SEP96	7
501-05K	Submit Revised Final WP	26SEP96		0
501-05L	AFCEE Review Revised Final WP	30SEP96	30OCT96	23
501-06	Preliminary Assessment	14NOV96	12DEC96	20
501-07	PRELIMINARY ASSESSMENT REPORT (CDRL A007)	13DEC96	23MAY97	114
501-07A	Prepare Advance Draft PA Report (CDRL A007)	13DEC96	14JAN97	21
501-07B	Submit Advance Draft PA Report (CDRL A007)	15JAN97		0
501-07C	AFCEE Advance Review Draft PA Report (CDRL A007)	16JAN97	17FEB97	23
501-07D	Prepare Draft PA Report (CDRL A007)	18FEB97	4MAR97	11
501-07E	Submit Draft PA Report (CDRL A007)	5MAR97		0
501-07F	TNRCC Review Draft PA Report (CDRL A007)	6MAR97	3APR97	21
501-07G	Prepare Final PA Report (CDRL A007)	4APR97	21APR97	12
501-07H	Submit Final PA Report (CDRL A007)	22APR97		0
501-07I	AFCEE Review Final PA Report (CDRL A007)	23APR97	23MAY97	23
502-01	Background Study	31OCT96	13NOV96	10
503-01	Soil Borings	14NOV96	5DEC96	15
504-01	Monitoring Wells	14NOV96	5DEC96	15
505-01	Sampling & Analysis	21NOV96	2JAN97	28
506-01	MISCELLANEOUS TECHNICAL REPORTS (CDRL A030AA)	27MAR96A	1APR97	258
506-02	BACKGROUND STUDY REPORT - WSA	9JAN97	16JUN97	112
506-02A	Prepare Advance Draft Background Study Report	9JAN97	7FEB97	22
506-02B	Submit Advance Draft Background Study Report	10FEB97		0
506-02C	AFCEE Review Advance Draft Report	11FEB97	11MAR97	21
506-02D	Prepare Draft Background Study Report	12MAR97	26MAR97	11
506-02E	Submit Draft Background Study Report	27MAR97		0
506-02F	TNRCC Review Draft Report	28MAR97	28APR97	22
506-02G	Prepare Final Background Study Report	29APR97	13MAY97	11
506-02H	Submit Final Background Study Report	14MAY97		0



Plot Date 24SEP96
Data Date 27JUL96
Project Start 1FEB96
Project Finish 31JUL97

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

Sheet 1 of 4

CARSWELL NAS, FT WORTH
PA/RFI FOR PARCEL D
CDRL A001AA, APPENDIX A

IRP II D.O. 0021

Date	Revision	Checked	Approved

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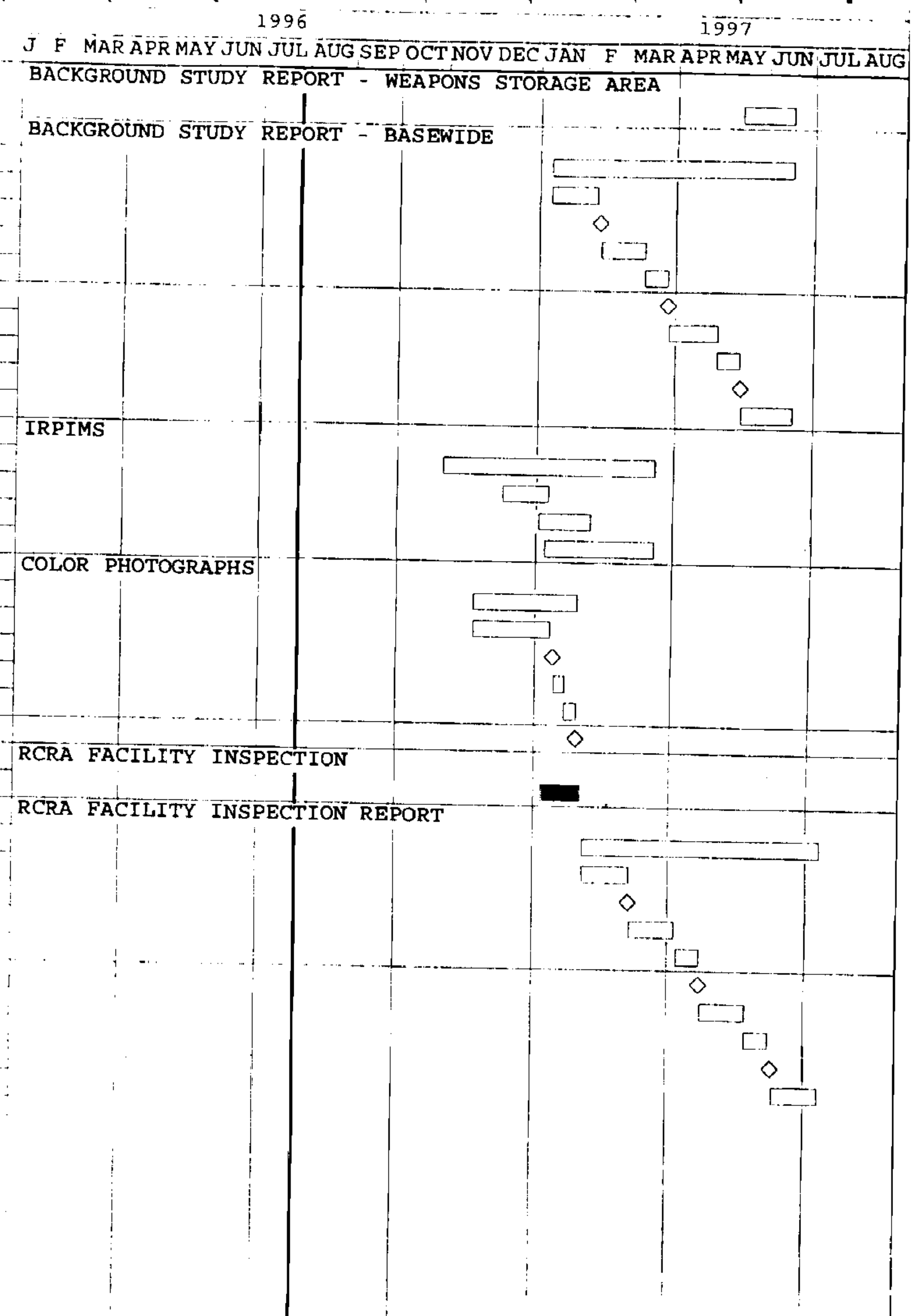
ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
506-02I	AFCEE Review Final Report	15MAY97	16JUN97	22
506-03	BACKGROUND STUDY REPORT - Basewide	9JAN97	16JUN97	112
506-03A	Prepare Advance Draft Background Study Report	9JAN97	7FEB97	22
506-03B	Submit Advance Draft Background Study Report	10FEB97		0
506-03C	AFCEE Review Advance Draft Report	11FEB97	11MAR97	21
506-03D	Prepare Draft Background Study Report	12MAR97	26MAR97	11
506-03E	Submit Draft Background Study Report	27MAR97		0
506-03F	TNRCC Review Draft Report	28MAR97	28APR97	22
506-03G	Prepare Final Background Study Report	29APR97	13MAY97	11
506-03H	Submit Final Background Study Report	14MAY97		0
506-03I	AFCEE Review Final Report	15MAY97	16JUN97	22
506-04	IRPIMS DATA MANAGEMENT (CDRL B003)	31OCT96	19MAR97	97
506-04A	Submittal 1 (BCHCON,LDI,SLI,WCI) (CDRL B003)	10DEC96	8JAN97	20
506-04B	Submittal 2 (BCHCON,GWD,LTD) (CDRL B003)	3JAN97	5FEB97	24
506-04C	Submittal 3 (BCHCON,SAMP,TEST,RES) (CDRL B003)	7JAN97	19MAR97	52
506-05	COLOR PHOTOGRAPHS (CDRL A031)	21NOV96	28JAN97	46
506-05A	Prepare Draft Photographs (CDRL A031)	21NOV96	10JAN97	34
506-05B	Submit Draft Photographs (CDRL A031)	13JAN97		0
506-05C	AFCEE Review Draft Photographs (CDRL A031)	14JAN97	20JAN97	5
506-05D	Prepare Final Photographs (CDRL A031)	21JAN97	28JAN97	6
506-05E	Submit Final Photographs (CDRL A031)	29JAN97		0
1003-01	RCRA Facility Inspection	6JAN97	31JAN97	20
1003-02	RCRA FACILITY INSPECTION REPORT (CDRL A030AD)	3FEB97	9JUL97	111
1003-02A	Prepare Advance Draft RFI Report (CDRL A030AD)	3FEB97	5MAR97	23
1003-02B	Submit Advance Draft RFI Report (CDRL A030AD)	6MAR97		0
1003-02C	AFCEE Review Advance Dft RFI Rpt (CDRL A030AD)	7MAR97	4APR97	21
1003-02D	Prepare Draft RFI Report (CDRL A030AD)	7APR97	21APR97	11
1003-02E	Submit Draft RFI Report (CDRL A030AD)	22APR97		0
1003-02F	TNRCC Review Draft RFI Report (CDRL A030AD)	23APR97	22MAY97	22
1003-02G	Prepare Final RFI Report (CDRL A030AD)	23MAY97	6JUN97	10
1003-02H	Submit Final RFI Report (CDRL A030AD)	9JUN97		0
1003-02I	AFCEE Review Final RFI Report (CDRL A030AD)	10JUN97	9JUL97	21



Plot Date 24SEP96
Data Date 27JUL96
Project Start 1FEB96
Project Finish 31JUL97

(c) Primavera Systems, Inc

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

Sheet 4 of 4

CARSWELL NAS, FT WORTH
PA/RFI FOR PARCEL D
CDRL A001AA, APPENDIX A

IRP II D.O. 0021

Date	Revision	Checked	Approved

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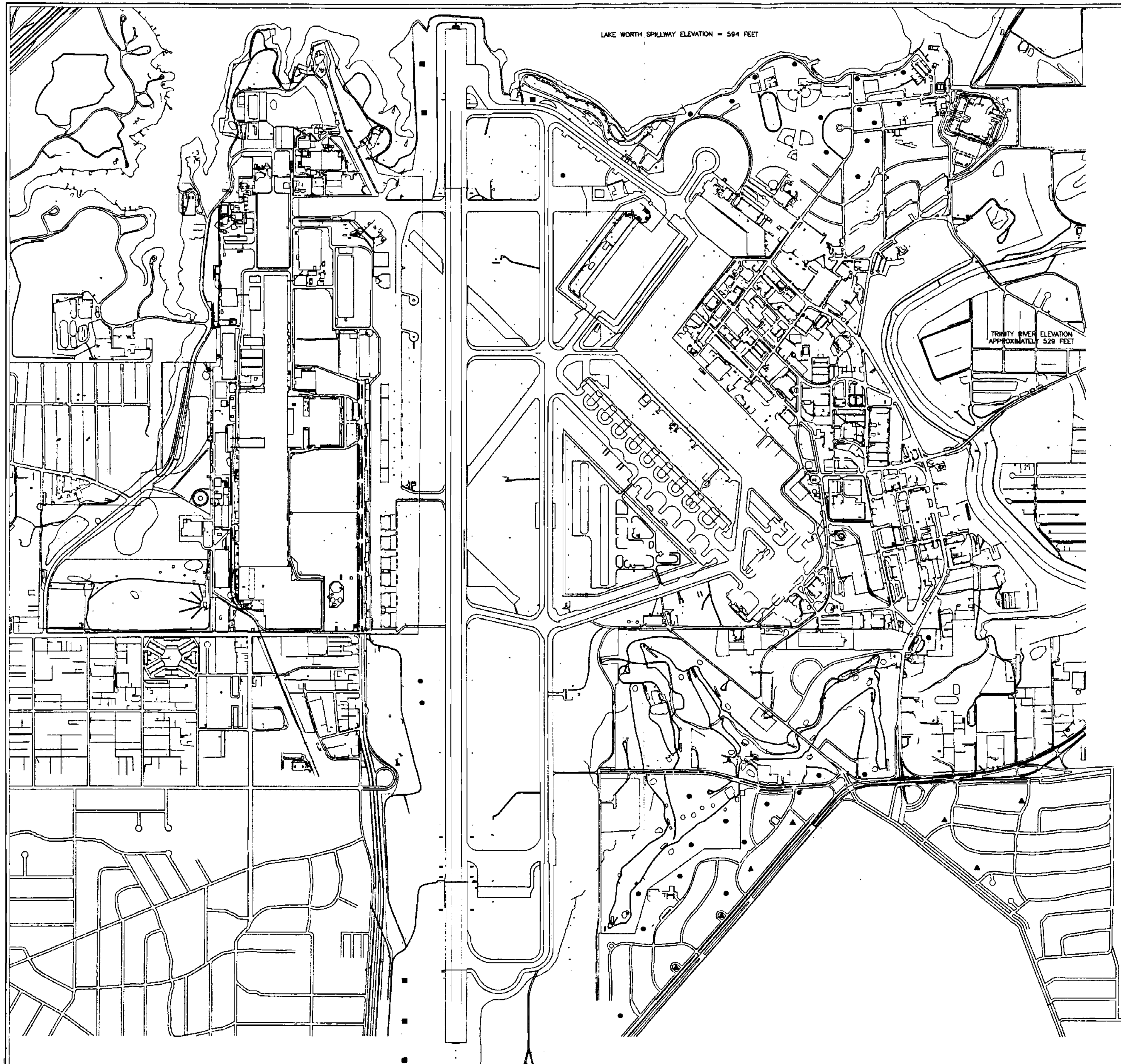


Legend

- ● Proposed Surface/Subsurface Background Soil Sample Location (29)
- ▲ Proposed Subsurface Background Soil Sample Location (7)
- ■ Proposed Surface Background Soil Sample Location (6)

A total of 30 surface samples and 30 subsurface samples will be collected from the 42 potential locations shown. Surface and subsurface sample pairs will be co-located whenever possible (●).

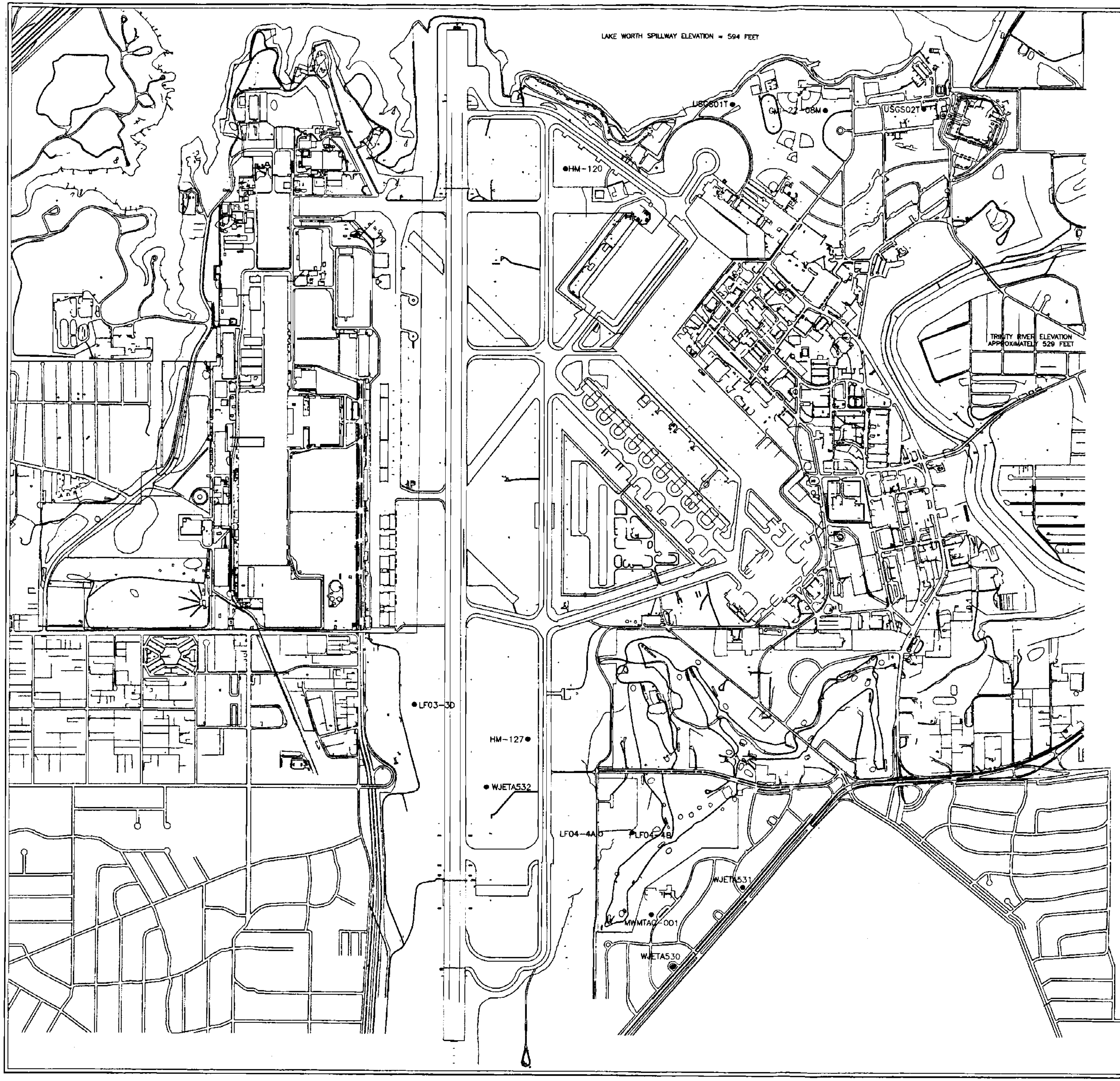
When field conditions or observations do not allow the collection of both samples from a location, one or both samples will be collected from an alternate location (▲ ■).

Such conditions would include encountering shallow bedrock or saturated soil, or observing potential wind-blown contamination from nearby sources (lead-based paint chips, for example).

Naval Air Station Fort Worth JRB
Fort Worth, Texas

Proposed Background Soil Sample Locations

PROJ. MGR. L. SCHUETTER	ACAD FILE NO. PLATE1.DWG	FIGURE NO. PLATE 1
DRAWN BY J. HUNTER	PROJ. NO. 05-G-47900	DATE 6/4/96



Legend

W-153 ● Proposed Existing Well Location for Background Sampling

WJETA530 ● Proposed Well Location to be Installed for Background Purposes

LF04-4A ○ Proposed Alternate Existing Well Location for Background Sampling

WELL ID	WELL SELECTION RATIONALE
USGS01T USGS02T GMI-22-08M	Upgradient from known source areas. Groundwater flow is primarily to the East Southeast onto the base from Lake Worth.
HM-120	Upgradient from known source areas on NAS Fort Worth JRB groundwater flow is primarily to the east from AFP-4. Bedrock surface dips variably from East to South.
HM-127 LF03-3D WJETA532	Upgradient/cross gradient from known NAS Fort Worth JRB source areas. Additionally these locations are on the "bank" of the major paleochannel and does not intersect the TCE Plume according to historical analytical results.
LF04-4A LF04-4B MWMTAC-001 WJETA530 WJETA531	These locations are selected to include Terrace Alluvium water which migrates onto NAS Fort Worth JRB from the West on the South side of the base. Groundwater flow in this area ranges from Northeast to East. These locations are up/cross gradient from known NAS Fort Worth JRB source areas.

Naval Air Station Fort Worth JRB
Fort Worth, Texas

Proposed Background Groundwater Sampling Locations

PROJ. MGR.	ACAD FILE NO.	FIGURE NO.	
L. SCHUETTER	PLATE2.DWG	PLATE 2	
DRAWN BY	PROJ. NO.		DATE
J. HUNTER	05-G-47900		6/4/96

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

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ADMINISTRATIVE RECORD

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