N83447.AR.000634
NAS FORT WORTH
5090.3a

FINAL WORK PLAN FOR PALUXY WELLS INSTALLATION AND SAMPLING NAS FORT WORTH TX

3/1/2002

ELLIS ENVIRONMENTAL GROUP

720 0 File: 17G
D.E.

NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
TEXAS

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 780

FINAL

Work Plan

Paluxy Wells Installation and Sampling *at* Naval Air Station Fort Worth Joint Reserve Base, TX

Contract No. F41624-00-D-8032
Delivery Order No. 0009

Prepared for
Air Force Center for Environmental Excellence
Brooks Air Force Base, TX

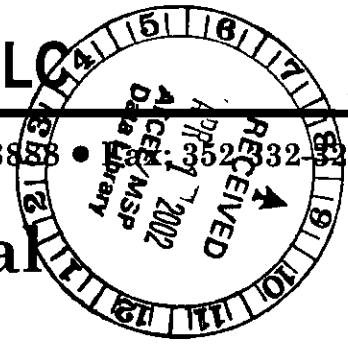
Prepared by
Ellis Environmental Group, LC
414 SW 140th Terrace
Newberry, FL 32669
(352) 332-3888

March 2002

720 2

Ellis Environmental Group, LC

304 SW 140th Terrace Newberry, Florida 32669 • 352-332-3838 • Fax: 352-332-3222



Letter of Transmittal

To:	Mr. Don Ficklen	**Date:**	March 29, 2002
	HQ AFCEE/ERD	**Attention:**	Team Chief
	3207 North Road	**Re:**	Paluxy Wells Installation and Sampling
	Brooks AFB, TX 78235-5363		

Project Number 7020-710

We Are Sending You [X] **Attached** [ ] **Under Separate Cover**

Copies	Description
2	Final Work Plan

These Are Transmitted as Checked Below:

- [ ] For Approval
- [ ] For Your Information
- [ ] As Requested
- [ ] For Review and Comment
- [ ] Review and Correct
- [ ] Review and File
- [ ] Returned for Corrections
- [ ] Prints Returned after Loan to Us
- [ ] Other

Remarks:

Copy to: _____ **Signed:** Kai Porro

If Enclosures are not as noted, please notify us at once

COMMENT RESPONSES:
DRAFT WORK PLAN
PALUXY WELLS INSTALLATION AND SAMPLING
AT NAVAL AIR STATION FORT WORTH JOINT RESERVE BASE, TX

The following comments have been provided by Mike Dodyk of AFCEE and Lynn Morgan of HydroGeoLogic, Inc.

General comments from AFCEE:

Comment 1 *Fig 2-2. Revise labeling of Lake Worth.*

RESPONSE: Correction made in Final Report.

Comment 2 Fig 2-11. Recommend a numbering system be developed for the three wells to match those of the other wells on base. Suggest WEEGPU005,006 & 007.

RESPONSE: Correction made in Final Report.

Comment 3 Page 3-1 Section 3.1. First paragraph should state proposed well locations are shown on Figure 2-11.

RESPONSE: Correction made in Final Report.

Comment 4 Page 3-1 et al. Change all references to 'Base Civil Engineer' to 'Public Works Officer'.

RESPONSE: Correction made in Final Report.

Comment 5 Page 3-3, Section 3.2.2. Figure 3.1 illustrates a typical Paluxy Monitoring Well construction.

RESPONSE: Correction made in Final Report.

Comment 6 Page 5-2 Section 5.2, 2nd paragraph, last sentence. The field office is located on base and the staging area is located at the IDW area on base.

RESPONSE: Correction made in Final Report.

General Comments from HydroGeoLogic

Comment 1 *Background on AOC 2 RFI (including regulator's comments about Paluxy data gaps), SAIC's recent work, etc. should be provided. Explain why AFCEE is installing the wells.*

RESPONSE: Language was added to the Introduction section explaining why AFCEE is installing the wells.

Comment 2 *Bullet the objectives:*

- *Characterize the hydraulic characteristics of the Goodland/Walnut and Paluxy in the Northern Lobe.*
- *Characterize the nature and extent of any VOC contamination in the Paluxy.*

RESPONSE: Section 1.2 (Objectives) was added to the Final Report and included the new bullets.

Comment 3 *Show how the Paluxy locations were chosen, perhaps by including a bedrock map.*

RESPONSE: Added to Final Report.

Comment 4 *State whether there is a contingency plan if you discover that the Walnut Formation is fractured.*

Specific Comments

Comment 1 *Section 1.0 Introduction – Change "formally" to "formerly".*

RESPONSE: Correction made in Final Report.

Comment 2 *Section 1.0 Introduction – Last sentence, Change "will" to "may".*

RESPONSE: Correction made in Final Report.

Comment 3 *Section 1.0 Introduction – Add, "if contamination is present" to the end of the paragraph.*

RESPONSE: Correction made in Final Report.

Comment 4 *Section 1.1 Background –Note that the EPA is the lead agency on regarding VOC contamination migrating from Plant 4, including the plume on NAS Fort Worth JRB. I think it would be best not to imply that this is related to AOC 2*

investigations- but rather a data gap investigation related to the plume itself and therefore not part of the IRP process.

RESPONSE: Added to Final Report.

Comment 5 *Section 2.1.1 Climate - A reference is needed.*

RESPONSE: Added to Final Report.

Comment 6 *Section 2.3 Groundwater – (2) Mention that the Walnut formation is fractured in some areas, and totally eroded in the "window area".*

RESPONSE: Added to Final Report.

Comment 7 *Figure 2-2 – Remove "h" from the word Fort in Figure heading and remove "Lake Worth" from the runway area.*

RESPONSE: Correction made in Final Report.

Comment 8 *Figure 2-4 – Under the Legend, add "Proposed" before "Paluxy Well Locations".*

RESPONSE: Correction made in Final Report.

Comment 9 *Figure 2-6 – Suggest inserting this figure immediately before Figure 2-5.*

RESPONSE: Correction made in Final Report.

Comment 10 *Figure 2-7 – Consider adding the recently installed Paluxy(WHGLPU001-4) wells in one of the cross sections to have the most current information.*

RESPONSE: Added to Final Report.

Comment 11 *In the second paragraph, provide either one hydraulic conductivity (k) measurement from the area being investigated, or a range of all the k measurements. HydroGeoLogic, IT, and other companies' measurements vary greatly.*

RESPONSE: Correction made in Final Report.

Comment 12 *Section 2.3.1.1 – Only refer to TCE concentrations within the northern lobe since that is the subject of this investigation.*

RESPONSE: Correction made in Final Report.

Comment 13 *Section 2.3.1.1 – Suggest rewording the last two sentences of the paragraph.*

RESPONSE: Correction made in Final Report.

Comment 14 *Section 2.3.2 – Add information found on the Goodland Walnut mentioned in the next section to this section since it is more applicable. The Walnut well installed on the southern lobe had high recharge along the bedding planes.*

RESPONSE: Correction made in Final Report.

Comment 15 *Section 3-1 – Change the reference of Figure "3-1" to "2-11" in the first paragraph. Suggest checking overhead lines and buildings at this time, rather than waiting until well installation.*

RESPONSE: Correction made in Final Report.

Comment 16 *Figure 3-1 – Alluvium is misspelled. Check the depth of the 6" PVC surface casing.*

RESPONSE: Correction made in Final Report.

Comment 17 *Section 3.2.1 – In the third paragraph, mentions soil samples being collected- is that the case? Review the last sentence- will everything be treated as hazardous until proven otherwise?*

RESPONSE: Correction made in Final Report.

Comment 18 *Section 3.2.2 – Change Reference to Figure "2-11" to "3-1".*

RESPONSE: Correction made in Final Report.

Comment 19 *Section 3.3 – Last sentence, change ". Refer" to "and in the".*

RESPONSE: Correction made in Final Report.

Comment 20 *Section 3.3.2 – In the second paragraph, change "5.0" to "6.0".*

RESPONSE: Correction made in Final Report.

Comment 21 *Appendix A, Section 2.0 – Pluralize "objective".*

RESPONSE: Correction made in Final Report.

Comment 22 *Appendix A, Section 2.2 – After the second bullet, change "the basewide TCE plume has impacted" to "VOC contamination is present in".*

RESPONSE: Correction made in Final Report.

Comment 23 *Appendix A, Table 3-1 – Why are Priority pollutant metals and SVOCs Sampled? VOCs are the contaminants of concern.*

RESPONSE: Correction made in Final Report.

Comment 24 *Appendix A, Section 3.2 – The sampling should be handled under the basewide plume and CERCLA, instead of under RCRA and the hazardous waste permit.*

RESPONSE: Correction made in Final Report.

Comment 25 *Overhead lines and buildings should be investigated at this time.*

RESPONSE: Correction made in Final Report.

Comment 26 *Appendix C – Add boring logs and USGS Paluxy well construction logs. Lynn Morgan will provide these.*

RESPONSE: Added to Final Report.

Preface

This document contains the Final Work Plan (WP) for the Paluxy Wells Installation and Sampling at the Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB), Texas.

Ellis Environmental Group, LC (EEG) prepared this report under contract to the U.S. Air Force Center for Environmental Excellence (AFCEE), Contract No. F41624-00-D-8032, Delivery Order No. 0009, in support of the Air Force Installation Restoration Program (IRP).

Responsible key EEG personnel are as follows.

Rich Wheeler, PE – Assistant Program Manager
Rick Levin, PG – Project Manager

This contract will be administered by the Defense Contract Management Command (DCMC), 9549 Koger Blvd., Gadsen Building, Suite 200, St. Petersburg, Florida 33702. The contracting officer will be Mr. Cliff Trimble. The contracting officer's representative will be Mr. Don Ficklen (210-536-5290), located at the AFCEE/Environmental Restoration Division, 3207 North Road, Brooks Air Force Base (AFB), Texas 78235-5363.

Contents

Figures

Tables

Appendices

Abbreviations & Acronyms

µg/L	micrograms per liter
cm/s	centimeters per second
ft/d	feet per day
gpd/ft	gallons per day per foot
gpd/ft^2	gallons per day per square foot
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AFP	Air Force Plant
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DCMC	Defense Contract Management Command
DO	dissolved oxygen
EC	electrical conductance
EEG	Ellis Environmental Group, LC
EPA	Environmental Protection Agency
FFA	Federal Facilities Agreement
GSAP	Groundwater Sampling and Analysis Plan
IDW	investigation-derived waste
IRP	Installation Restoration Program
JRB	Joint Reserve Base
MOU	Memorandum of Understanding
NAS	Naval Air Station
NCP	National Contingency Plan
NGVD	national geodetic vertical datum
NPL	National Priorities List
OVM	organic vapor meter
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RRR	Risk Reduction Rules
SWMU	solid waste management unit
TCE	trichloroethene
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic carbon
TWC	Texas Water Commission
USGS	U.S. Geological Survey
VOC	volatile organic compound

1.0 Introduction

This report sets forth the requirements for the construction and sampling of three Paluxy Monitoring Wells at the Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB), formerly Carswell Air Force Base (AFB). As part of the U.S. Air Force Installation Restoration Program (IRP), the monitoring wells constructed will fill data gaps relating to the northern lobe plume and may be incorporated into the long-term groundwater monitoring program if contamination is present.

1.1 Background

The objectives of the U.S. Air Force IRP are to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for sites that pose a threat to human health and welfare or the environment.

Environmental contamination was identified at U.S. Air Force Plant No. 4 (AFP 4) through site investigations conducted during the 1980s. As a result, AFP 4 was placed on the National Priorities List (NPL) in August 1990. A Federal Facilities Agreement (FFA) was entered into between the Texas Natural Resource Conservation Commission (TNRCC), Environmental Protection Agency (EPA) Region VI, and the U.S. Air Force. Investigation, remediation, and monitoring information can be located in the following references: Environmental Science and Engineering, Inc. (ESE), 1994; HydroGeoLogic, 1997; Parsons Engineering Science, Inc. (Parsons), 1997; Jacobs Engineering Group Inc. (Jacobs), 1998.

Although the Air Force developed the IRP in response to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), NAS Fort Worth JRB is not listed on the NPL and, as such, is not subject to corrective action under CERCLA. The primary regulatory programs that govern the investigation, remediation, and closure of NAS Fort Worth JRB sites are the Resource Conservation and Recovery Act (RCRA) and the TNRCC Risk Reduction Rules (RRR) Program. The TNRCC is the lead regulatory agency for activities to be conducted at the subject sites The Environmental Protection Agency (EPA) is the lead agency regarding volatile organic compounds (VOC) contamination migrating from Plant 4, including the plume on NAS Fort Worth JRB.

On February 7, 1991, the former Carswell AFB was issued an RCRA hazardous waste permit (HW-50289) by the Texas Water Commission (TWC). This permit requires an RCRA facility investigation of all solid waste management units (SWMUs) listed in Permit Provision VIII (as well as those SWMUs subsequently added to the list) in order to determine whether hazardous constituents listed in 40 Code of Federal Regulations (CFR) Part 264, Appendix IX, have been released into the environment.

A Memorandum of Understanding (MOU) was signed by the acting secretaries of the Air Force and Navy on June 8 and 9, 1993. The MOU outlined the general terms under which the Air Force would transfer responsibility for portions of the former Carswell AFB to the Navy. The MOU established a final target date of September 20, 1994, for the transfer of host responsibilities from

the Air Force to the Navy. On September 23, 1994, the Navy and Air Force executed another MOU to amend the previous MOU. The Navy assumed "host responsibilities" for NAS Fort Worth JRB on October 1, 1994, but did not assume several key environmental program responsibilities.

In a letter dated February 26, 1996, the Air Force deputy assistant secretary interpreted and amended the original MOU. This amendment confirmed the Air Force's acceptance of funding and management responsibilities for the final remediation of all environmental restoration requirements attributable to Carswell AFB operations that occurred prior to October 1, 1994. In an MOU dated June 19, 1996, the parties reached agreement regarding the cleanup of NAS Fort Worth JRB. The June 19, 1996, Cleanup MOU will control in the event that it conflicts on cleanup issues with this Compliance MOU.

1.2 Objectives

Trichloroethene (TCE) contamination exists within the Terrace Alluvium groundwater NAS Fort Worth JRB. TCE contamination in groundwater at NAS Fort Worth JRB is generally described as one plume. The portion of the TCE plume that is migrating west to east in the flightline area, or northern portion of the Base, is referred to as the northern lobe; the portion migrating west to east in the landfill area, or southern portion of the Base, is referred to as the southern lobe. The construction and monitoring of the new Paluxy wells will be utilized to fill data gap related to the TCE northern lobe plume. Data gaps have been identified as part of the review comments to the Final RCRA Facility Investigation Report, Area of Concern 2, NAS Fort Worth, Texas (Appendix D). The location of the three new monitoring wells have been selected based on the geophysical work conducted by SAIC.

The objectives of the data gap investigation include:

- Identify the hydraulic characteristics of the Goodland/Walnut and Paluxy Formations in the northern lobe
- Characterize the nature and extent of any VOC contamination in the Paluxy Formation

2.0 Summary of Existing Information

2.1 Site Description

The Air Force transferred the majority of the property of Carswell AFB to the U.S. Navy to become NAS Fort Worth JRB on October 1, 1994. NAS Fort Worth JRB is located in Tarrant County, 8 miles west of downtown Fort Worth, Texas (**Figure 2-1**). The Base is located approximately 32 degrees north latitude and 97 degrees west longitude. The NAS Fort Worth JRB property, totaling approximately 2,555 acres, is comprised of the main Base and two non-contiguous parcels. The main Base, approximately 2,264 acres, is bordered by Lake Worth to the north, the West Fork of the Trinity River and Westworth Village to the east, Fort Worth to the northeast and southeast, and White Settlement to the west and southwest, with AFP 4 to the west.

The area surrounding NAS Fort Worth JRB is dominantly suburban residential. Cities and municipalities surrounding NAS Fort Worth JRB, with their respective populations from the 1990 census, include Fort Worth (447,000), Westworth Village (2,350), Sansom Park Village (3,928), River Oaks (6,580), and White Settlement (15,472).

2.1.1 Climate

The Fort Worth region is classified subhumid, with mild winters and hot, humid summers. The average annual precipitation is 31.5 inches. The majority of the precipitation falls between April and October. Average annual temperature is 66 degrees Fahrenheit. July is typically the hottest month, averaging 86 degrees Fahrenheit, with January typically the coldest, averaging 45 degrees Fahrenheit. Temperatures may change rapidly with 20- to 30-degree fluctuations in several hours. Average annual relative humidity is approximately 63 percent.

Prevailing winds are primarily southerly from March through November. December through February typically encounters northerly winds. Average wind speed is approximately 8 knots. Severe thunderstorms with wind speeds of 65 knots and hail are common. Summer weather patterns make the formation of tornados possible (National Weather Service, 2002).

2.1.2 Physiography

Two physiographic provinces comprise NAS Fort Worth JRB. The southeastern portion of the Base lies in the Grand Prairie section of the Central Lowlands Physiographic Province. The Central Lowlands are defined by broad, east-sloping terrace surfaces that are interrupted by west-facing escarpments. The topographic surface is typically grass-covered and treeless except for isolated stands of upland timber. The northwestern portion of the NAS Fort Worth JRB area lies within the Western Cross Timbers Physiographic Province. The Western Cross Timbers Province is characterized by rolling topography and heavy growth of post and blackjack oaks.

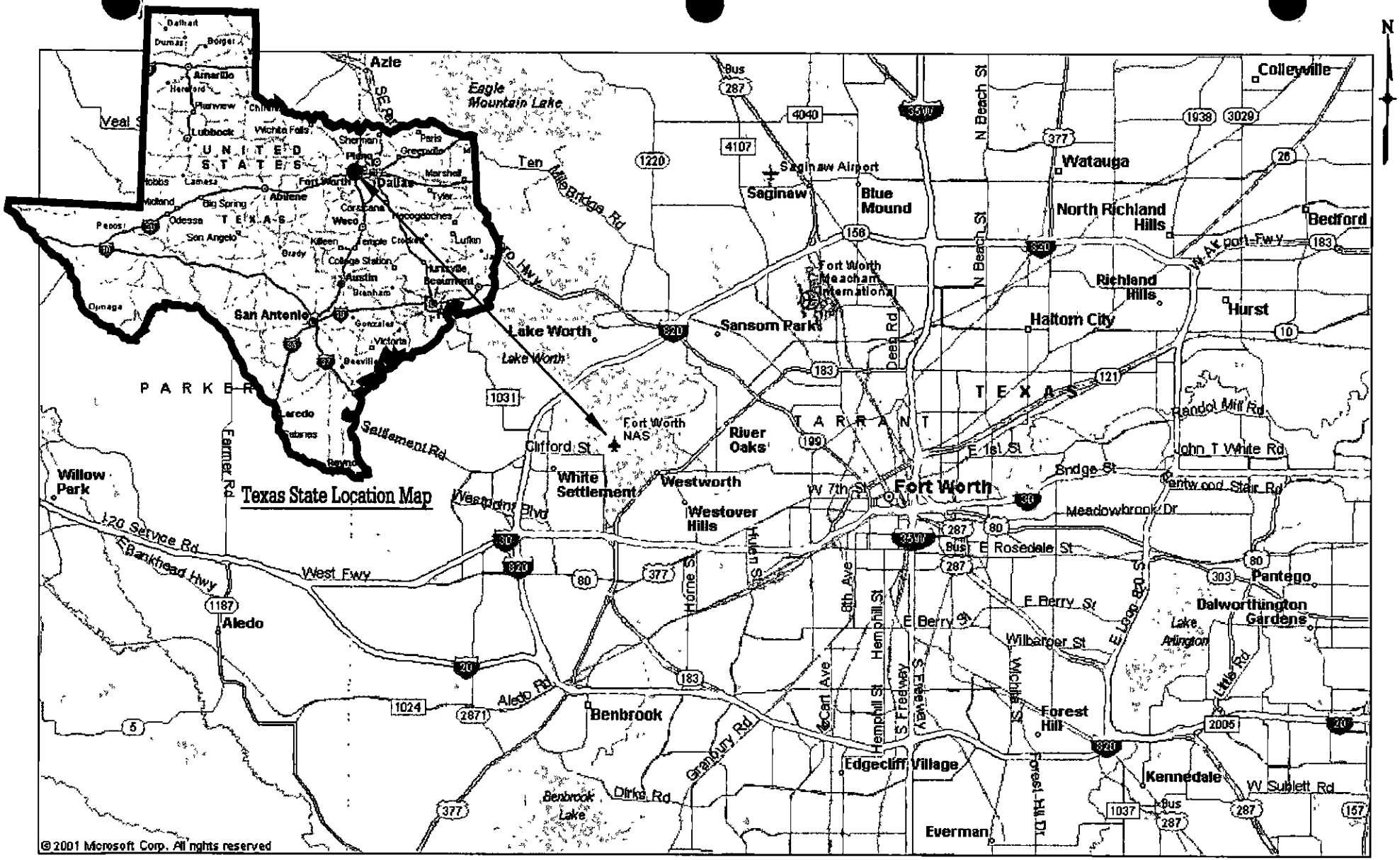


Figure: 2–1

Site Location Map

EEG No: 7020.710 Date: 3–29–02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client: U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

7020 15

Surface elevations range from approximately 620 feet above the national geodetic vertical datum (NGVD) along the southwestern side of the Base to approximately 530 feet above NGVD along the eastern side of the Base. **Figure 2-2**, a portion of the Lake Worth and Benbrook U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles, illustrates topographic relief of the NAS Fort Worth JRB area

Soils generally consist of the Aledo-Bolar-Sanger Association. This association is defined as gently sloping to moderately steep, very shallow to deep loam and clay upland soils.

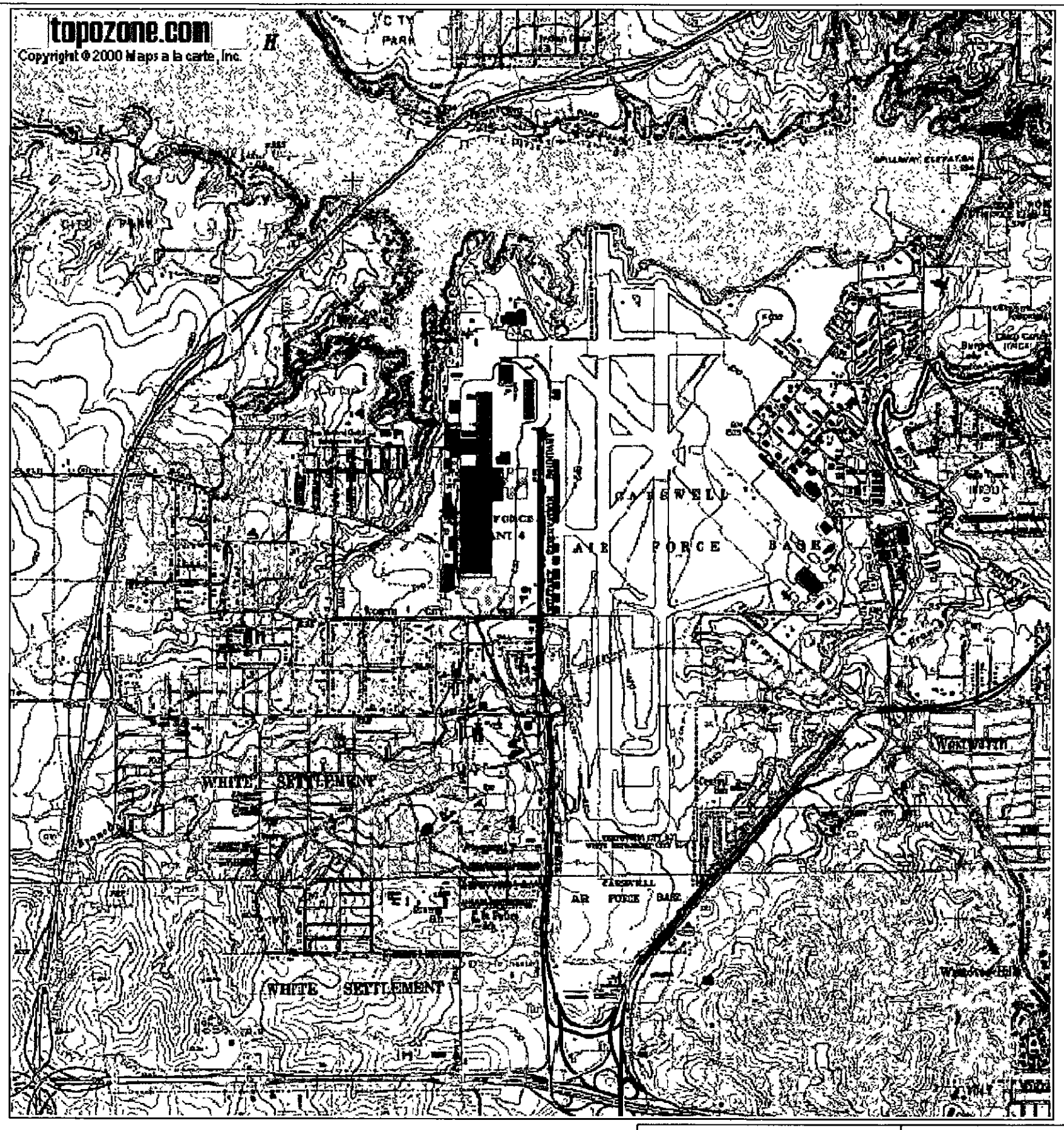
2.2 Regional Geology

A partial stratigraphic column (**Figure 2-3**) of NAS Fort Worth JRB depicts the major stratigraphic units of the Quaternary and uppermost Upper Cretaceous age strata. The portion of the stratigraphic section of interest, from youngest to oldest, is.

1. Quaternary Alluvium, inclusive of fill material and terrace deposits (Terrace Alluvium)
2. Lower Cretaceous Goodland Limestone of the Fredericksburg Group
3. Lower Cretaceous Walnut Marl of the Fredericksburg Group (Walnut Formation)
4. Lower Cretaceous Paluxy Sandstone of the Trinity Group (Paluxy Formation)
5. Lower Cretaceous Glen Rose of the Trinity Group (Glen Rose Formation)

Quaternary Alluvium is found at surface over most of NAS Fort Worth JRB and unconformably overlies strata of Upper Cretaceous age. This alluvium includes floodplain and fluvial terrace detritus of clay, silt, sand, and gravel that occur as a veneer on the eroded surface of the previously mentioned Upper Cretaceous strata. The Quaternary Alluvium found throughout the area was deposited by the Trinity River in terrace deposit along the river valley banks, resulting from eustatic sea level fluctuations during the Pleistocene and Holocene epochs. Reworking of these deposits by the ancestral and recent Trinity River has resulted in the series of Pleistocene age terraced river alluvium deposits. These terraced deposits are at varying elevations corresponding to sea level changes during Quaternary continental glaciation. The Pleistocene terrace deposits, gravel, sand, and silt, are found at higher topographic elevations than the Holocene alluvial detritus found in the alluvial-filled valleys of present streams.

Previous drilling at NAS Fort Worth JRB indicates the alluvial deposits to be from less than 10 feet in thickness to approximately 50 feet. Alluvium thickness generally increases to the east-southeast toward the Trinity River. Variations in thickness are a result of stream channeling/reworking and erosion. Typically, silt and clay with varying amounts of sand and gravel occur from surface to 5 to 10 feet. Underlying the silt and clay is a sand and gravel unit that usually increases in grain size with depth. The sands are fine- to coarse-grained, tan to rust in color, and composed predominantly of quartz grains. Gravel is typically limestone and fossil shell fragments. The gravels were deposited as channel lag deposits on the scoured upper surface of the underlying Lower Cretaceous strata. The alluvial deposits are heterogeneous with varying stratigraphy occurring over short distances.



Site Location

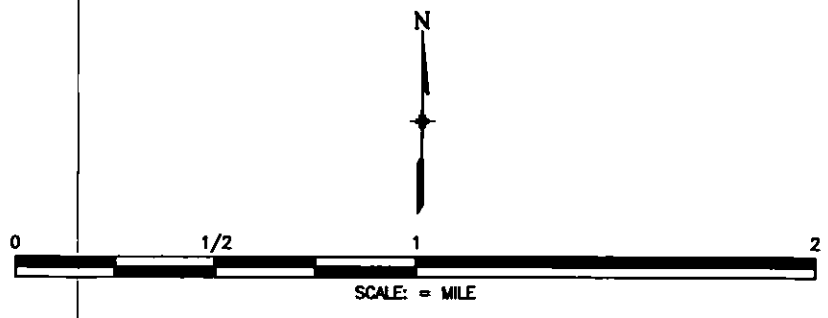


FIGURE: 2-2
NAS Forth Worth JRB
Topographic Map

EEG NO: 7020.710 Date: 3-29-02

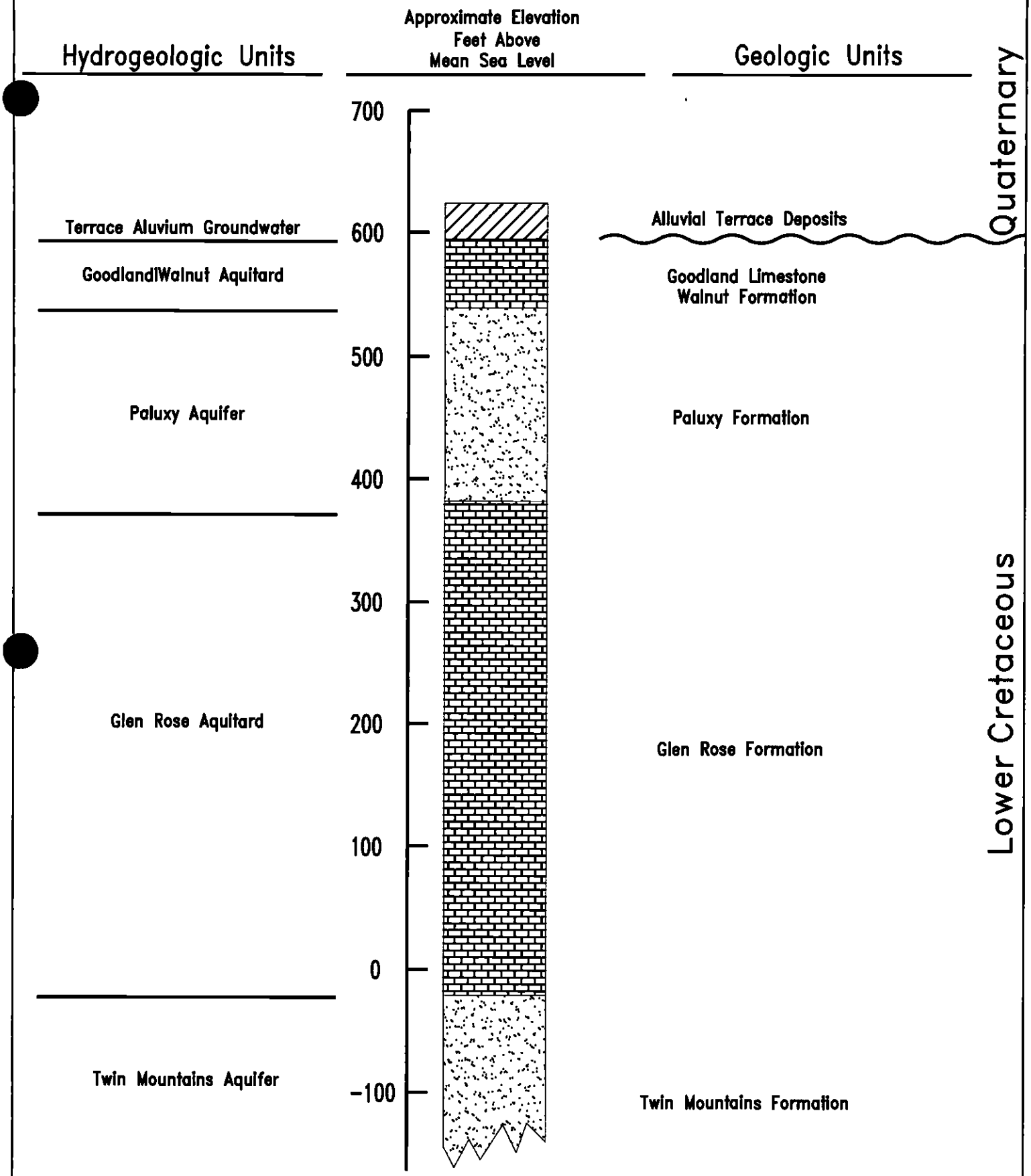
ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER
FOR ENVIRONMENTAL EXCELLENCE



Source: Radian, 1989

FIGURE: 2–3

Statigraphic Column Correlating Hydrogeologic Units and Geologic Units

EEG No: 7020.710 Date: 3–29–02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624–00–D–8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

Quaternary strata is underlain by the Lower Cretaceous Goodland and Walnut Formations. Both formations' lithologies are fossiliferous, hard limestone interbedded with calcareous shale. The Goodland Limestone is white, fossiliferous, thin to massive, resistant with gray to yellow-brown silty marl. Conformably underlying the Goodland is the Walnut Formation. The Walnut Formations lithology is limestone, yellow to gray, hard, fossiliferous, interbedded with brown arenaceous clay, fissile shale, iron-stained limestone, and fossiliferous, soft shale. These strata are generally dry, although small amounts of water are occasionally present in the shale and clay units (Radian, 1991).

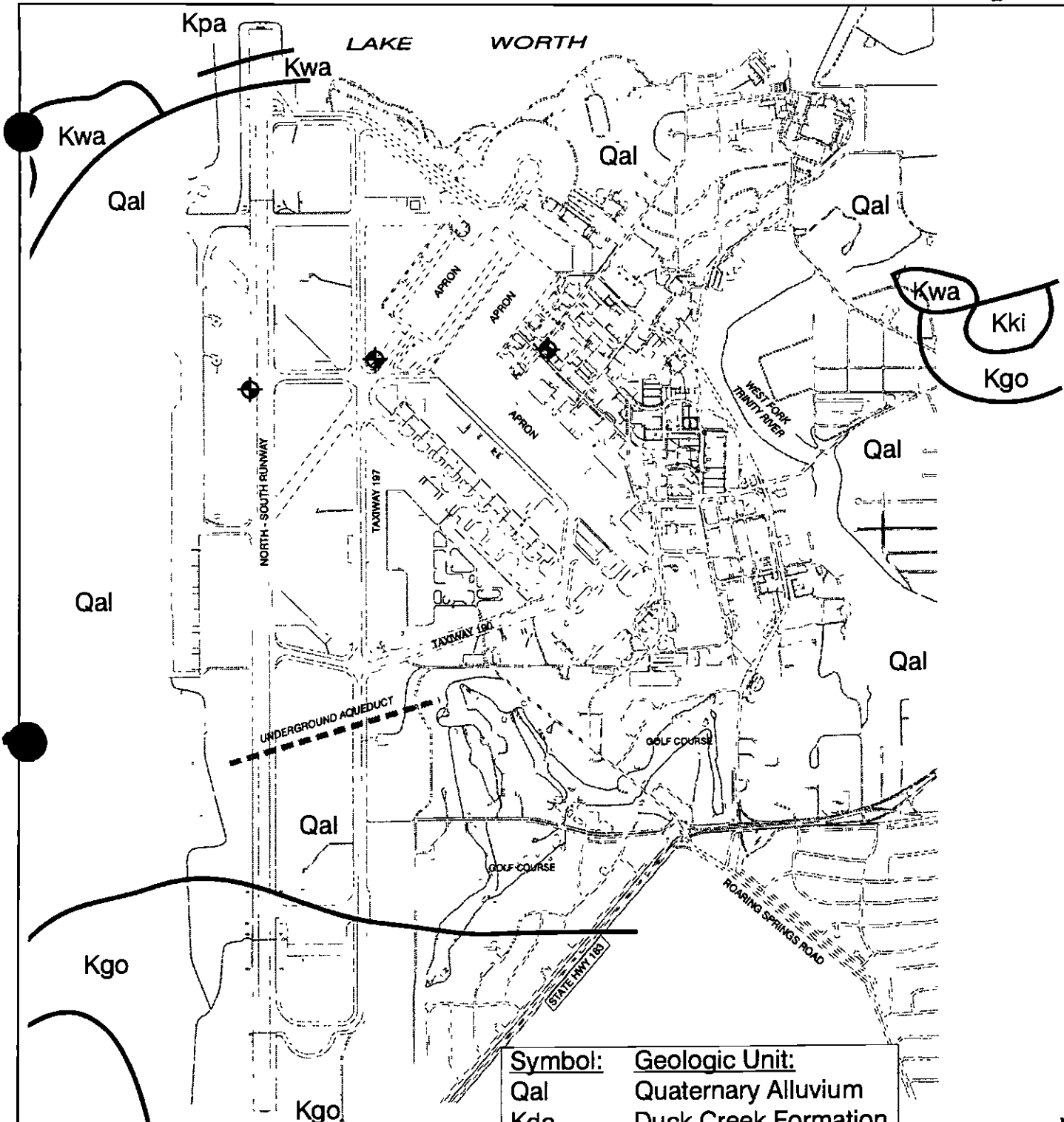
Unconformably underlying the Walnut Formation is the Paluxy Formation, also of Lower Cretaceous age. Regionally, the Paluxy is divided into upper and lower sandstone units, separated by a shale member. The upper Paluxy is a light gray to greenish-gray fine-grained sandstone with shale interbeds. The lower Paluxy is generally a coarse-grained sandstone, grading upward to a fine-grained sandstone with variable shale and limestone interbeds. The Paluxy ranges in thickness from 140 to 190 feet, averaging 160 feet under Tarrent County (Radian, 1991).

The Paluxy is exposed along the southern shore of Lake Worth at the northern boundary of NAS Fort Worth JRB and along the erosional channel of the Trinity River. The Paluxy Formation is either aerially exposed or in contact with the overlying Quaternary Alluvium where the Goodland and Walnut Formations have been removed.

Lower Cretaceous strata dip regionally to the southeast. The surface elevation of the Lower Cretaceous strata varies across NAS Fort Worth JRB by erosion of the Trinity River, both current and ancient. The Goodland and Walnut Formations have been removed by erosion of the Trinity River to the west of the NAS facility and along valley of the Trinity River to the north and the east of the facility. The locally irregular topography of the bedrock surface is characteristic of an erosional surface altered by fluvial processes. This, in turn, is characterized by the variable nature and thickness of the overlying sequence of Quaternary sediments. The surface geology at NAS Fort Worth JRB is depicted in **Figure 2-4**. **Figure 2-5** represents a map view of NAS Fort Worth with a cross section. A generalized geologic cross section of NAS Fort Worth is depicted in **Figure 2-6**. Additional geologic cross sections are depicted in **Figures 2-7, 2-8, 2-9,** and **2-10**.

2.3 Groundwater

The following five hydrogeologic units, listed from the shallowest to the deepest, located in the NAS Fort Worth JRB area include (**Figure 2-3**): (1) an upper perched-water zone occurring in the alluvial terrace deposits associated with the Trinity River (Terrace Alluvium), (2) an aquitard of predominantly dry limestone with interbedded fine-grained clay and shale layers of the Goodland and Walnut Formations (the Walnut Formation is fractured in some areas, and totally eroded in the "window area"), (3) an aquifer in the sandstone of the Paluxy Formation, (4) an aquitard of relatively impermeable limestone in the Glen Rose Formation, and (5) a major aquifer in the sandstone of the Twin Mountains Formation. **Table 2-1** presents additional information on the stratigraphic units found beneath NAS Fort Worth JRB. Each of the major hydrogeologic units beneath NAS Fort Worth JRB is examined in more detail in the following paragraphs.



Symbol:	Geologic Unit:
Qal	Quaternary Alluvium
Kdc	Duck Creek Formation
Kki	Kiamichi Formation
Kgo	Goodland Limestone
Kwa	Walnut Formation
Kpa	Paluxy Formation

N

LEGEND

Proposed Paluxy Well Locations

2,000 1,000 0' 2,000

SCALE: 1" = 2,000 Feet

Source: Hydro Geologic

FIGURE: 2-4

NAS Fort Worth JRB
Surface Geology

EEG No: 7020.710 Date: 1-24-02

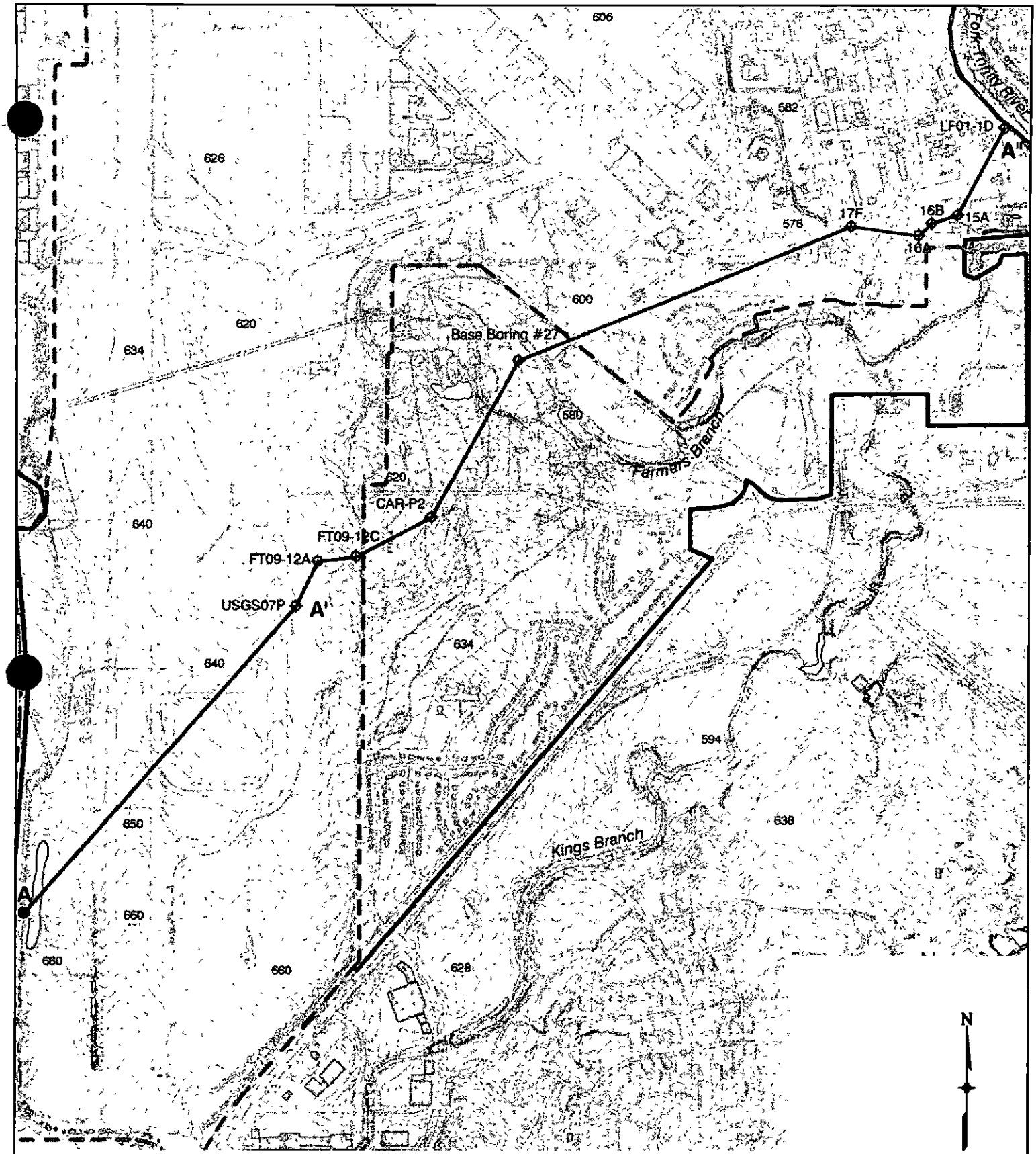
ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE



Source: HydroGeoLogic, 2000

FIGURE: 2–5

Map View of Geologic Cross Section A–A'–A"

EEG No: 7020.710 Date: 3–29–02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

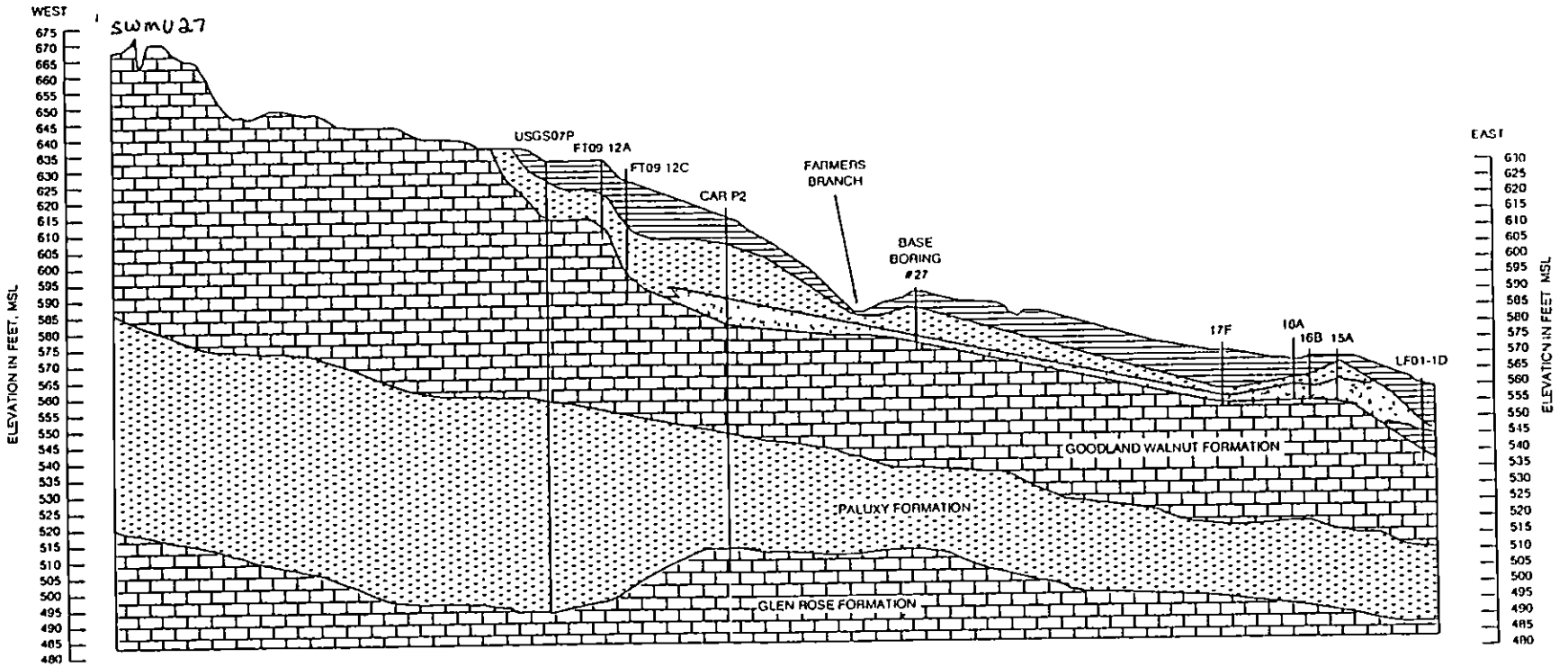
NAS Fort Worth, Texas

Contract No. F41624–00–D–8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

A

A'



NOTES

1 STRATIGRAPHIC CONDITIONS ARE KNOWN ONLY AT THE MONITORING WELLS AND BORINGS, CONTACTS ARE INTERPOLATED BETWEEN CONTROL POINTS

2 WITH THE EXCEPTION OF THE AREA BETWEEN USGS07P AND CAR P2 THE CONTACT BETWEEN THE GOODLAND WALNUT AND PALUXY FORMATIONS DISPLAYS THE REGIONAL DIP OF 35 40 FEET PER MILE

Source: Radian, 1986; HGI, 1999

Figure: 2-6
Generalized Geologic Cross Section of NAS Fort Worth JRB, Texas

EEG No: 7020.710

Date: 1-24-02

ELLIS ENVIRONMENTAL GROUP, LC

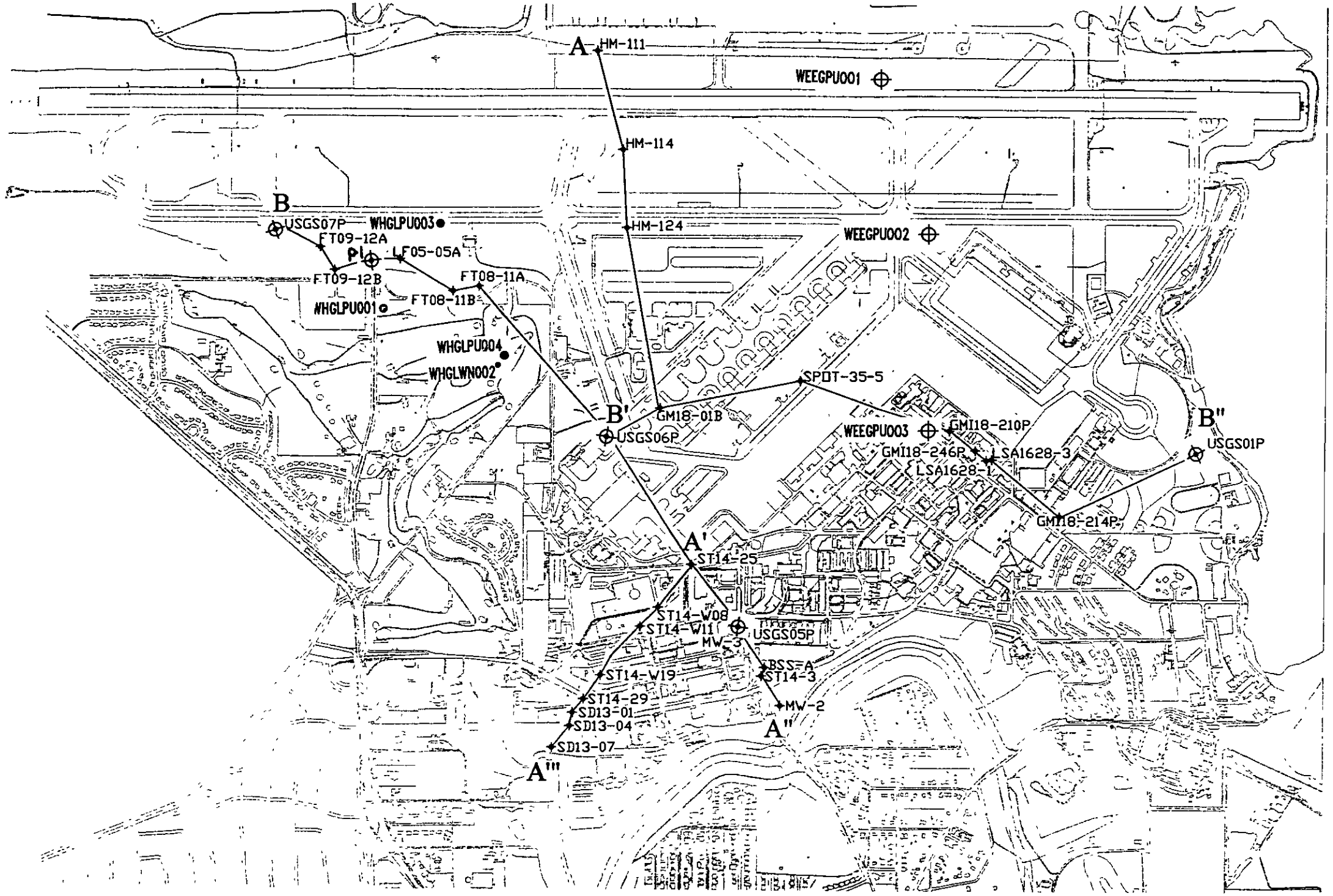
Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client: U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

720 22



Source: HydroGeoLogic, 2000

1,300 650 0 1,300

SCALE: 1" = 1,300 Feet

N

Legend

- Boring location
- A—A' Cross Section Line
- WEEGPU001 Proposed Paluxy Monitoring Well
- WHGLPU001 Existing Paluxy Monitoring Well
- WHGLWN002 Existing Paluxy Monitoring Well
- USGS01P Existing Paluxy Monitoring Well

FIGURE: 2-7

Cross Section Location Map

EEG NO: 7020.710 Date: 3-29-02

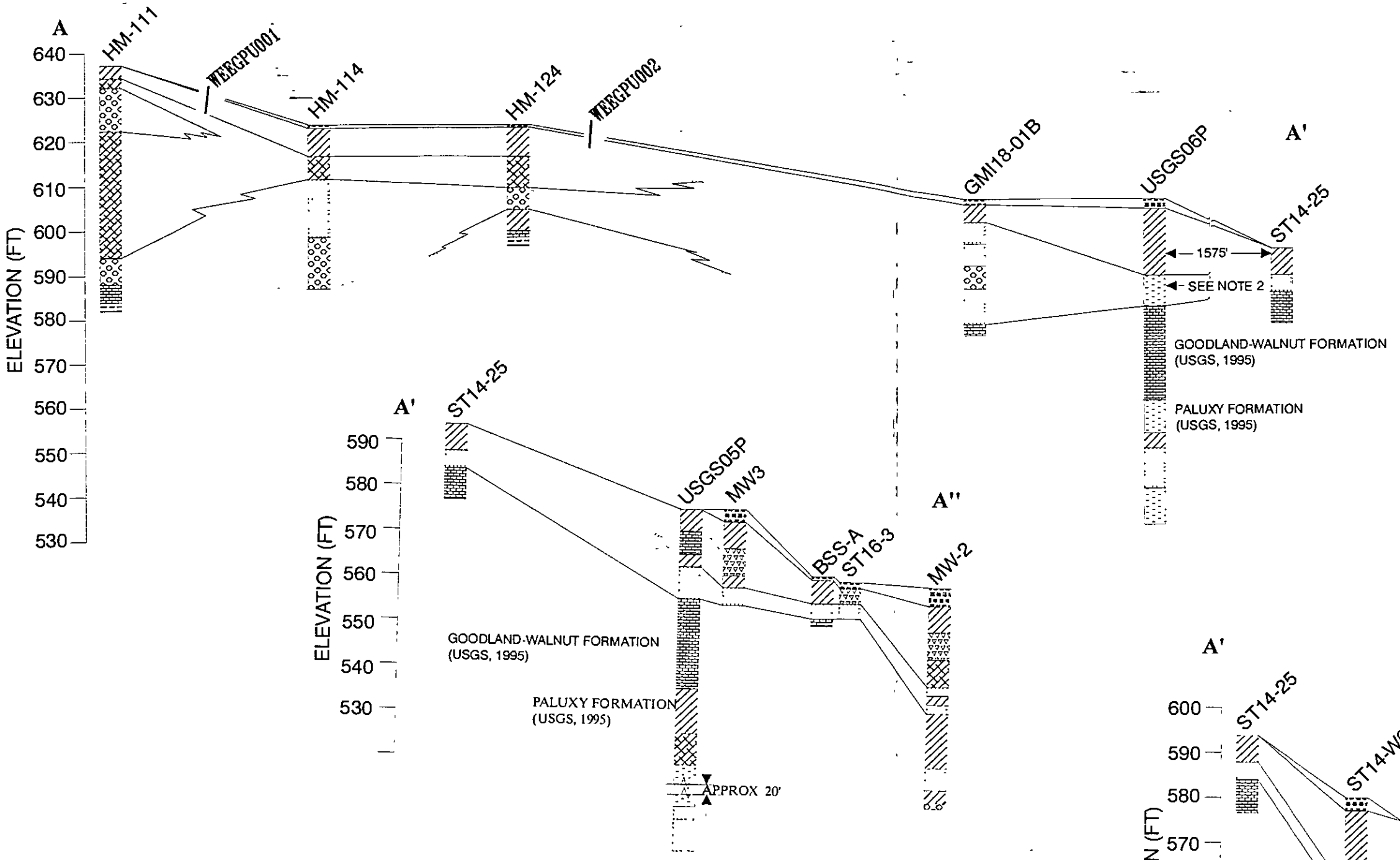
ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE



NOTE

1) SEE FIGURE 2 4 FOR THE CROSS SECTION LOCATION AND BORING LOG REFERENCES

2) THE LITHOLOGIC LOGS FOR CERTAIN USGS BORINGS (USGS, 1996) CHARACTERIZE THESE SEQUENCES AS "SANDSTONE" WHICH, WHEN COMPARED WITH OTHER LOGS IN THIS AREA, SEEMS UNEXPECTED AT THIS ELEVATION IN THE SECTION THEREFORE, HYDROGEOLOGIC HAS CORRELATED THESE UNITS WITH THE TERRACE ALLUVIAL SANDS

1,200 600 0 1,200
SCALE: 1" = 1,200 Feet

Source: HydroGeoLogic, 2000

FIGURE: 2-8

Cross Sections
A-A', A-A", AND A-A'"

EEG ND:7020.710 Date:3-29-02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

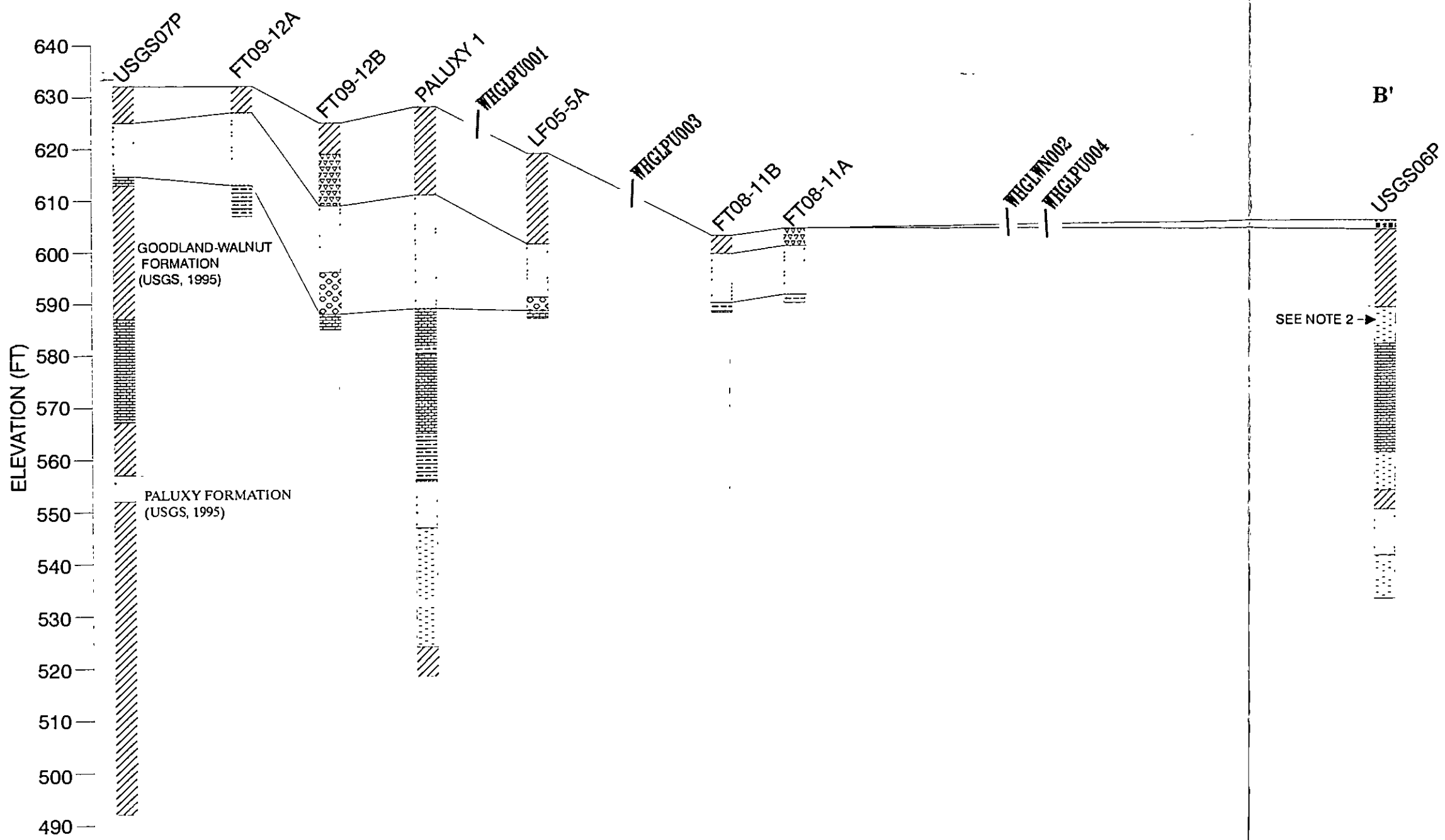
NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

B

B'



NOTE

1) SEE FIGURE 2 4 FOR THE CROSS SECTION LOCATION AND BORING LOG REFERENCES.

2) THE LITHOLOGIC LOGS FOR CERTAIN USGS BORINGS (USGS, 1996) CHARACTERIZE THESE SEQUENCES AS "SANDSTONE" WHICH, WHEN COMPARED WITH OTHER LOGS IN THIS AREA, SEEMS UNEXPECTED AT THIS ELEVATION IN THE SECTION THEREFORE, HYDROGEOLOGIC HAS CORRELATED THESE UNITS WITH THE TERRACE ALLUVIAL SANDS

1,200 600 0 1,200
SCALE: 1" = 1,200 Feet

Source: HydroGeoLogic, 2000

FIGURE: 2–9
Cross Sections
B–B'

EEG NO:7020.710 Date:3–29–02

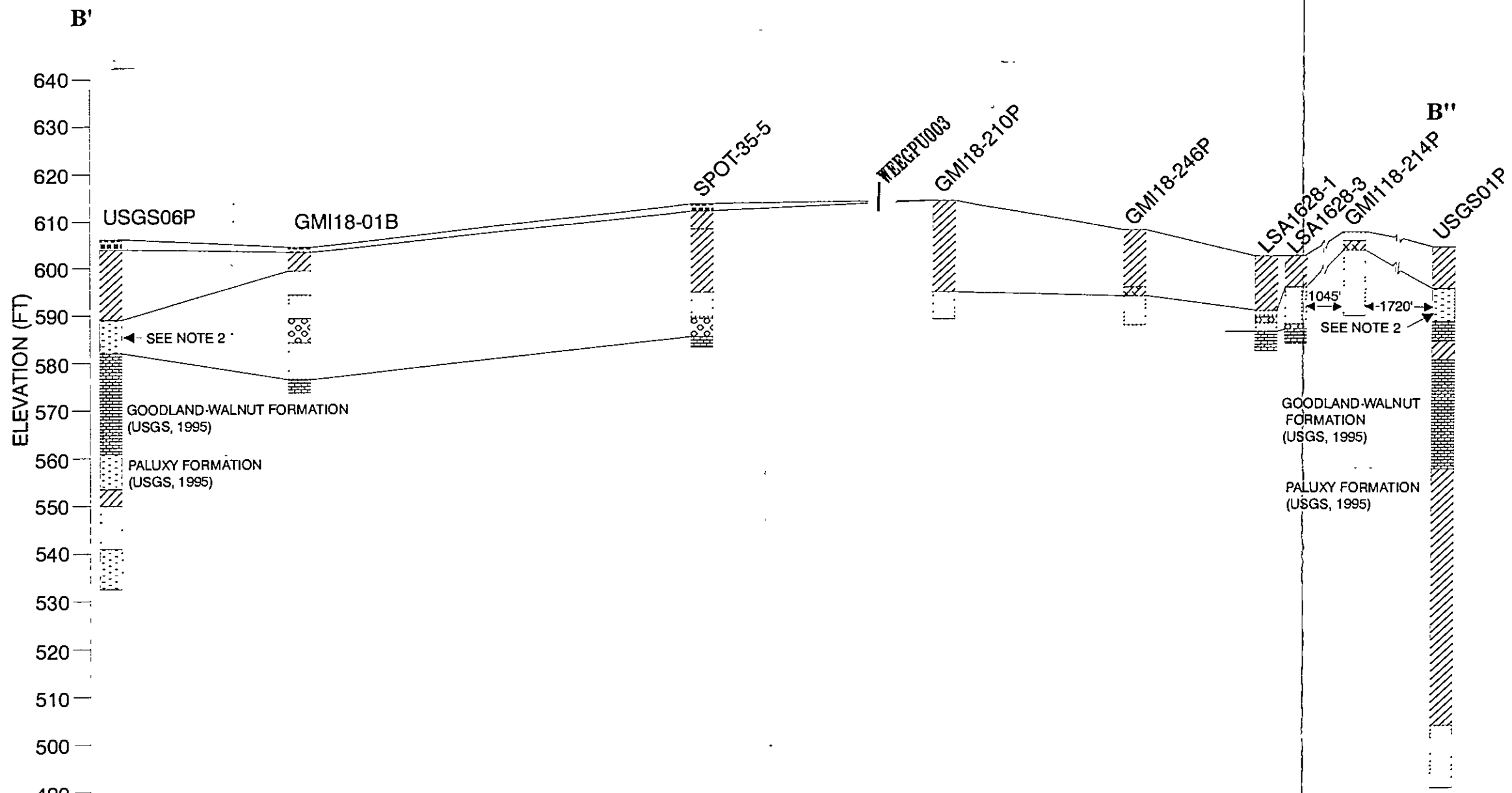
ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624–00–D–8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE



NOTE

1) SEE FIGURE 2 4 FOR THE CROSS SECTION LOCATION AND BORING LOG REFERENCES

2) THE LITHOLOGIC LOGS FOR CERTAIN USGS BORINGS (USGS, 1996) CHARACTERIZE THESE SEQUENCES AS "SANDSTONE" WHICH, WHEN COMPARED WITH OTHER LOGS IN THIS AREA, SEEMS UNEXPECTED AT THIS ELEVATION IN THE SECTION THEREFORE, HYDROGEOLOGIC HAS CORRELATED THESE UNITS WITH THE TERRACE ALLUVIAL SANDS.

1,200 600 0 1,200
SCALE: 1" = 1,200 Feet

Source: HydroGeoLogic, 2000

FIGURE: 2-10
Cross Sections
B'-B"

EEG NO:7020.710 Date:3-29-02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

Table 2-1. Stratigraphic Units at NAS Fort Worth JRB, Texas

Era	System	Series/Group	Stratigraphic Unit	Thickness (Feet)[1]	Lithologic Characteristics[2]	Water-Yielding Characteristics
Cenozoic	Quaternary (1.8 mya to present)	Holocene	Fill material	0	Construction debris	Permeability varies; gravels and sands permeable
			Recent alluvial deposits	0-50	Gravel, sand, silt, clay	Permeability varies, gravels and sands permeable
		Pleistocene	Terrace alluvial deposits	0-60	Gravel, sand, silt, clay	Permeability varies, gravels and sands permeable
Mesozoic	Cretaceous (65 to 140 mya)	Comanchean / Fredericksburg	Goodland limestone	0-40	White fossiliferous limestone, coarsely nodular, resistant, and dense, contains some marl	Impermeable where not weathered; considered confining unit
			Walnut Formation	0 5-30	Medium to dark grey clay and limestone with shell conglomerates, fossiliferous, Gryphaea beds	Very low permeability, considered confining unit
		Comanchean / Trinity	Paluxy Formation	130-175	Light grey to greenish-grey sandstone and mudstone, fine-grained to coarse-grained sandstone	Considered an aquifer, yields small to moderate quantities of water
			Glen Rose Formation	150, range unknown at AFP 4	Brownish-yellow and gray alternating limestone, marl, shale, and sand	Low permeability; considered confining unit in area of AFP 4
			Twin Mountains Formation[3]	200, range unknown at AFP 4	Fine- to coarse-grained sandstone shale and claystone, basal gravel conglomerate	Coarse sandstones and parts of formation considered aquifer, yields moderate to large quantities of water

Notes:

Table adapted from USGS, 1996.

1 = Thickness determined from site logs, except for Glen Rose Limestone and Twin Mountains Formation (Baker et al., 1990, Figure 4, as cited in USGS 1996)

2 = Lithologic characteristics determined from field observations and from Winton and Adkins, 1919, University of Texas, Bureau of Economic Geology, 1972; U S Army Corps of Engineers, 1986; Baker et al , 1990; Environmental Science and Engineering, Inc , 1994, all as cited in USGS 1996.

3 = This stratigraphic name does not conform to the usage of the USGS.

mya = million years ago

2.3.1 Terrace Alluvium Deposits

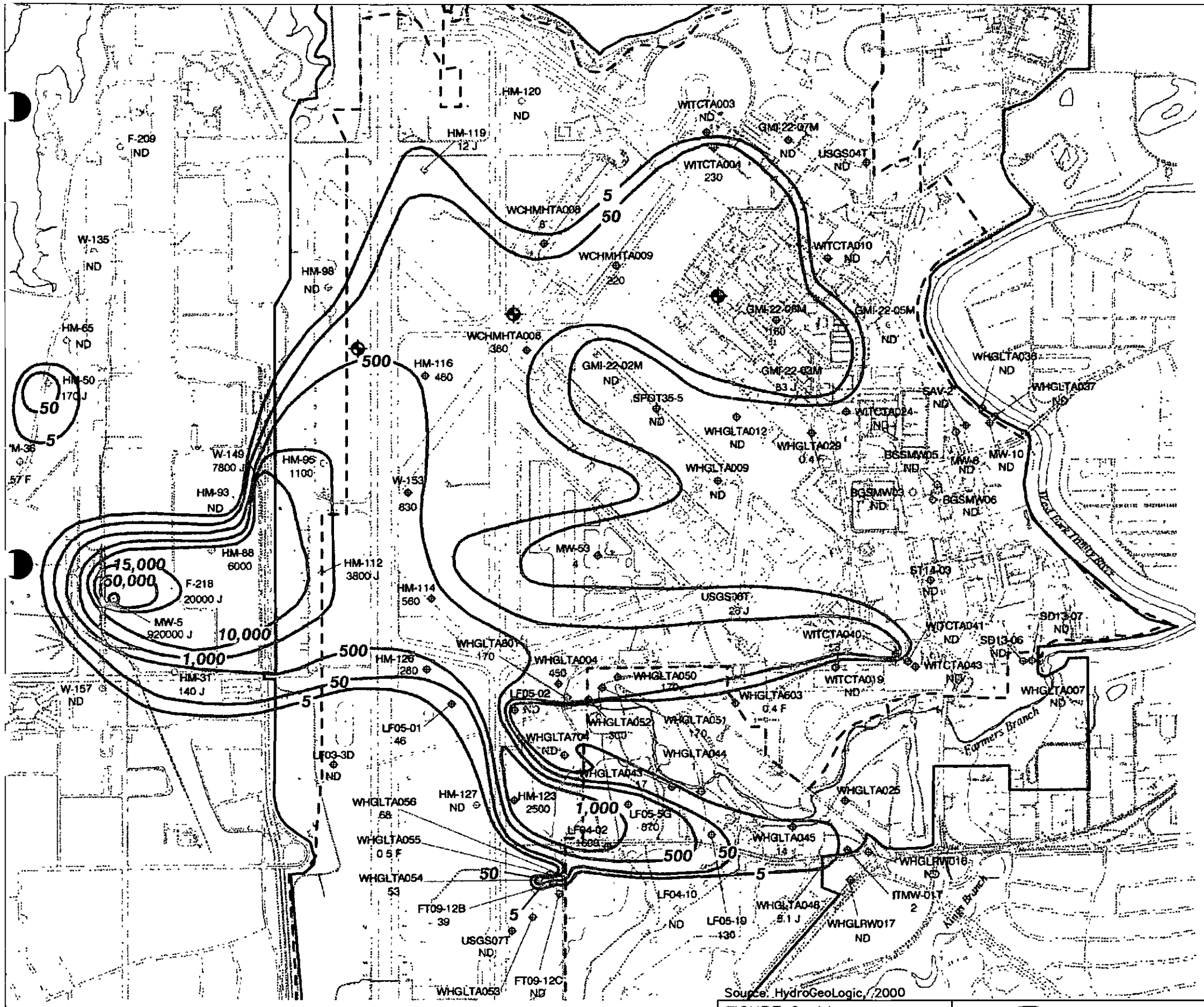
The uppermost groundwater in the area occurs within the pore space of the grains of silt, clay, sand, and gravels deposited by the Trinity River. In some parts of Tarrant County, primarily in those areas adjacent to the Trinity River, groundwater from the terrace deposits is used for irrigation and residential use. However, groundwater from the terrace deposits is not often used as a source of potable water due to its limited distribution, poor yield, and susceptibility to surface/storm-water pollution (USGS, 1996).

Recharge to the water-bearing deposits occurs through infiltration from precipitation and from surface water bodies. Extensive on-site pavement and construction restricts this recharge. Additional recharge, however, comes from leakage in water lines, sewer systems, storm drains, and cooling water systems. This inflow of water to the shallow aquifer locally affects groundwater flow patterns and contamination transport. The estimated hydraulic conductivity of the Terrace Alluvium groundwater is 4.57 gallons per day per square foot (gpd/ft^2) (Radian, 1989).

The primary flow direction of water in the Terrace Alluvium is generally eastward toward the West Fork Trinity River, although localized variations exist across the Base. Groundwater flow on the southern side of the Former Carswell AFB is to the northeast. The hydraulic gradient across the Base is variable, reflecting variations in the flow direction and localized recharge. Groundwater discharge occurs into surface water on-site, specifically Farmers Branch Creek. Potentiometric maps of NAS Fort Worth JRB Terrace Alluvium groundwater developed from data obtained in previous gauging events show an easterly trend in groundwater flow across the Base toward the West Fork Trinity River.

2.3.1.1 Groundwater Contamination

Trichloroethene (TCE) concentrations exist up to 2,500 micrograms per liter (µg/L) within the Terrace Alluvium at Carswell. No potable water supply wells are completed in the Terrace Alluvium within 0 5 mile of NAS Fort Worth JRB. TCE contamination in groundwater at NAS Fort Worth JRB is generally described as one plume. The portion of the TCE plume that is migrating west to east in the flightline area, or northern portion of the Base, is referred to as the northern lobe; the portion migrating west to east in the landfill area, or southern portion of the Base, is referred to as the southern lobe. **Figure 2-11** provides the approximate extent of the TCE plume.



Source: HydroGeoLogic, 2000

N

1,200 600 0 1,200

SCALE: 1" = 1,200 Feet

Legend

- NAS Fort Worth JRB (Carswell Field)
- Former Carswell Air Force Base
- 500 — TCE Concentration Contour (µg/L)
- MW-53 ◆ — NAS Fort Worth JRB Basewide Sampling Well
- 50 — TCE Concentration (µg/L)
- WHGLTA036 ◆ — Monitoring well data collected as part of other investigations during April 2001.
- ND — TCE Concentration (µg/L)
- HM-119 ◆ — AFP 4 Semi-Annual Monitoring Well
- 17 — TCE Concentration (µg/L)
- SD13-07 ◆ — Monitoring well data collected as part of other investigations during July 2001.
- ND — TCE Concentration (µg/L)

ND = Not Detected at Laboratory Method Detection Limit of 0.5µg/L

F = The analyte was positively identified, but the associated value is below the PQL.

J = The analyte was positively identified, but the quantitation is an estimation.

Legend

◆ = Proposed Paluxy Monitoring Well Locations

File: 17A-86
D.E.

FIGURE: 2-11

TCE Plume
Terrace Alluvium Deposits
April through July, 2001

EEG NO: 7020.710 Date: 3-29-02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

2.3.2 Goodland / Walnut Aquitard

The groundwater within the terrace deposits is isolated from groundwater within the lower aquifers by the low permeability rocks of the Goodland Limestone and Walnut Formations. The primary inhibitors to vertical groundwater movement within these units are the fine-grained clay and shale layers that are interbedded with layers of limestone. Some groundwater movement does occur between the individual bedding planes of both of these units, but the vertical hydraulic conductivity has been calculated to range between 1.2×10^{-9} centimeters per second (cm/s) to 7.3×10^{-11} cm/s for the NAS Fort Worth JRB and AFP 4 area. This corresponds to a vertical advective velocity rate that ranges between 1.16×10^{-3} feet per day (ft/d) to 5.22×10^{-3} ft/d (ESE, 1994). During the Risk Assessment/Focus Feasibility Study (HydroGeoLogic, 2000b), the Walnut Formation was observed during monitoring well installation in the Southern Lobe TCE plume to be fractured and appeared to have higher hydraulic conductivities than the Upper Paluxy. A monitoring well (WHGLWN002) was installed in the Walnut Limestone Formation in order to characterize the unit.

At the AFP 4 "window area," the Goodland/Walnut Aquitard is breached, and the Alluvial Terrace groundwater is in direct communication with the groundwater in the Paluxy Aquifer. A significant number of monitoring wells and borings have been advanced on NAS Fort Worth JRB, and no evidence has been found indicating that a similar window exists on the Base property.

2.3.3 Paluxy Aquifer

The Paluxy Aquifer is an important source of potable groundwater for the Fort Worth area. Many of the surrounding communities, particularly White Settlement, obtain their municipal water supplies from the Paluxy Aquifer. Groundwater from the Paluxy Aquifer is also used in some of the surrounding farms and ranches for agricultural purposes. Due to the extensive use of the Paluxy Aquifer, water levels have declined significantly over the years. Water levels in the NAS Fort Worth JRB vicinity have not decreased as much as in the Fort Worth area due to its proximity to the Lake Worth recharge area and the fact that the Base does not use water from the Paluxy Aquifer. Drinking water at the Base is supplied by the City of Fort Worth, which uses Lake Worth as its water source. The groundwater of the Paluxy Aquifer is contained within the openings created by gaps between bedding planes and cracks and fissures in the sandstones of the Paluxy Formation. Just as the Paluxy Formation is divided into upper and lower sand members, the aquifer is likewise divided into upper and lower aquifers. The upper sand is finer-grained and contains a higher percentage of shale than the lower sand. Hydraulic conductivity and transmissivity within the upper sand is calculated to be 130 to 140 gpd/ft^2 and 1,263 to 13,808 gallons per day per foot (gpd/ft), respectively (Radian, 1989).

During 2000, several data gap investigations were conducted in support of a Risk Assessment/Focused Feasibility Study (HydroGeoLogic, 2000b). As part of the investigations, three monitoring wells were installed and screened in the Paluxy upper sands (WHGLPU001, WHGLPU003, and WHGLPU004). Well completion details are presented in Appendix C. TCE concentrations in WHGLPU001 ranged from non-detect to 5 µg/L over the three sampling events. No other deep wells at Carswell have contained volatile organic compounds (VOCs).

2.3.4 Glen Rose Aquitard

Below the Paluxy Aquifer are the fine-grained limestone, shale, marl, and sandstone beds of the Glen Rose Formation. The thickness of the formation ranges from 250 to 450 feet. Although the sands in the Glen Rose Formation yield small quantities of groundwater in the area, the relatively impermeable limestone acts as an aquitard restricting water movement between the Paluxy Aquifer above and the Twin Mountains Aquifer below.

2.3.5 Twin Mountains Aquifer

The Twin Mountains Formation is the oldest and deepest water supply source used in the NAS Fort Worth JRB area. The Twin Mountains Formation occurs approximately 600 feet below NAS Fort Worth JRB with a thickness of between 250 to 430 feet. Recharge to the Twin Mountains Aquifer occurs west of NAS Fort Worth JRB where the formation crops out. Groundwater movement follows the regional eastward slope of the bedrock. Like the groundwater in the Paluxy Aquifer, the Twin Mountains groundwater occurs under unconfined conditions in the recharge area and becomes confined as it moves downgradient. Transmissivities in the Twin Mountain Aquifer range from 1,950 to 29,700 gpd/ft and average 8,450 gpd/ft in Tarrant County.

3.0 Proposed Field Activities

3.1 Northern Lobe TCE Plume Investigation

Three monitoring wells will be installed within the Northern Lobe TCE Plume to determine impact, if any, to the Paluxy Aquifer. All three wells will be installed within the boundaries of NAS Fort Worth JRB. The proposed well locations are shown on **Figure 2-11**. Actual well locations may deviate slightly from the proposed locations due to cultural influences, e.g., buildings, buried utilities, overhead lines.

All three wells will be advanced approximately 15 feet into the Paluxy Formation, screened within the uppermost portion of the Paluxy, and completed as groundwater monitoring wells (**Figure 3-1**). The monitoring wells will be installed as 2-inch polyvinyl chloride (PVC) wells with 10 feet of screen set within the Paluxy. A Schedule of the field activities is presented in Appendix D

3.2 General Drilling Practices

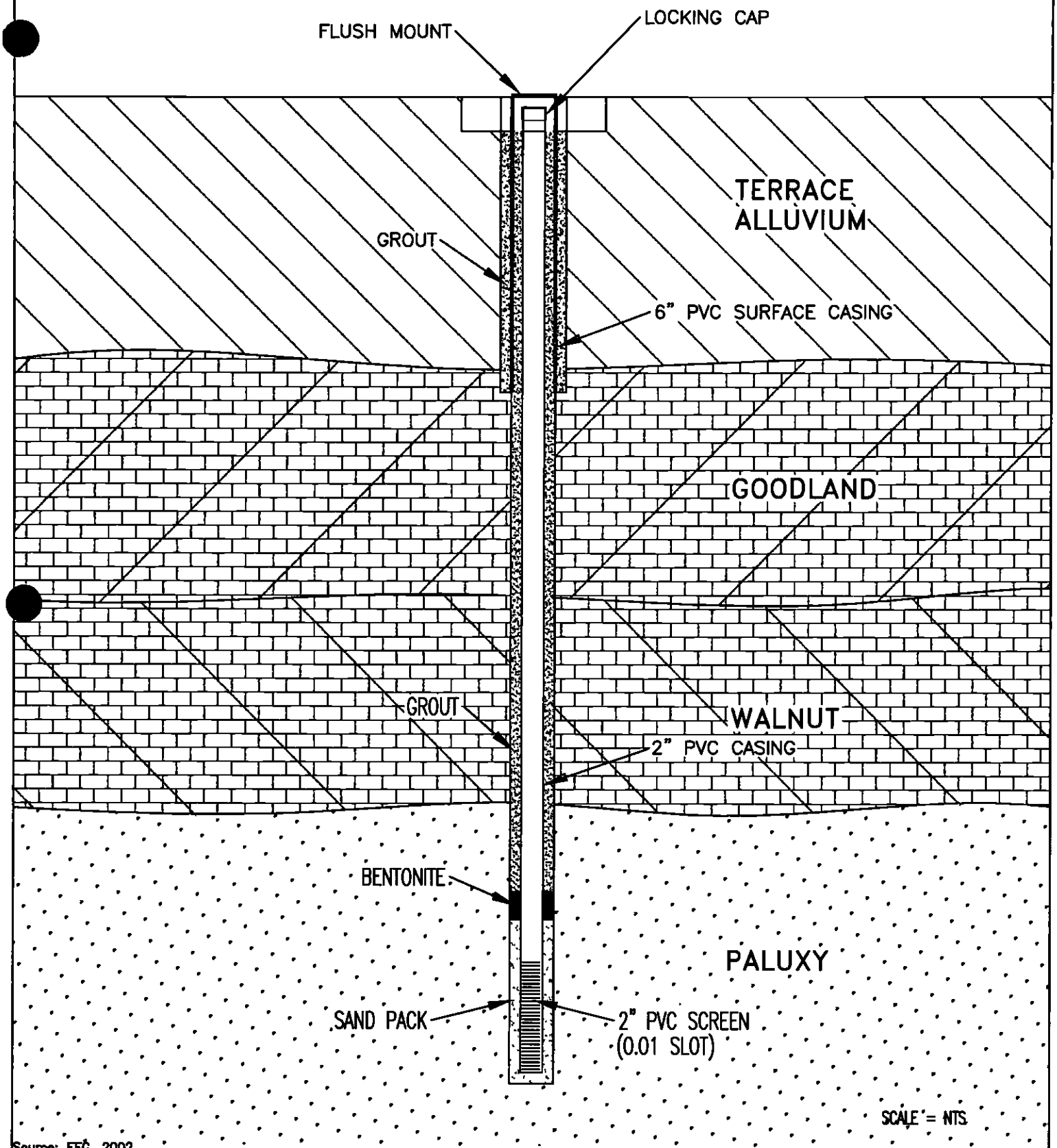
All drilling activities shall conform to State and local regulations and will be supervised by a professional geologist or engineer. Ellis Environmental Group, LC (EEG) will obtain permits and other documents required by State and local authorities.

The location of borings will be coordinated, in writing, with the AFCEE Base Point of Contact (Mike Dodyk) and the Public Works Officer (or equivalent) prior to drilling. Mud-rotary and coring techniques will be used for the drilling of the three borings. EEG and its subcontractors will take measures to prevent cross-contamination between aquifers. Casing will be set through the unconsolidated alluvial sediments (Terrace Alluvium) prior to coring through the Goodland and Walnut Formations, with total depth approximately 15 feet into the Paluxy Formation (approximately 80 feet total depth).

Drilling fluids used during mud-rotary operations will consist of 100 percent sodium bentonite. A log of drilling activities will be kept in a bound field notebook. Information logged will include location, time on site, personnel and equipment on site, downtime, materials used, samples collected, measurements taken, and any other pertinent information necessary to reconstruct field activities at a later date. At the end of each day, the drilling supervisor will complete a Log of Daily Time and Materials Form. Refer to the Field Sampling Plan, Appendix A.

EEG will dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the AFCEE Base Point of Contact (Mike Dodyk) and Public Works Officer (or other designated NAS Fort Worth JRB representative).

TYPICAL PALUXY MONITORING WELL



Source: EEG, 2002

FIGURE: 3-1

Typical Paluxy Well Diagram

EEG No: 7020.710 Date: 3-29-02

ELLIS ENVIRONMENTAL GROUP, LC

Paluxy Wells Work Plan

NAS Fort Worth, Texas

Contract No. F41624-00-D-8032
Delivery Order No. 009

Client:
U.S. AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE

3.2.1 Sampling and Logging

Lithology in all boreholes and of all bedrock cores will be logged. The boring log form will be used for recording the lithologic information. Information on the boring logs will include borehole location, drilling information, sampling information, and recovery and sample description information. Additional information recorded will include depth to water table, caving or sloughing of the borehole, changes in drilling rate, presence of organic material, and presence of fractures or voids in consolidated material and formation tops.

Lithologic description of consolidated materials will give special attention to fractures, vugs, solution cavities and their filling or coating, and any other characteristics affecting permeability.

All samples will be monitored with an organic vapor meter (OVM). The samples shall be handled as to minimize the loss of volatiles. Cuttings will be examined for any potential hazardous characteristics. Materials suspected of being hazardous due to abnormal color, odor, or OVM readings will be containerized in conformance with RCRA, State, and local requirements.

3.2.2 Monitoring Well Borehole Requirements

The inside diameter of the borings will be at least 4 inches larger than the outside diameter of the casing and well screen. The total outside diameter of the boring will not exceed 8 inches. In each of the three Paluxy Wells, an outer casing extending through the alluvium will be installed.

The completed monitoring wells will be sufficiently straight to allow passage of pumps or sampling devices and will be plumb within one degree of vertical where water level is greater than 30 feet below ground surface, unless approved by the Air Force Center for Environmental Excellence (AFCEE), who may waive a plumbness requirement. EEG or its drilling contractor will use a single-shot deviation tool to demonstrate plumbness. Monitoring wells not meeting plumbness specifications will be redrilled and/or reconstructed.

3.2.3 Casing Requirement

The casing requirements are as follows.

1. All casing will be new, unused, and decontaminated.
2. Glue will not be used to join casings, and casings will be joined only with compatible welds or couplings that will not interfere with the planned use of the well.
3. All PVC will conform to American Society for Testing and Materials (ASTM) Standard F-480-88A or National Sanitation Foundation Standard 14.
4. The casing will be straight and plumb within the tolerance stated for the borehole.
5. The driller will cut a notch in the top of the casing to be used as a measuring point for water levels.

All monitoring wells will be constructed using flush-threaded 2-inch-diameter Schedule 40 PVC casing. The notches cut in the top of the monitoring well casings for water level measuring points will be oriented on the north side of each casing.

3.2.4 Well Screen Requirements

AFCEE well screen requirements are as follows:

1. All requirements that apply to casing will also apply to well screen, except strength requirements.
2. Monitoring wells will not be screened across more than one water-bearing unit.
3. Screens will be factory-slotted and wrapped.
4. Screen slots will be sized to prevent 90 percent of the filter pack from entering the well.
5. The bottom of the screen will be capped, and the cap will be joined to the screen by threads.

The monitoring wells will be constructed using flush-mounted 2-inch-diameter Schedule 40 PVC casing and screen. Paluxy Wells will consist of a 10-foot section of 10-slot (0.010-inch) PVC. Bottoms of the screens will be capped using flush-threaded PVC caps.

3.2.5 Annular Space Requirements

Annular space requirements are as follows:

1. The annular space will be filled with a filter pack, a bentonite seal, and casing grout between the well string and the borehole wall.
2. As the annular space is being filled, the well string will be centered and suspended such that it does not rest on the bottom of the hole.

For wells greater than 50 feet deep, at least two stainless steel centralizers will be used, one at the bottom and one at the top of the screen. Additional centralizers will be used as needed.

3.2.6 Filter Pack Requirements

The filter pack will consist of silica sand or gravel and will extend from the bottom of the hole to at least 2 feet above the top of the well screen. After the filter pack settles, the top of the sand pack will be sounded to verify its depth during placement Additional filter pack will be emplaced as required to return the level of the pack to 2 feet above the screen.

The filter pack material will be clean, inert, and well-rounded, and will contain less than 2 percent flat particles. The sand will be certified free of contaminants by vendor or subcontractor. If decontamination is necessary, the methods shall be approved in writing by AFCEE. The grain size of the filter pack material will be determined based on existing grain size distribution and uniformity coefficient compatible with the formation materials and the screen.

The filter pack will not extend across more than one water-bearing unit. The filter pack will be emplaced with a bottom discharge tremie pipe to prevent bridging. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. EEG will record the volume of the filter pack emplaced in the well. If potable water is necessary to place the filter pack, EEG will obtain prior approval from the regulatory agency providing oversight and will ensure that no contaminants are introduced into the well.

3.2.7 Bentonite Seal Requirements

Bentonite seal requirements are as follows:

1. The bentonite seal will consist of at least 2 feet of bentonite between the filter pack and the casing grout.
2. The bentonite will be hydrated before placement and shall be installed by pump tremie methods.
3. Only 100 percent sodium bentonite shall be used.

3.2.8 Casing Grout Requirements

Casing grout requirements are as follows:

1. Casing grout will extend from the top of the bentonite seal to ground surface.
2. Grout will be mixed in the following proportions: 94 pounds of neat Type I Portland or API Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water.
3. All grout will be pump tremied using a side-discharge tremie pipe, and pumping will continue until 20 percent of the grout has been returned to the surface.
4 In wells where the bentonite seal is visible and within 30 feet of the land surface, the 20 percent return is not necessary so long as the tremie pipe is pulled back as the grout is emplaced.

3.2.9 Surface Completion Requirements

Flush-mounted completions will incorporate the casing cut approximately 3 inches below the land surface and provide a water-tight casing cap to prevent surface water from entering the well. A ventilated well cap will be used to allow escape of gas. A freely draining valve box with a locking cover will be placed over the casing. The top of the casing will be at least one foot above the bottom of the box. The valve box lid will be centered in a 3-foot-diameter, 4-inch-thick concrete pad that slopes at a grade away from the box 1/4 inch per foot. The identity of the well will be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well, the concrete pad and valve box/lid assembly will be constructed to meet the strength requirements of surrounding surfaces.

3.3 Monitoring Well Purging and Analytical Purging

The monitoring wells will be sampled utilizing a low-flow purge technique, the procedure recommended for AFCEE projects. Detailed sampling protocol is included in Appendix C of the Final 2001 GSAP (HydroGeoLogic, 2001) and in the Field Sampling Plan, Appendix A.

3.3.1 Purging Procedures

MicroPurge® Well Wizard® bladder pumps will be used to purge and sample the monitoring wells. The bladder pump is ideal for low-flow purging and can sustain pumping rates between 0.1 to 0.5 liter/minute minimizing turbidity, oxygenation, mixing of chemically distinct zones, and potential loss of VOCs.

During all purging, water quality stabilization criteria (pH, temperature, dissolved oxygen [DO], oxidation-reduction potential [Eh] turbidity, and electrical conductance [EC]) will be continuously monitored using a flow-through cell. The measurements will be recorded on the groundwater field sampling data sheets. The criteria for sample collection will be the stabilization of water quality parameters as follows:

- Temperature: ±1°C
- pH: ±0.1 units
- EC: ±3% full scale range
- DO: ±0.10 milligrams per liter or 10% of value (whichever is greater)
- Eh: ±10 mV
- Turbidity: ±10% and less than 10 Nephelometric turbidity units whenever possible

3.3.2 Sampling Procedures

The monitoring wells will be sampled after the water quality stabilization criteria are met. If the parameters do not stabilize, the samples will be collected when a minimum subset of the above parameters stabilize as described in Appendix C of the Final 2001 GSAP (HydroGeoLogic, 2001).

Samples for VOC analysis will be collected first at each monitoring well, followed by the samples for semi-volatiles and then metals. Required sample containers, preservation methods, volumes, and holding times are provided in Section 6.0 of the Field Sampling Plan (Appendix A)

3.4 Investigation-Derived Waste Management

All purge and decontamination water will be stored in a poly tank at the IDW storage area located behind the RV storage area (AOC 6), then disposed of as described in the FSP (Appendix A).

4.0 References

Environmental Science and Engineering, Inc. (ESE), 1994. Summary of Remediation Projects at Air Force Plant 4 and Carswell Air Force Base.

HydroGeoLogic, Inc (HydroGeoLogic), 2000b. Final Work Plan Data Gap Investigation of Southern Lobe TCE Plume, NAS Fort Worth JRB, Texas, August 2000.

HydroGeoLogic, Inc. (HydroGeoLogic), 2001. Final 2001 Basewide Groundwater Sampling and Analysis Plan, NAS Fort Worth JRB, Texas, May 2001.

National Weather Service, 2002. www.nws.noaa.gov

Radian Corporation, 1991. Installation Restoration Program RI, Stage 2 Final Report, Carswell Air Force Base.

US Geological Survey (USGS), 1996. Hydrogeology at Air Force Plant 4 and Vicinity, and Water Quality of the Paluxy Aquifer, Fort Worth, Texas, Water Resources Investigations Report 96-4091, January 1996.

TAB

APPENDIX A

FINAL

Field Sampling Plan

Paluxy Wells Installation and Sampling *at* Naval Air Station Fort Worth Joint Reserve Base, TX

Contract No. F41624-00-D-8032
Delivery Order No. 0009

Prepared for
Air Force Center for Environmental Excellence
Brooks Air Force Base, TX

Prepared by
Ellis Environmental Group, LC
414 SW 140th Terrace
Newberry, FL 32669
(352) 332-3888

March 2002

Contents

Figures

Tables

Attachment A. Field Forms

Abbreviations & Acronyms

°C	degrees Celsius
3-D	three-dimensional
bgs	below ground surface
Fe	iron
JP-4	jet propulsion (grade 4) fuel
L/min	liter per minute
AFBCA	Air Force Base Conversion Agency
AFCEE	U.S. Air Force Center for Environmental Excellence
AGE	aerospace ground equipment
AOC	area of concern
ASTM	American Society for Testing and Materials
BRAC	Base Realignment and Closure
CAFB	Carswell Air Force Base
CFR	Code of Federal Regulations
COC	chain-of-custody
DNAPL	Dense Non-Aqueous Phase Liquids
DO	dissolved oxygen
DPT	direct push technology
DRMO	Defense Reutilization Management Office
EC	electrical conductivity
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
HSA	hollow stem auger
HSC	Health and Safety Coordinator
HSP	Health and Safety Plan
HW	hazardous waste
IDW	investigation-derived waste
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
IT	International Technology Corporation
JRB	Joint Reserve Base
LNAPL	light non-aqueous phase liquid
MEK	methyl ethyl ketone
MS	matrix spike
MSD	matrix spike duplicate
NAS	Naval Air Station
NDI	non destructive inspection
NGVD	National Geodetic Vertical Datum
NTU	nephelometric turbidity unit
OD	outside diameter
ORP	oxidation-reduction potential
OVA	organic vapor analyzer

OWS	oil/water separator
PAH	polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenol
PID	photoionization detector
PM	Project Manager
POC	point-of-contact
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA facility assessment
RFI	RCRA facility investigation
RRS	Risk Reduction Standards
RV	recreational vehicle
SAP	Sampling and Analysis Plan
SVOC	semi volatile organic compound
SWMU	solid waste management unit
TCE	trichloroethylene
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic carbon
TPH	total petroleum hydrocarbon
UN	United Nations
USAF	United States Air Force
USCS	United Soil Classification System
USGS	U. S Geological Survey
VOC	volatile organic compound
VSI	visual site inspection
WAA	waste accumulation area
WP	Work Plan

1.0 Introduction

The Field Sampling Plan (FSP) presents the requirements and procedures for conducting field operations and investigations. This project specific FSP has been prepared to ensure that (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible. This site specific FSP and the Basewide Quality Assurance Project Plan (QAPP) (HydroGeoLogic, 1998), shall constitute, by definition, the Sampling and Analysis Plan (SAP).

Guidelines followed in the preparation of this plan are set out in the Naval Air Station (NAS) Fort Worth Resource Conservation and Recovery Act (RCRA) Permit HW-50289 issued by the TNRCC on February 7, 1991. Additional reference documents followed in the preparation of this FSP include "AFCEE's Model Field Sampling Plan" (AFCEE, 1997) and the U.S. Air Force Center for Environmental Excellence (AFCEE) "Handbook for the Installation Restoration Program (IRP) for Remedial Investigations and Feasibility Studies" (AFCEE, 1993).

This FSP is required reading for all staff participating in the work effort. The FSP shall be in the possession of the field teams during sample collection. Ellis Environmental Group, LC (EEG) and its subcontractors shall be required to comply with the procedures documented in this FSP in order to maintain comparability and representativeness of the collected and generated data.

Controlled distribution of the FSP shall be implemented by EEG to ensure that the current approved version is being used. A sequential numbering system shall be used to identify controlled copies of the FSP. Controlled copies shall be provided to applicable United States Air Force (USAF) managers, regulatory agencies, remedial project managers (PMs), PMs, and quality assurance (QA) coordinators. Whenever USAF revisions are made or addenda added to the FSP, a document control system shall be put into place to ensure that (1) all parties holding a controlled copy of the FSP shall receive the revisions/addenda, and (2) outdated material is removed from circulation. The document control system does not preclude making and using copies of the FSP; however, the holders of controlled copies are responsible for distributing additional material to update any copies within their organizations. The distribution list for controlled copies shall be maintained by EEG.

2.0 Project Background

The following sections briefly describe the objectives of the Paluxy Well Installation and Sampling and the rationale for implementing this work plan (WP).

2.1 Site History

Carswell Air Force Base (CAFB) was officially closed on September 30, 1993. A parcel of the former CAFB, NAS Fort Worth Joint Reserve Base (JRB), is in the process of being transferred from Air Force to Navy management. Before the property transfer can be completed, required environmental investigations of potential contamination related to USAF activities at the NAS Fort Worth property are to be completed and contaminated sites are to be remediated.

This investigation will be managed by the USAF under the Environmental Restoration Account. Other portions of the former CAFB that are not being transferred to the Navy remain under Base Realignment and Closure (BRAC) funding and management.

2.2 Project Objectives

The overall objective of this project, and purpose of this field investigation, is to gather sufficient data to determine if volatile organic contaminants (VOCs) have migrated vertically from the surficial Terrace Alluvium into the Paluxy Formation.

Field studies that will be used include the following:

- Monitoring well installation and sampling. Three site boreholes will be advanced to the base of the Terrace Alluvium until bedrock is encountered. The boring will be cased to prevent migration of fluids from the Terrace Alluvium into the bedrock. Cores will be advanced from the top of the bedrock through the Goodland Limestone and Walnut Formation until approximately 15 feet into the Paluxy Formation. Data will be collected from existing records of previously installed monitoring wells.

- After monitoring wells are installed, a minimum of two sampling rounds will be conducted to determine if VOC contamination is present in the Paluxy Aquifer.

2.3 Project Site Description

NAS Fort Worth JRB is located in Tarrant County, eight miles west of downtown Fort Worth, Texas (see Figure 2-1 of WP). The Base is located approximately 32 degrees north latitude and 97 degrees west longitude. The NAS Fort Worth JRB property, totaling approximately 2,555 acres, is comprised of the main base and two noncontiguous parcels. The main base, approximately 2,264 acres, is bordered by Lake Worth to the north, the West Fork of the Trinity River and Westworth Village to the east, Fort Worth to the northeast and southeast, White Settlement to the west and southwest, with Air Force Plant (AFP) 4 to the west.

The area surrounding NAS Fort Worth JRB is dominantly suburban residential. Cities and municipalities surrounding NAS Fort Worth JRB, with their respective populations from the 1990

census, include Fort Worth (447,000), Westworth Village (2,350), Sansom Park Village (3,928), River Oaks (6,580), and White Settlement (15,472).

2.4 Project Site Contamination History

TCE contamination in groundwater at NAS Fort Worth JRB is generally described as one plume. The portion of the TCE plume that is migrating west to east in the flightline area, or northern portion of the base, is referred to as the northern lobe; the portion migrating west to east in the landfill area, or southern portion of the base, is referred to as the southern lobe. Although the major contaminant in the groundwater plume is TCE, TCE-related compounds, mainly cis-1-2-dichloroethene (cis-1,2,DCE), but including trans-1,2-dichloroehtene (trans-1,2-DCE), tetrachloroethene, and vinyl chloride, are also present in groundwater beneath the base. Figure 2-11 of the WP provides the approximate extent of the TCE and cis-1,2-DCE plumes.

3.0 Project Scope and Data Quality Objectives

The following sections describe the objectives of the field activities that will be conducted during the investigation.

3.1 Data Quality Objectives

The data generated by this project must be of sufficient quality and quantity to support the overall project objective: the long-term monitoring of the groundwater located at NAS Fort Worth JRB under the TNRCC Risk Reduction Program. The objectives and focus of this work will be to characterize the nature and extent of any contamination detected.

Data from the following categories are required for this study:

- Site Characterization – Data will be used to evaluate physical and chemical properties of the groundwater. The data will also be used to characterize the nature and extent of any contaminants detected.

- Health and Safety – Data will be used to establish the level of protection needed for the work party and other site-related personnel. This data will be gathered during intrusive activities by the use of organic vapor analyzers.

Site characterization data will be a combination of screening data and definitive data. Health and safety data will be collected as screening data. The definitions of screening data and definitive data, as established by the "Data Quality Objectives Process for Superfund Interim Final Guidance" (U.S. Environmental Protection Agency [EPA]/540/G-93/071, 1993), are as follows.

- Screening Data with Definitive Confirmation – Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup Screening data provides analyte identification and quantification. Although the quantification may be determined using analytical methods with quality assurance/quality control (QA/QC) procedures and criteria associated with definitive data, screening data without associated confirmation data are not considered to be data of known quality.

- Definitive Data – Definitive data will be generated using rigorous analytical methods, such as approved EPA reference methods. Data will be analyte-specific, with confirmation of analyte identity and concentration. These methods produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

The data generated by the laboratory analysis of samples must be sufficiently sensitive to allow comparison of the results to the TNRCC RRS. The Basewide QAPP (HydroGeoLogic, 1998) describes each method that will be performed as part of the investigation and outlines the quality

assurance measures the contract laboratory must follow. The analysis methods selected for samples collected from NAS Fort Worth JRB will produce screening as well as definitive data. **Table 3-1** presents the data quality levels and intended use for data collected during the RFI.

Table 3-1. Data Quality Levels and Intended Use for Field and Laboratory Data

Sampling Matrix	Parameters	Analytical Method	Field/Lab Analysis	Data Quality Level	Intended Use
Groundwater	VOCs	8260A	Lab	Definitive	Nature/extent of contaminants

3.2 Sample Analysis Summary

Provision VIII of Permit HW-50289 requires that soil and groundwater samples submitted for chemical analysis be analyzed in accordance with EPA SW-846 for all Appendix IX constituents, unless a shorter list can be justified. The Air Force has provided justification of a reduced list of analyses for the RFI in a letter to the TNRCC dated April 20, 1999. Table 3 2 provides a summary of the materials handled or potentially handled at each of the subject sites along with the proposed analyses for each site.

3.3 Proposed Field Activities

Three monitoring wells will be installed within the Northern Lobe TCE Plume to determine impact, if any, to the Paluxy Aquifer. All three wells will be installed within the boundaries of NAS Fort Worth JRB. The proposed well locations are shown on Figure 2-11 in the Work Plan Actual well locations may deviate slightly from the proposed locations due to cultural influences, e.g., buildings, buried utilities, overhead lines.

All three wells will be advanced approximately 15 feet into the Paluxy Formation, screened within the uppermost portion of the Paluxy, and completed as groundwater monitoring wells. The monitoring wells will be installed as 2-inch polyvinyl chloride (PVC) wells with 10 feet of screen set within the Paluxy.

The monitoring wells will be sampled after the water quality stabilization criteria are met. If the parameters do not stabilize, the samples will be collected when a minimum subset of the above parameters stabilize as described in Appendix C of the Final 2001 GSAP (HydroGeoLogic, 2001). A total of two sampling rounds will be performed.

Samples for VOC analysis will be collected first at each monitoring well, followed by the samples for semi-volatiles and then metals. Required sample containers, preservation methods, volumes, and holding times are provided in Section 5.0. **Table 3-2** summarizes the sample analysis method, number of samples, and number of QA samples.

Table 3-2. Groundwater Sample Analysis Summary

Site	Method	Matrix	No. of Samples[1,2]	No. of Equipment Blanks[3]	No. of Ambient Blanks[4]	No. of Trip Blanks	No. of Field Duplicates	No. of MS/MSD[5]	Total No. of Samples[2]
Paluxy Monitonng Well 1	SW8260B	Groundwater	1	1	1	1	1	1/1	7
Paluxy Monitoring Well 2	SW8260B	Groundwater	1	1	1	1	1	1/1	7
Paluxy Monitonng Well 3	SW8260B	Groundwater	1	1	1	1	1	1/1	7

Notes:

1 = Assume each monitonng well to be sampled for the listed analyses pending justification for an abbreviated list based on the analytical results from the soil investigation.

2 = Monitoring well to be sampled for two consecutive rounds 2 months apart. The number of samples is based on the number of samples collected during each sampling event, and on the assumption that there will be enough water in each well to purge and sample. The actual number of groundwater samples collected may vary depending on seasonal groundwater fluctuations.

3 = A maximum of one equipment blank will be taken per day.

4 = Ambient blanks for VOCs will only be sampled if VOCs are detected by the PID during the sampling effort.

5 = Monitoring wells will be sampled and paired with a QC sample from another wells.

Equipment Blanks = One equipment blank will be taken per day, per analysis (for example, 3 equipment blanks represents 1 sample/day for 3 days)

Field Duplicates = Collected on a 10% basis of investigation samples.

Trip Blanks = One trip blank will accompany each cooler that contains samples to be analyzed for VOCs. Trip blanks will only be analyzed for VOCs

Ambient Blanks = One ambient blank will be collected at the beginning of the field investigation for groundwater

4.0 Project Organization and Responsibility

Figure 4-1 shows the project organization, reporting relationships, and line authority. **Table 4-1** lists key project personnel and their respective telephone numbers. Other personnel will be assigned as necessary. The specific responsibilities are described in the following subsections.

Table 4-1. Key Project Personnel

Name	Title	Organization	Telephone
Don Ficklen	Team Chief	AFCEE/ERD	(210) 536-5290
Michael Dodyk	NAS Fort Worth JRB POC	AFCEE/ERD	(817) 782-7167
Rich Wheeler	Program Manager	EEG	(352) 333-2655
Rick Levin	Project Manager	EEG	(352) 333-2679
Karen Hatfield	QA Manager	EEG	(352) 333-2681
Jason Shannon	Health & Safety Officer	EEG	(352) 333-2649
TBD	Lab Project Manager	TBD	TBD
TBD	Lab Operations Manager	TBD	TBD
TBD	Lab QA Officer	TBD	TBD
TBD	Lab Sample Custodian	TBD	TBD
Mark Webster	Project Geologist	EEG	(817) 732-4160
Miquette Rochford	Senior Reviewer	HydroGeoLogic	(703) 736-4511

TBD = To be determined

4.1 Management Responsibilities

4.1.1 Program Manager

The program manager's responsibilities will include the following:

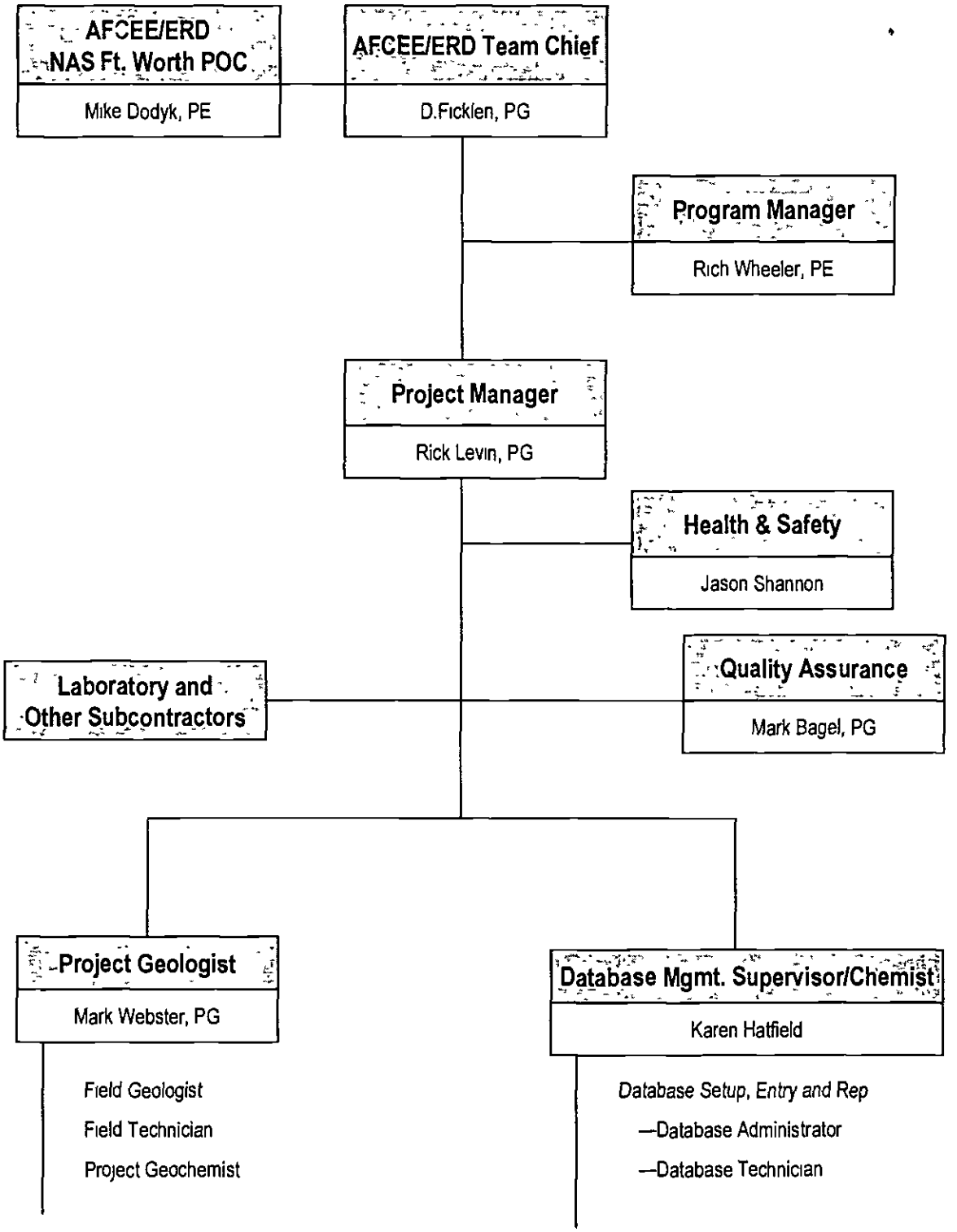
- Reviewing and approving the WP, QAPP, FSP, and Health and Safety Plan (HSP)
- Providing sufficient resources to the project team so that it can respond fully to the requirements of the investigation
- Providing direction and guidance to the PM
- Reviewing the final project report
- Providing other responsibilities as requested by the PM

4.1.2 Project Manager

The PM will be the prime point of contact with AFCEE and will have primary responsibility for technical, budget, and scheduling matters. His duties will include:

- Reviewing and approving project plans and reports
- Assigning duties to the project staff and orienting the staff to the needs and requirements of the project

Figure 4-1. Project Organization Chart



- Obtaining the approval of the QA manager for proposed variances to the WP and FSP
- Supervising the performance of project team members
- Providing budget and schedule control
- Reviewing subcontractor work and approving subcontract invoices
- Ensuring that major project deliverables are reviewed for technical accuracy and completeness before their release, including data validity
- Ensuring that all resources of the laboratory are available on an as-required basis
- Overseeing final analytical reports

4.2 Quality Assurance and Health and Safety Responsibilities

4.2.1 Quality Assurance Manager

Responsibilities of the QA manager will include:

- Serving as official contact for QA matters for the project
- Identifying and responding to QA/QC needs and problem resolution needs
- Answering requests for guidance or assistance
- Reviewing, evaluating, and approving the FSP and QAPP and all changes to these documents
- Verifying that appropriate corrective actions are taken for all nonconformances
- Verifying that appropriate methods are specified in the FSP and QAPP for obtaining data of known quality and integrity
- Fulfilling other responsibilities as requested by the PM
- Evaluating subcontractor quality program
- Training staff on QA subjects
- Supervising staff in QA program-related tasks
- Recommending changes in the QA program

4.2.2 Health and Safety Coordinator

Responsibilities of the health and safety coordinator (HSC) will include

- Developing the HSP
- Ensuring that the requirements of the QAPP are satisfied
- Providing other responsibilities as identified in the HSP

4.3 Laboratory Responsibilities

4.3.1 Laboratory Project Manager

The laboratory's PM will report directly to EEG's PM and will be responsible for the following:

- Ensuring that all resources of the laboratory are available on an as-required basis
- Overseeing final analytical reports

4.3.2 Laboratory Operations Manager

The laboratory's operations manager will report to the laboratory's PM and will be responsible for the following:

- Coordinating laboratory analyses
- Supervising in-house chain-of-custody
- Scheduling sample analyses
- Overseeing data review
- Overseeing preparation of analytical reports
- Approving final analytical reports prior to submission to EEG

4.3.3 Laboratory Quality Assurance Officer

The laboratory's QA officer has the overall responsibility for data after it leaves the laboratory. The QA officer will be independent of the laboratory but will communicate data issues through the laboratory's PM. In addition, the QA officer will be responsible for the following:

- Conduct audits of laboratory analyses
- Provide oversight of laboratory QA
- Provide oversight of QA/QC documentation
- Conduct detailed reviews of data
- Determine whether to implement laboratory corrective actions, if required
- Define appropriate laboratory QA procedures
- Prepare laboratory standard operation procedures

4.3.4 Laboratory Sample Custodian

The laboratory's sample custodian will report to the operations manager. Responsibilities of the sample custodian will include:

- Receiving and inspecting the incoming sample containers
- Recording the condition of the incoming sample containers
- Signing appropriate documents
- Verifying chain of custody and its correctness
- Notifying laboratory manager and laboratory supervisor of sample receipt and inspection
- Assigning a unique identification number and customer number, and entering each into the sample receiving log
- Initiating transfer of the samples to appropriate lab sections with the help of the laboratory operations manager
- Controlling and monitoring access/storage of samples and extracts

4.4 Field Responsibilities

4.4.1 Project Geologist

The project geologist will be responsible for geologic interpretations as well as acting as lead coordinator for field activities. The project geologist's duties and responsibilities will include:

- Providing orientation and any necessary training to field personnel (including subcontractors) on the requirements of the FSP, HSP, and QAPP before the start of work

- Providing direction and supervision to the sampling crews
- Monitoring sampling operations to ensure that the sampling team members adhere to the QAPP and FSP
- Ensuring the use of calibrated measurement and test equipment
- Maintaining a field records management system
- Coordinating activities with the PM
- Supervising geological data interpretation activities
- Overseeing field data documentation and conducting quality checks on interpretive geologic work products
- Reviewing reports for compliance with State of Texas and EPA requirements
- Assuming the duties of the HSC if directed by the HSC

4.5 Subcontractors

Subcontractors will be used for the drilling of monitoring wells during the field investigation. In addition, laboratory analyses of all samples collected during the investigation will also be subcontracted to an analytical laboratory.

Qualified subcontractors will be selected in accordance with AFCEE requirements and EEG's procurement and QA procedures. Subcontractors will meet predetermined qualifications developed by the PM and defined in the procurement bid packages. Each bid submitted will be reviewed for technical, QA, and purchasing requirements. All subcontractors will be required to follow the procedures of the WP, FSP, QAPP, and HSP. Periodic QC inspections of each subcontractor may be performed as specified in the FSP (Section 7.4), QAPP (Section 9.1), and HSP (Section 1.3 2). These inspections will be performed by the QA manager or his designee as unannounced audits to confirm adherence to the procedures and guidance outlined in the aforementioned documents. Such inspections may relate to health and safety, QAPP requirements, or field standard operating procedures.

5.0 Field Operations

The overall project field logistics and activities necessary to complete the project sampling objectives described in the work plan are presented in this section. All field work will be conducted in accordance with the site HSP. EEG is the prime contractor for the field investigation. The point of contact (POC) at the base will be Mr. Michael Dodyk. EEG's project geologist/field coordinator will be Mr. Mark Webster.

5.1 Geologic Standards

The lithologic descriptions for consolidated materials (igneous, metamorphic, and sedimentary rocks) shall follow the standard professional nomenclature (cf. Tennissen, A.C., 1983, Nature of Earth Materials, 2nd Edition, pp. 204-348), with special attention given to describing fractures, vugs, solution cavities and their fillings or coatings, and any other characteristics affecting permeability. Colors shall be designated by the Munsell Color System.

The lithologic descriptions for unconsolidated materials (soils [engineering usage] or deposits) shall use the name of the predominant particle size (e.g., silt, fine sand, etc.). The dimensions of the predominant and secondary sizes shall be recorded using the metric system. The grain size and name of the deposit shall be accompanied by the predominant mineral content, accessory minerals, color, particle angularity, and any other characteristics. The classic deposit descriptions shall include, as a supplement, symbols of the Unified Soil Classification System (USCS). The color descriptions shall be designated by the Munsell Color System.

Columnar sections, well and boring logs, well construction diagrams, cross sections, and three-dimensional (3-D) diagrams shall use these patterns. Supplementary patterns shall follow Swanson, R. G., 1981, Sample Examination Manual, American Association of Petroleum Geologists, pp. IV-41 and 43. Geologic structure symbols shall follow American Geological Institute Data Sheets, 3d Edition, 1989, sheets 3.1 through 3.8.

The scales for maps, cross sections, or 3-D diagrams shall be selected in accordance with the geologic and hydrologic complexity of the area and the purposes of the illustrations. Geophysical logs shall be run at a constant vertical scale of 1 inch equals 20 feet. When geophysical logs are superimposed on geologic logs, cross sections, or 3-D diagrams, the scales shall be the same. If defining geological conditions requires other scales, additional logs at those scales shall be provided.

For orientation, the cross sections shall show the northern end on the viewer's right. If the line of cross section is predominantly east-west, the eastern end is on the right. Maps shall be oriented with north toward the top, unless the shape of the area dictates otherwise. Indicate orientation with a north arrow.

5.2 Site Reconnaissance, Preparation, and Restoration Procedures

Areas designated for intrusive sampling shall be surveyed for the presence of underground utilities. Utility locations are determined using existing utility maps; in the field, they are verified by using a hand-held magnetometer or utility probe. Prior to commencement of drilling activities,

digging permits will be obtained from NAS Fort Worth JRB. The base civil engineer will be contacted to verify that selected locations are free of underground utilities Those locations not clear of underground utilities will be relocated to achieve clearance, and then verified for clearance a second time. Vehicle access routes to sampling locations shall be determined prior to any field activity.

A centralized decontamination area shall be provided for drilling rigs and equipment. The decontamination area shall be large enough to allow storage of cleaned equipment and materials prior to use, as well as to stage drums of decontamination waste. The decontamination area shall be lined with a heavy gauge plastic sheeting, and designed with a collection system to capture decontamination waters. Solid wastes shall be accumulated in 55-gallon drums and subsequently transported to a waste storage area designated by the USAF. Smaller decontamination areas for personnel and portable equipment shall be provided as necessary. These locations shall include basins or tubs to capture decontamination fluids, which shall be transferred to a large accumulation tank as necessary. These designated areas of decontamination shall be determined during the pre-construction meeting. The field office is located on base and the staging area is located at the IDW area on base.

Each work site or sampling location shall be returned to its original condition when possible. Efforts shall be made to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments such as wetlands. Following the completion of work at a site, all drums, trash, and other waste shall be removed. Decontamination and/or rinse water and soil cuttings shall be transported to the designated locations as described in Section 5.9. At the completion of field activities, all capital equipment and consumable materials will be removed or turned over to base personnel in accordance with AFCEE procedures. A final site walk will be conducted with the base representative, at his/her discretion, to ensure that all sampling locations have been restored satisfactorily before final demobilization from the site.

5.3 Borehole Drilling, Lithologic Sampling, Logging, and Abandonment

5.3.1 General Drilling Procedures

All drilling activities shall conform to state and local regulations and will be supervised by a professional geologist or engineer. EEG will obtain and pay for all permits, applications, and other documents required by state and local authorities.

The location of all borings will be coordinated, in writing, with the base civil engineer, or equivalent, before drilling commences. When drilling boreholes through more than one water-bearing zone or aquifer, EEG and its subcontractors will take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

The drill rig will be cleaned and decontaminated in accordance with the procedure in Section 5.8. The drill rig shall not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable, and will not be permitted.

Drilling fluids shall not be used for this project unless prior authorization is obtained from the TNRCC or the EPA. A log of drilling activities will be kept in a bound field notebook. Information in the log book will include location, time on site, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any observations or information that would be necessary to reconstruct field activities at a later date.

EEG will dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or NAS Fort Worth JRB representative.

5.3.2 Sampling and Logging

The lithology in all boreholes will be logged. The Monitor Well Boring Log form (Attachment A) will be used for recording the lithologic logging information. Information on the boring log sheet includes the borehole location, drilling information, sampling information (such as sample intervals), recovery, blow counts, and sample description information.

Unconsolidated samples for lithologic description will be obtained continuously at 2-foot intervals using split spoon samplers and standard penetration tests. Lithologic descriptions of unconsolidated materials encountered in the boreholes will generally be described in accordance with American Society for Testing and Materials (ASTM) D-2488-90 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM, 1990). Descriptive information to be recorded in the field will include the following: (1) identification of the predominant particles: size and range of particle sizes; (2) percent of gravel, sand, fines, or all three; (3) description of grading and sorting of coarse particles; (4) particle angularity and shape, and (5) maximum particle size or dimension.

Plasticity of fines description include the following: (1) color, using Munsell Color System; (2) moisture (dry, wet, or moist); (3) consistency of fine-grained soils; (4) structure of consolidated materials; and (5) cementation (weak, moderate, or strong).

Identification of the USCS group symbol will be used. Additional information to be recorded includes the depth to the water table, caving or sloughing of the borehole, changes in drilling rate, depths of laboratory samples, presence of organic materials, presence of fractures or voids in consolidated materials, and other noteworthy observations or conditions, such as the locations of geologic boundaries.

Lithologic descriptions of consolidated materials encountered in the boreholes will generally be described in accordance with Section 5.1. Consolidated samples for lithologic description will be obtained continuously at 2-foot intervals using split spoon samplers and standard penetration tests All samples will be monitored with an organic vapor monitor (e.g , photoionization detector [PID], organic vapor analyzer [OVA]). The samples shall be handled in such a way as to minimize the loss of volatiles; these procedures are described in Section 6.2. Cuttings will be examined for their hazardous characteristics. Materials suspected to be hazardous because of abnormal color, odor, or organic vapor monitor readings will be containerized in conformance with RCRA, state, and local requirements.

5.4 Monitoring Well Construction

The on-site project geologist will supervise the drilling, soil boring, geophysical surveys, lithologic sampling, and monitoring well construction, and will be a professional geologist or engineer. A professional geologist will affix his or her signature and registration/certification seal to all drilling logs, as-built well construction diagrams, lithologic logs, sampling records, and similar documents. Although floating petroleum products (i.e., light non-aqueous phase liquids [LNAPLs]) are not anticipated, shallow monitoring wells shall be screened across the water table if they are encountered. The length of the screen will be such that tidal and seasonal water table fluctuations shall not cause water levels to rise above or fall below the screened interval. If dense petroleum products (i.e., dense non-aqueous phase liquids [DNAPLs]) are encountered, monitoring wells will be screened at the bottom of the aquifer to capture the DNAPL.

5.4.1 Drilling Requirements

All drilling and well installations will conform to state and local regulations, and EEG will obtain and pay for all permits, applications, and other documents required by state and local authorities. The location of all borings will be coordinated in writing with the base civil engineer, or equivalent, before drilling commences.

The rig will be cleaned and decontaminated according to the guidelines described in Section 5.8. The rig will not leak any fluids that may enter the borehole or contaminate equipment that is placed in the hole. Rags or absorbent materials will not be used to absorb leaking fluids.

EEG and its drilling subcontractors will dispose of all trash, waste grout, cuttings, and drilling fluids as coordinated with the base civil engineer or representative. Monitoring wells will be completed in the alluvial terrace groundwater only, thereby preventing cross-connection or cross-contamination of other water bearing zones or aquifers.

5.4.2 Monitoring Well Borehole Requirements

Mud-rotary and coring drilling is to be used for this project. The inside diameter of the borehole will be at least 4 inches larger than the outside diameter of the casing and well screen.

The completed monitoring wells will be sufficiently straight to allow passage of pumps or sampling devices and will be pumped within 1 degree of vertical where the water level is greater than 30 feet below land surface unless otherwise approved by AFCEE. AFCEE may waive a plumbness requirement. Any request for a waiver from straightness or plumbness specifications will be made in writing to AFCEE in advance of mobilization for drilling. EEG or its drilling subcontractor will use a single-shot declination tool to demonstrate plumbness. Monitoring wells not meeting straightness or plumbness specifications will be redrilled and/or reconstructed.

Formation samples for lithologic description will be obtained continuously at 2-foot sampling intervals. All samples will be monitored with an organic vapor monitor (e.g., PID, OVA). The samples will be handled in such a way as to minimize the loss of volatiles; these procedures will be described in Section 6.2. Cuttings will be examined for their hazardous characteristics. Materials that are suspected to be hazardous because of abnormal color, odor, or organic vapor

monitor readings shall be containerized in conformance with RCRA, state, and local requirements. The Monitor Well Boring Log (Attachment A) will document the following information for each boring: (1) boring or well identification (this identification shall be unique, and EEG will ensure that it has not been used previously at the installation); (2) purpose of the boring (e.g., soil sampling, monitoring well); (3) location in relation to an easily identifiable landmark; (4) names of drilling contractor and logger; (5) start and finish dates and times; (6) drilling method; (7) types of drilling fluids and depths at which they were used (not applicable to the drilling method used for this project); (8) diameters of surface casing, casing type, and methods of installation; (9) depth at which saturated conditions were first encountered; (10) lithologic descriptions and depths of lithologic boundaries; (11) sampling-interval depths; (12) zones of caving or heaving; (13) drilling rate; and (14) drilling rig reactions, such as chatter, rod drops, and bouncing.

In addition to the above, the following information shall be recorded when rock core samples are collected: (1) the depth interval and top and bottom of each core shall be marked on the core box, (2) percentage of core recovered, (3) number of fractures per foot, (4) angle of fractures relative to the core axis, and (5) breaks due to coring and core handling shall be distinguished from naturally occurring fractures.

A standard penetration test shall be performed each time a split spoon sample is taken. The test shall be performed in accordance with ASTM D-1586.

5.4.3 Casing Requirements

The casing requirements that will be followed are the following: (1) all casing will be new, unused, and decontaminated according to the specifications of Section 5.8; (2) glue will not be used to join casing, and casings will be joined only with compatible welds or couplings that shall not interfere with the planned use of the well; (3) all polyvinyl chloride (PVC) will conform to the ASTM Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System), (4) all metal casing will be seamless stainless steel casing, and the casing "mill" papers will be included in the appendix of the technical report; (5) the casing will be straight and plumb within the tolerance stated for the borehole; and (6) the driller shall cut a notch in the top of the casing to be used as a measuring point for water levels.

All monitoring wells for this project will be constructed using flush-threaded 2-inch-diameter Schedule 40 PVC casing. The notches cut in the top of the monitoring well casings for water level measuring points will be oriented on the north side of each casing for uniformity.

5.4.4 Well Screen Requirements

AFCEE well screen requirements are the following: (1) all requirements that apply to casing will also apply to well screen, except for strength requirements; (2) monitoring wells will not be screened across more than one water-bearing unit; (3) screens will be factory slotted or wrapped; (4) screen slots will be sized to prevent 90 percent of the filter pack from entering the well, and for wells where no filter pack is used, the screen slot size will be selected to retain 60 to 70

percent of the formation materials opposite the screen; and (5) the bottom of the screen is to be capped, and the cap will be joined to the screen by threads.

The monitoring wells will be constructed using flush-threaded 2-inch-diameter Schedule 40 PVC casing and screen. The upper 20 feet of the uppermost flow zone of the uppermost aquifer will be screened with 0.010-inch continuous slotted PVC. No well screen will be over 20 feet in length; however, every effort will be made to install monitoring wells with a maximum screen length of 10 feet. It is anticipated that well screens will be placed from the lowest portion of the alluvial terrace groundwater zone through the surface of the water table. The bottom of the screen will be capped using a flush threaded PVC cap.

5.4.5 Annular Space Requirements

The annular space requirements are the following: (1) the annular space will be filled with a filter pack, a bentonite seal, and casing grout between the well string and the borehole wall; and (2) as the annular space is being filled, the well string will be centered and suspended such that it does not rest on the bottom of the hole, and for wells greater than 50 feet deep, at least two stainless steel centralizers will be used, one at the bottom and one at the top of the screen. Additional centralizers will be used as needed.

5.4.6 Filter Pack Requirements

The filter pack will consist of silica sand or gravel and will extend from the bottom of the hole to at least 2 feet above the top of the well screen. After the filter pack is emplaced, the well will be surged with a surge block for 10 minutes. The top of the sand pack will be sounded to verify its depth during placement. Additional filter pack will be emplaced as required to return the level of the pack to 2 feet above the screen. The well will then be surged again for 5 minutes and additional filter pack will be emplaced as required to bring its level to 2 feet above the screen.

The filter pack material will be clean, inert, and well rounded, and will contain less than 2 percent flat particles. The sand will be certified free of contaminants by vendor or contractor. If decontamination is necessary, the methods shall be approved in writing by AFCEE.

The filter pack will have a grain size distribution and uniformity coefficient compatible with the formation materials and the screen. This will be calculated as described in Chapter 12, Ground Water and Wells, 2nd Edition (Driscoll, 1986). The grain size of the filter pack material will be determined based on existing grain size analysis prior to mobilization to the field. The filter pack will not extend across more than one water-bearing unit. In all wells (deep or shallow), the filter pack will be emplaced with a bottom discharge tremie pipe of at least 1-1/2 inches in diameter to prevent bridging. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. EEG will record the volume of the filter pack emplaced in the well. If potable water is necessary to place the filter pack, EEG will obtain prior approval from the regulatory agency providing oversight and will ensure that no contaminants are introduced into the well.

5.4.7 Bentonite Seal Requirements

The bentonite seal requirements that will be followed are the following: (1) the bentonite seal will consist of at least 2 feet of bentonite between the filter pack and the casing grout, (2) the bentonite will be hydrated before placement and shall be installed by pump tremie methods, and (3) only 100 percent sodium bentonite shall be used.

5.4.8 Casing Grout Requirements

The casing grout requirements are the following: (1) the casing grout will extend from the top of the bentonite seal to ground surface; (2) the grout will be mixed in the following proportions: 94 pounds of neat Type I Portland or American Petroleum Institute Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water; (3) all grout will be pump tremied using a side-discharge tremie pipe, and pumping will continue until 20 percent of the grout has been returned to the surface; and (4) in wells where the bentonite seal is visible and within 30 feet of the land surface, the 20 percent return is not necessary so long as the tremie pipe is pulled back as the grout is emplaced.

5.4.9 Surface Completion Requirements

For flush-mounted completions, the casing will be cut about three inches below the land surface and provide a water-tight casing cap to prevent surface water from entering the well. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole will be placed in the upper portion of the casing, or a ventilated well cap will be used. A freely draining valve box with a locking cover will be placed over the casing. The top of the casing will be at least one foot above the bottom of the box. The valve box lid will be centered in a three-foot diameter, four-inch thick concrete pad that slopes away from the box at 1/4 inch per foot. The identity of the well will be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well or for other reasons, the concrete pad and valve box/lid assembly will be constructed to meet the strength requirements of surrounding surfaces.

When aboveground surface completion is used, the well casing will be extended 2 or 3 feet above land surface. A casing cap will be provided for each well, and the extended casing will be shielded with a steel sleeve that is placed over the casing and cap and seated in a 3-foot-by-3-foot-by-4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole will be placed in the well casing, or a ventilated well cap will be used. The concrete surface pad will be reinforced with steel reinforcing bars at least 1/4 inch in diameter. The ground surface will be freed of grass and scoured to a depth of 2 inches before setting the concrete pad. The diameter of the sleeve will be at least 6 inches greater than the diameter of the casing. The pad will be sloped away from the well sleeve. A lockable cap or lid will be installed on the guard pipe. The identity of the well will be permanently marked on the casing cap and the protective sleeve. Three 3-inch diameter concrete-filled steel guard posts, each 5 feet in total length, will be installed radially from each well head. The guard posts will be recessed approximately 2 feet into the ground and set in concrete. The guard posts will not be installed in the concrete pad placed at the well base. The protective sleeve and guard posts will be painted with a color specified by the installation civil engineer.

All wells will be secured as soon as possible after drilling with corrosion-resistant locks for both flush and aboveground surface completions. The locks will either have identical keys or be keyed for opening with one master key. The lock keys will be delivered to the appropriate Air Force personnel following completion of the field effort. A Monitor Well Boring Log will be completed for each well (Attachment A)

5.5 Monitoring Well Development

The monitoring well development requirements are the following: (1) all newly installed monitoring wells will be developed no sooner than 24 hours after installation to allow for grout curing; (2) all drilling fluids used during well construction will be removed during development; (3) wells will be developed using surge blocks and bailers or pumps (prior approval for any alternate method will be obtained, in writing, from AFCEE before well construction begins), and wells will be developed until the turbidity of the well is less than or equal to 10 nephelometric turbidity units (NTU) and remains within a 5-NTU range for at least 30 minutes and the stabilization criteria in Section 6.1 are met; (4) discharge water color and volume will be documented; (5) no sediment will remain in the bottom of the well; (6) no detergents, soaps, acids, bleaches, or other additives will be used to develop a well; and (7) all development equipment will be decontaminated according to the specifications of Section 5.8.

5.6 Abandoning Monitoring Wells

All abandonment of monitoring wells, when necessary, shall be performed in accordance with state and local laws and regulations. If slurry is used, a mud balance and/or Marsh Funnel will be used to ensure that the density (lbs/gal) of the abandonment mud mixture conforms to the manufacturer's specification. All abandoned monitoring wells will be checked 24 to 48 hours after mud/solid bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications or quality assurance checks may be recommended by the manufacturer and will be followed. Additionally, if significant settling has occurred, a sufficient amount of mud/solid bentonite will be added to attain its initial level. These slurry/solid bentonite curing checks and any addition of mud/solid bentonite will be recorded in the field logs.

5.7 Surveying

All surveying locations of field activities will be measured by a state of Texas certified land surveyor as the distance in feet from a reference location that is tied to the state plane system. The surveys will be third order (cf. Urquhart, L.C., 1962 Civil Engineering Handbook, 4th Edition, pp. 96 and 97). An XY-coordinate system will be used to identify locations. The X-coordinate will be the east-west axis; the Y-coordinate will be the north-south axis. The reference location is the origin. All surveyed locations will be reported using the state plane coordinate system. The surveyed control information for all data collection points will be recorded and displayed in a table. The table will give the X and Y coordinates in state plane coordinate values, the ground elevation, and the measuring point elevation if the location is a groundwater monitoring well. The elevation of all newly installed wells and piezometers will be surveyed at the water level measuring point (notch) on the riser pipe. The elevation of the ground surface at each water level measuring point will be included in the survey.

The X-Y coordinates for each sample location will be determined to within 0.1 feet and referenced to the State Plane Coordinate System. Vertical control will be to the National Geodetic Vertical Datum (NGVD) and will be within 0.01 feet for all sampling locations.

5.8 Equipment Decontamination

All equipment that may directly or indirectly contact samples will be decontaminated in a designated decontamination area. This includes casing, drill bits, auger flights, portions of drill rigs that stand above boreholes, sampling devices, and instruments, such as slugs and sounders. In addition, EEG and its subcontractors will take care to prevent the sample from coming into contact with potentially contaminating substances such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure will be used to decontaminate large pieces of equipment such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. The external surfaces of equipment will be washed with high-pressure hot water and Alconox, or equivalent laboratory-grade detergent, and if necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The equipment will then be rinsed with potable water. The inside surfaces of casing, drill rod, and auger flights will also be washed as described.

The following procedure will be used to decontaminate sampling and drilling devices such as split spoons and augers that can be hand-manipulated. For sampling and smaller drilling devices, the equipment will be scrubbed with a solution of potable water and Alconox, or equivalent laboratory-grade detergent. The equipment will then be rinsed with copious quantities of potable water followed by a rinse with ASTM Type II reagent-grade water. High-pressure liquid chromatograph-grade water and distilled water purchased in stores are not acceptable substitutes for ASTM Type II Reagent-Grade Water The equipment will then be rinsed with pesticide-grade methanol followed by a rinse with pesticide-grade hexane. The equipment will then be allowed to air dry on a clean surface or rack, such as Teflon®, stainless steel, or oil-free aluminum, elevated at least 2 feet above ground. If the sampling device will not be used immediately after being decontaminated, it will be wrapped in oil-free aluminum foil or placed in a closed container made of stainless steel, glass, or Teflon®.

Reagent-Grade II water, methanol, and hexane will be purchased, stored, and dispensed only in glass, stainless steel, or Teflon® containers. These containers will have Teflon® caps or cap liners EEG and its subcontractors will assure that these materials remain free of contaminants. If any question of purity exists, new materials will be used.

All fluids generated during decontamination activities will be placed in United Nations (UN)-approved steel 55-gallon drums. All drums will be properly labeled as to content and shall be staged in a central location designated by the base representative for temporary storage pending removal and disposal.

5.9 Waste Handling

Waste handling will be dealt with on a site-by-site basis. Waste will be classified as either non-investigative waste or investigative waste per the requirements of 30 TAC Section 335, Subchapter R, and 40 CFR Part 261, Subpart C. Non-investigative waste, such as litter and household garbage, will be collected on an as-needed basis to maintain each site in a clean and orderly manner. This waste will be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers will be sealed boxes or plastic garbage bags.

Waste containers will be labeled with the following information: type of matrix being contained, depth from which matrix was obtained, date matrix was contained, company name and phone number, and whether matrix is considered hazardous or not.

Characterization of investigation-derived waste (IDW) will be based on sample analysis obtained during the field investigation following EPA approved methods. Hazardous waste classification will first be determined as per 40 CFR Sections 261.2, 261.3, or 261.4. Waste that is non-hazardous is then classified as Class 1, Class 2, or Class 3, according to 30 TAC Sections 335.505 to 335.507. Once the IDW has been characterized, an eight-digit waste code number will be provided as required in Section 335.501. The disposal of IDW will be conducted in a timely and cost-effective manner and in accordance with all state and federal regulations.

IDW will be properly containerized and temporarily stored at each site, prior to transportation. Depending on the constituents of concern, fencing or other special markings may be required. The number of containers will be estimated on an as-needed basis. Acceptable containers will be sealed in either 55-gallon drums or small dumping bins with lids. The containers will be transported in such a manner to prevent spillage or particulate loss to the atmosphere.

The IDW will be segregated at the site according to matrix (solid or liquid) and as to how it was derived (drill cuttings, drilling fluid, decontamination fluids, and purged groundwater). Each container will be properly labeled with site identification, sampling point, date, depth, matrix, constituents of concern, and other pertinent information for handling.

Waste generated during the field activities will be handled and disposed of in accordance with applicable federal, state, and local regulations. Disposable materials such as latex gloves, aluminum foil, paper towels, etc., shall be placed and sealed in plastic garbage bags for disposal with sanitary waste from the site. Soil cuttings will be placed in 55-gallon steel open top drums with lids. Development and purge waters evacuated from groundwater monitoring wells, and all fluids generated during decontamination activities, will be placed in 55-gallon steel drums. Drums will be properly labeled with the appropriate boring or well number, and content, and will be staged in a central location designated by the base representative for temporary storage pending removal and disposal.

5.10 Hydrogeological Conceptual Model

The project geologist or engineer will develop a base and site geological and hydrological conceptual model from pre-existing U.S. Geological Survey (USGS), regional, state, and local studies and information developed during the project. Maps and cross sections will be used to

depict the conceptual model. The model will be the basis for evaluating soil boring and monitoring well locations, contaminant distribution (plume delineation), and the closeness of fit to natural conditions of analytical or computer-based numerical models.

The project geologist will evaluate the reliability of predictions resulting from use of the model. Reliability will be based on sufficiency and representativeness of field data, model calibration, degree of change of field data during calibration, and model sensitivity to changes in selected variables The values assigned to nodes of numerical models and the amount of change of field values will be displayed on maps or cross sections.

5.11 Corrective Action

Table 5-1 contains a summary of field quality control procedures and corrective actions.

Table 5-1. Field Corrective Action Procedures

Situation	Calibration	Frequency	Field Objective Affected	Corrective Action Procedure
Equipment malfunction PID/OVA pH SC Temperature Turbidity	 Calibrated to ±20% of known calibration gas Calibrated with two buffer solutions that bracket expected sample pH Calibrated with two standards in expected range of sample SC Calibrate within expected temperature range of samples Calibrate within expected range of sample turbidity	 Daily Daily Daily Monthly Daily	Equipment is calibrated and operating properly	Notification of site supervisory personnel Correct problem, recalibrate Repair or replace malfunctioning parts Recalibrate and/or replace standards Submission of document to Project Geologist, Project Manager, and Quality Assurance Manager
Incorrect sample collection procedures	NA	NA	Samples are taken according to standard operating procedures	Notification of site supervisory personnel Review of situation and correct procedures Submission of document to Project Geologist, Project Manager, and Quality Assurance Manager
Insufficient sample volume collection	NA	NA	Sufficient sample volume is provided to maintain sample integrity so that all required analyses can be conducted	Notification of site supervisory personnel by laboratory manager Review site affected and impact of samples on site characterization - correct procedures Submission of document to Project Geologist, Project Manager, and Quality Assurance Manager
Incorrect measurement data collection	NA	NA	Measurements are conducted according to standard operating procedures	Notification of site supervisory personnel Review of situation and correct procedures Submission of document to Project Geologist, Project Manager, and Quality Assurance Management

NA = Not applicable

6.0 Environmental Sampling

6.1 Sampling Procedures

All purging and sampling equipment will be decontaminated according to the specifications in Sections 5.8 and 7.3 prior to any sampling activities and will be protected from contamination until ready for use. The construction material of the sampling devices (e.g., plastic, PVC, metal, etc.) discussed below will be appropriate for the contaminant of concern and shall not interfere with the chemical analyses being performed.

6.1.1 Groundwater Sampling

When numerous monitoring wells are to be sampled in succession, wells expected to have low levels of contamination will be sampled prior to wells expected to have higher levels of contamination. This practice will help reduce the potential for cross contamination between wells. All sampling activities will be recorded in the field log book. Additionally, all sampling data will be recorded on a Field Sampling Report form (Attachment A).

Before groundwater sampling begins, wells will be inspected for signs of tampering or other damage. If tampering is suspected, (i.e., casing is damaged, lock or cap is missing) this shall be recorded in the field log book and on the well sampling form, and reported to the project geologist/field coordinator. Wells that are suspected to have been tampered with will not be sampled until the project geologist/field coordinator has discussed the matter with the PM.

Before the start of sampling activities, plastic sheeting will be placed on the ground adjacent to the well. The plastic sheeting will be used to provide a clean working area for clean equipment to be placed during sampling. Water will be removed from the protective casing or from vaults around the well casing prior to venting and purging. Every time a casing cap is removed to measure water level or collect a sample, the air in the breathing zone will be checked with an organic vapor meter and the air in the well bore shall be checked with an explosimeter. Procedures in the HSP will be followed when high concentrations of organic vapors or explosive gases are detected. Air monitoring data will be recorded on the well sampling form.

Purge pump intakes will be equipped with a positive check valve to prevent purged water from flowing back into the well. Purging and sampling will be performed in a manner that minimizes aeration in the well bore and the agitation of sediments in the well and formation. Equipment will not be allowed to free-fall into a well.

In addition to the information required in Section 8.0, the following information will be recorded each time a well is purged and sampled: (1) depth to water before and after purging; (2) well bore volume calculation; (3) sounded total depth of the monitoring well; (4) the condition of each well, including visual (mirror) survey; (5) the thickness of any non-aqueous layer; and (6) field parameters, such as pH, temperature, electrical conductivity (EC), oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity. This information will be encoded in IRP Information Management System (IRPIMS) files when required.

6.1.1.1 Water Level Measurement

An interface probe will be used since a nonconductive floating product layer is suspected at some of the proposed well locations. The interface probe will be used to determine the presence of floating product, if any, prior to measurement of the ground-water level. The groundwater level will then be measured to the nearest 0.01 foot using an electric water level indicator. Water levels will be measured from the notch located at the top of the well casing and recorded on the well sampling form. If well casings are not notched, measurements will be taken from the north edge of the top of the well casing, and a notch will be made using a decontaminated metal file.

Following water level measurement, the total depth of the well from the top of the casing will be determined using a weighted tape or electric sounder and recorded on the well sampling form. The water level depth will then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. All water level and total depth measuring devices will be routinely checked with a tape measure to ensure measurements are accurate.

6.1.1.2 Purging Prior to Sampling

Purging of monitoring wells is performed to evacuate water that has been stagnant in the well and may not be representative of the aquifer. Purging will be accomplished using the micropurge technique. Micropurge is a low-flow-rate monitoring well purging and sampling method that induces laminar (non turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing groundwater directly from the sampled aquifer, horizontally through the well screen, and into the sampling device.

Pumps capable of achieving low-flow rates in the range of 0.1 to 0.5 liters per minute (L/min) will be used for purging and sampling. These low flow rates minimize disturbance in the screened aquifer, resulting in the following: (1) minimal production of artificial turbidity and oxidation, (2) minimal mixing of chemically distinct zones, (3) minimal loss of volatile organic compounds, and (4) collection of representative samples while minimizing purge volume.

Pumps will be lowered to the middle of the screened interval or slightly above the interval (i.e., a measured depth of 43 percent of the saturated screened interval below the top of the water table). This is to minimize the resuspension of solids that have collected at the bottom of the well and to minimize the potential mixing of stagnant water trapped in the casing above the screen. The key is to minimize the disturbance of water and solids in the well casing.

As a guide to flow-rate adjustment during purging, water levels will be checked and recorded to monitor drawdown in the well. Groundwater will be pumped in a manner that minimizes the stress to the system to the extent practical taking into account established site sampling objectives. The goal is to purge the well at a rate that does not draw down the static water level more than 0.33 feet.

Temperature, pH, EC, DO, ORP, and turbidity will also be measured during purging and recorded on the well sampling form. Measurements will be taken every 3 to 5 minutes when flow rates are in the 0.1 to 0.5 L/min range. Stabilization is achieved after all parameters have stabilized for three consecutive readings. Successive readings should be approximately within ±1.0°C for

temperature, ±0.1 units for pH, ±3 percent for EC, ±0.1 mg/L or 10 percent (whichever is greater) for DO, ±10 percent for ORP, and less than 10 NTUs for turbidity. In general, the order of stabilization is pH, temperature, and EC, followed by ORP, DO, and turbidity. Water samples will be collected immediately after parameter stabilization using the same pump as was used in purging. Field equipment will be calibrated in accordance with the Basewide QAPP (CH2M HILL, 1996), Section 6.0, and in Section 7.2 of this FSP.

In lieu of measuring all six parameters (temperature, pH, EC, turbidity, DO, and ORP), a minimum subset would include pH, EC, and either turbidity or DO as critical stabilization parameters. If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. Turbidity is a very conservative parameter in terms of stabilization and is almost always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in groundwater may exceed 10 NTUs. (USEPA, 1996)

For wells known to have a less than 0.1 L/min flow rate, a low-flow (<0.1L/min) pump will be lowered into the well to mid-screen as described above and set in place a minimum of 48 hours prior to the initiation of purging procedures. This procedure will reduce the purge volume requirements. Water samples will be collected as soon as parameters have stabilized (USEPA, 1996).

Alternately, if a well is known to have less than a 0.1 L/min flow rate, then a passive sampling device could be lowered to mid-screen as described above and set in place a minimum of 48 hours prior to retrieval. Regulatory approval for sample volumes that are lower than required by individual EPA analytical methods would have to be obtained prior to using this procedure (USEPA, 1996).

If during low-flow purging the drawdown is greater than 0.33 feet, then the micropurge technique is assumed to be invalid and will be discontinued. The reason is that groundwater flow to the pump is no longer considered to be laminar across the screen from the aquifer. The flow in the vicinity of the pump would then contain a vertical component from the stagnant water column in the filter pack and casing.

In this situation (i.e., drawdown >0.33 feet at low-flow rates), the pumping rate will be increased and a minimum of three borehole volumes will be removed to ensure that all of the stagnant water has been removed from the borehole. The drawdown will continue to be monitored and the pumping rate will be adjusted to avoid pumping the well dry. Measurements for water quality parameters will be taken every 3 to 5 minutes. After three well volumes have been removed and water quality parameters have stabilized for three consecutive readings, water samples will be collected when the water level has recovered to 80 percent of its static water level or 16 hours after completion of purging. Water samples will be collected using either a low-flow pump or a Teflon® bailer.

If the parameters do not stabilize, then five well volumes will be removed and water samples will be collected when the water level has recovered to 80 percent of its static water level or 16 hours

after completion of purging. Water samples will be collected using either a low-flow pump or a Teflon® bailer.

If a well is purged dry, then the well will be sampled as soon as a sufficient volume of groundwater has entered the well to enable the collection of necessary groundwater samples. (USEPA, 1992) Water samples will be collected using either a low-flow pump or a Teflon® bailer.

Water removed from the well during purging will be containerized. Detailed information concerning IDW is presented in Section 5.9. A maximum of five (5) well volumes may be removed from any well before it is sampled. *The well bore volume is defined as the volume of submerged casing, screen, and filter pack.* One well volume can be calculated using the following equation (Ohio EPA, 1993):

$$V = H \times F$$

where V = one well volume
H = the difference between the depth of well and depth to water (feet)
F = factor for volume of one foot section of casing (gallons) from **Table 6-1**

F can also be calculated from the formula:

$$F = \pi(D/2)^2 \times 7.48 \text{ gal/ft}$$

where D = the inside diameter of the well casing (feet) and $\pi = 3.141593$.

Table 6-1. Volume of Water in One-Foot Section of Well Casing

Diameter of Borehole (inches)	F Factor (gallons)
1 5	0.09
2	0 16
3	0 37
4	0 65
6	1 47
8	2.60
10	4 04
12	5.81

6.1.1.3 Sample Collection

At newly developed wells, water samples may only be collected after a 24-hour period has elapsed from the conclusion of monitoring well development activities.

Following the micropurge techniques outlined above, a small positive-displacement pump (e.g., bladder pump) may be used collect water samples. Samples to be analyzed for volatile or gaseous constituents will not be withdrawn with pumps or at flows that degas the samples. Water-quality indicators will be monitored during micropurge (turbidity, dissolved oxygen, specific conductance, temperature, etc.).

Groundwater samples will be collected after the critical water quality indicators have stabilized for three consecutive readings. Stabilization shall be defined as follows: temperatur e±1.0°C, pH ±0.1 units, EC ±3 percent, DO ±0.1 mg/L or 10 percent (whichever is greater), ORP ±10 percent, and turbidity less than 10 NTUs between three consecutive readings. Where possible, groundwater samples will be collected using the same pump used in the purging procedure. If the parameters do not stabilize, a subset (pH, EC, and turbidity or DO) will be used as the stabilization parameters. If subset parameters do not stabilize, then the sample shall be collected as described above in Section 6.1.1.2, and the anomalous parameters shall be brought to the field coordinator's attention (per CH2M HILL, Jan 1997). Field equipment will be calibrated in accordance with the base-wide QAPP (CH2M HILL, 1996).

The preservative hydrochloric acid shall be added to the VOC sample bottle before introducing the sample water. The sample shall be collected from the pump discharge line using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization The sample vial shall be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it shall be inverted and gently tapped to ensure no air bubbles are present in the vial. If bubbles are present after the initial filling, the vials shall be discarded and the VOC sampling effort shall be repeated. Refilling of vials will result in loss of preservatives. After the containers are sealed, sample degassing may cause bubbles to form. These bubbles shall be left in the container. These samples shall never be composited, homogenized, or filtered.

The pH of preserved samples will be checked in the field by pouring a small amount of the water sample onto pH paper. The paper will not touch the sample inside the container. The pH of acidified VOC samples will not be checked. The preservation checks will be documented in the chain-of-custody forms. One preserved VOC sample per day per sampling crew shall be checked with pH paper. The sole purpose of this sample is to check the pH of VOC samples, it will not be submitted for analysis.

Required sample containers, preservation methods, volumes and holding times are given in Section 6.2 and **Table 6-2**. Sampling equipment shall be decontaminated in accordance with Section 5.8 upon completion of sampling activities.

Table 6-2. Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Name	Analytical Methods	Container[a]	Preservation[b,c]	Minimum Sample Volume or Weight	Maximum Holding Time
Metals (except mercury)	SW6010A, SW6020 and SW-846 AA methods	P, G, T	HNO_3 to pH < 2, 4°C	500 mL or 8 ounces	180 days (water and soil)
Mercury	SW7470 SW7471	P, G, T	HNO_3 to pH < 2, 4°C	500 mL or 8 ounces	28 days (water and soil)
Chlorinated herbicides	SW8150B, SW8151	G, Teflon-lined cap, T	4°C, pH 5–9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Cyanide, total and amenable to chlorination	SW9010A, SW9012	P, G, T	4°C; NaOH to pH >12, 0 6g ascorbic acid	500 mL or 4 ounces	14 days (water and soil)
Dioxins and furans	SW8290	G, Teflon-lined cap, T	4°C, 0 008% $Na_2S_2O_3$ (kept dark)	1 liter or 8 ounces	30 days to extraction and 45 days after extraction (water and soil)
Organochlorine pesticides and polychlorinated biphenyls (PCBs)	SW8080A, SW8081	G, Teflon-lined cap, T	4°C, pH 5–9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Organo-phosphorus pesticides	SW8140	G, Teflon-lined cap, T	4°C, pH 5–9	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water), 14 days until extraction and 40 days after extraction (soil)
Sulfide	SW9030	P, G, T	4°C, NaOH to pH >9, 2ml zinc acetate	500 mL or 4 ounces	7 days
Total organic carbon	SW9060	one 250 m/L polyethylene	4°C; H_2SO_4 to pH < 2	250 m/L	28 days
Methane	SW3810 Mod	3 40-mL clear glass vials with rubber septa & Teflon lined caps	4°C	120mL	14 days
Ferrous iron	HACH method #8146	100-mL glass vials	NA	NA	Field method – analyze immediately
Alkalinity	E310 1	One 500-mL polyethylene	4°C	250mL	14 days
Common anions	SW9056	one 1-L polyethylene	4°C	100mL	28 days for Br^-, F^-, Cl^- and SO_4^{-2}; 48 hours for NO_3^-, NO_2^-, and PO_4^{-3}

Name	Analytical Methods	Container[a]	Preservation[b,c]	Minimum Sample Volume or Weight	Maximum Holding Time
Semi-volatile organics	SW8270B SW8310	G, Teflon-lined cap, T	4°C, 0 008% $Na_2S_2O_3$	1 liter or 8 ounces	7 days until extraction and 40 days after extraction (water); 14 days until extraction and 40 days after extraction (soil)
Volatile organics (water)	SW8260B	G, Teflon-lined septum	4°C, 0 008% $Na_2S_2O_3$ (HCl to pH < 2 for volatile aromatics by SW8260)b	2 x 40 mL or 4 ounces	14 days; 7 days if unpreserved by acid
Volatile organics (soil)	SW8260B/SW5035	EnCore Sampler	4°C, frozen at -12°C within 2 days of collection	3 x 5 gram cores	14 days

Notes:

a = Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T)

b = No pH adjustment for soil

c = Preservation with 0 008 percent $Na_2S_2O_3$ or by ascorbic acid is only required when residual chlorine is present

6.1.1.4 Rinse Water Sampling

When numerous WAAs are to be rinsed and sampled in succession, those facilities expected to have low levels of contamination or no contamination will be sampled prior to those expected to have higher levels of contamination. This practice will help reduce the potential for cross contamination between the WAAs. All sampling activities will be recorded in the field log book. Additionally, all sampling data will be recorded on a Field Sampling Report form. An example Field Sampling Report form is shown in Attachment A.

In addition to the information required in Section 8.0, the following information will be recorded each time a WAA is rinsed and sampled: (1) the condition of each WAA, (2) the presence of any waste products, and (3) field parameters; i.e., OVA readings. This information will be encoded in the IRPIMS files when required.

6.1.1.4.1 Sample Collection

The water will be collected by the use of an aluminum funnel that will direct the rinse water into the appropriate sample container. The sample container will be filled until full or a meniscus is visible, as applied to 40 mL vials, and immediately sealed. When a 40 mL vial is sealed, it will be inverted and gently tapped to ensure no air bubbles are present in the vial. If bubbles are present after the initial filling, the vials shall be reopened and topped off with rinse water. Extreme care will be taken during the refilling of vials to prevent a loss of preservatives. After the vial is sealed, sample degassing may cause bubbles to form. These bubbles shall be left in the container. These samples shall never be composited, homogenized, or filtered.

All water not collected during this sampling procedure will be removed from the floor drains, if present via a pump. If floor drains are not present, then plastic sheeting will be laid out to collect excess rinse water. All excess rinse water will be containerized in 55-gallon drums and disposed of in accordance with Section 5.9 of this FSP. All drums will be stored at the staging area until the analytical data has been reviewed.

6.1.1.4.2 Sample Preservation

The laboratory will provide sample containers that are appropriately preserved. Required sample containers, preservation methods, volumes and holding times are given in Section 6.2 and **Table 6-2.**

6.2 Sample Handling

6.2.1 Sample Containers

Sample containers will be provided to field personnel, pre-cleaned and treated according to EPA specifications for the methods. No sampling containers will be reused for the sampling events of this RFI. Containers will be stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

6.2.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in **Table 6-2**. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods used in this FSP are specified in **Table 6-2**.

6.2.3 Sample Identification

The following information will be written in the log book and on the sample label when samples are collected for laboratory analysis:

- Project identification (name and number)
- Sample identification number
- Sample location
- Preservatives added
- Date and time of collection
- Requested analytical methods
- Sampler's name

Each sample will be assigned a unique identification number that describes where and what type of sample was collected. The number that will be used in the field will consist of a maximum 15 digit alphanumeric code. Once data is ready to be entered into the IRPIMS database, the alphanumeric code will be truncated to 10 digits. This system is explained in detail as follows:

abbbccccdd

where a represents the medium (e.g., W = monitoring well, P = wipe sample, R = rinse sample, B = soil boring, U = surface water sample, or E = sediment sample)

bbb represents EEG, Inc. designation (e.g , EEG)

cccccc represents the aquifer/upper or lower (e.g., TA [Terrace Alluvium], P [Paluxy], U [Upper], L [Lower])

dd represents the location identification (Locid) (e.g., 01, 02)

For example, the groundwater sample collected from monitoring well 01 would be identified as "WEEGPU01." Duplicate samples will be submitted to the laboratory blind. A note in the field log book and the Field Sampling Report form will identify the location and sample number that has been duplicated.

QC samples will be identified by the use of a similar system of identifiers with a maximum of 10 characters. The QC sampling number system is summarized below.

aabbccdd

where aa represents medium (e.g. ER = equipment rinsate, TB = trip blank, AB = ambient blank, EB = equipment blank)

bb represents the day, e.g., 15

cc represents the month, e.g., 06

dd represents the year, e.g., 02

For example, an equipment blank collected on the 15th day of June in the year 2002 will be "EB150602."

The field coordinator will maintain a list that describes how each QC sample corresponds with specific environmental samples. For instance, each trip blank will be correlated with a particular set of samples shipped to the laboratory, and each rinsate will be correlated to those samples collected by a particular set of decontaminated sampling tools.

6.3 Sample Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

Chain of custody (COC) records will be maintained for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession; (2) it is in their view, after being in their possession; (3) it was in their possession, and they locked it up; or (4) it is in a designated secure area. All sample containers will be sealed in a manner that will prevent or detect tampering if it occurs. In no instance will tape be used to seal sample containers. Samples will not be packaged with activated carbon. Attachment A contains a sample COC form.

The following minimum information concerning the sample will be documented on the COC form (as illustrated in Attachment A):

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of matrix spike/matrix spike duplicate (MS/MSD)
- Preservative used
- Analyses required
- Name of collector(s)
- Pertinent field data (pH, temperature, etc.)

- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples will be uniquely identified, labeled, and documented in the field at the time of collection in accordance with Section 6 2.3 of the FSP. Samples collected in the field will be transported to the laboratory or field testing site as expeditiously as possible When a 4°C requirement for preserving the sample is indicated, the samples will be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a VOC sampling vial filled with water) will be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

6.4 Field Quality Control Samples

Field quality control samples such as blanks and duplicates will be collected as described in the following sections.

6.4.1 Ambient Blank

The ambient blank consists of ASTM Type II reagent-grade water poured into a VOC sample vial at the sampling site. It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection. Ambient blanks will be collected downwind of possible VOC sources One ambient blank will be collected at the beginning of the field investigation. Additional ambient blanks will be collected if site conditions warrant.

6.4.2 Equipment Blank

An equipment blank is a sample of ASTM Type II reagent-grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks will be collected immediately after the equipment has been decontaminated. The blank will be analyzed for all laboratory analyses requested for the environmental samples collected at the site. One equipment blank will be collected per day when environmental samples are collected.

6.4.3 Trip Blank

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent-grade water, transported to the sampling site, handled like an environmental sample, and returned

to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank will accompany each cooler of samples sent to the laboratory for analysis of VOCs.

6.4.4 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously, or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field so that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest. One duplicate sample will be collected for every 10 groundwater samples collected.

6.4.5 Field Replicates

A field replicate sample, also called a split, is a single sample divided into two equal parts for analysis. The sample containers are assigned an identification number in the field such that they cannot be identified as replicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field replicate samples prior to the beginning of sample collection. Replicate sample results are used to assess precision. One replicate sample will be collected for every 10 groundwater samples

7.0 Field Measurements

7.1 Parameters

7.1.1 Field Parameters for Water Samples

The pH will be measured during the groundwater purging. The pH of each water aliquot will be measured by a portable pH meter. The pH meter will be calibrated with two buffer solutions of the appropriate range for the expected values of pH. The meter will be recalibrated daily.

7.2 Equipment Calibration and Quality Control

Field equipment will be maintained and calibrated to the standards in their respective operations manuals. Equipment failures will be repaired in the field if possible; if not, the instrument will be tagged, removed from use, and returned for repair or replacement. Field equipment will be calibrated daily before the start of sampling activities. Calibration records will be maintained on the Calibration Log (Attachment A). The calibration record will include a unique instrument number (e.g., serial number), standards used, concentrations, and meter readings.

7.3 Equipment Maintenance and Decontamination

7.3.1 Equipment Maintenance

Field equipment will be kept in a controlled storage room and will be decontaminated prior to return to storage; any malfunctions will be reported to the field coordinator. The field coordinator will initiate actions necessary for the repair or replacement of defective equipment. Equipment maintenance logs are kept updated and on file. Power supplies of battery-powered instruments will be checked daily. Rechargeable instruments will be recharged daily.

7.3.2 Decontamination of Field Instruments

Decontamination of field instruments will be instrument-specific. The probes of the pH meters will be rinsed with reagent-grade water before and after each use, and at the end of each day. No decontamination is required for the OVA.

7.4 Field Performance and System Audits

The project geologist or a designated representative will conduct weekly informal audits of the field activities. The weekly audit for completeness will include the following items:

- Sample labels
- Chain of custody records
- Field notebooks
- Sampling operations
- Document control

The first three items above will be checked for completeness. Sampling operations will be reviewed to determine if they are performed as stated in the WP or as directed by the project

geologist. The informal document control audit will consist of checking each document for completeness, including items such as signatures, dates, and project numbers.

An unscheduled systems audit of field operations will be conducted using the project-specific work plan and will be used to review the total data generation. The audit will include on-site review of the field operational system, physical facilities for sampling, and equipment calibrations. A performance audit may be conducted by the PM and project geologist if deemed necessary by the PM, project geologist, lab coordinator, or client. The audit may focus on verifying that proper procedures are being followed so that subsequent sample data will be valid. Prior to the audit, a checklist will be prepared by the PM and project geologist that will serve as a guide for the performance audit.

The audit will verify whether or not the following items are being accomplished: (1) collection of samples follows the available written procedures; (2) chain of custody procedures are followed for traceability of samples origin; (3) appropriate QC checks are being made in the field and documented in the field log book; (4) specified equipment is available, calibrated, and working properly; (5) sampling crews are adequately trained; (6) record-keeping procedures are being followed and appropriate documentation is maintained, and corrective action procedures are followed. An audit report summarizing the results and corrections will be prepared and filed in the project files.

8.0 Record Keeping

EEG will maintain field records sufficient to recreate all sampling and measurement activities and to meet all IRPIMS data loading requirements. The information shall be recorded with indelible ink in a permanently bound notebook with sequentially numbered pages. These records shall be archived in an easily accessible form and made available to the USAF upon request.

The following information will be recorded for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. The following information will be recorded for all field measurements: (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument will also be recorded.

The following additional information will be recorded for all sampling activities: (1) sample type and sampling method; (2) the identity of each sample and depth(s), where applicable, from which it was collected; (3) the amount of each sample; (4) sample description (e.g., color, odor, clarity); (5) identification of sampling devices; and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

The following section describes the field documentation procedures, which will be followed as a means of recording observations and findings during the RFI field investigation. Documentation will include the form of field log books, various sample and calibration forms, site photographs, and drawings/sketches. All documentation will be completed in indelible ink and corrections will be stricken out with a single line and initialed. Examples of field forms are included in Attachment A

8.1 Field Log Book

Log books with sequentially numbered pages will be kept at the site during all field activities and will be assigned to each sample team. These logs will be updated, continually, and will constitute master field investigation documents. Information to be recorded in the logs includes, but is not limited to, the following:

- Project identification
- Field activity subject
- General work activity, work dates, and general time of occurrence
- Unusual events
- Subcontractor progress or problems
- Communication with the client or others
- Weather conditions
- EEG personnel, subcontractors, and visitors on site
- Sample number and time of day for each sample collected for analysis
- Listing by sample number of samples collected during the day, sorted by chain-of-custody record number (compiled at the end of the day)
- Record of telephone call to laboratory informing it of sample shipment
- Accomplishment of decontamination of drilling rig, construction materials, and sampling equipment

- Accomplishment of required calibration checks
- Disposition of purge water, decontamination fluids, and soil cuttings
- Variances from project plans and procedures (details will be recorded in the log book)
- Accomplishment of tailgate safety meetings
- Review of project procedures with site personnel
- Head space screening and breathing zone readings
- Accomplishment of decontamination of water sampling equipment
- Photographs taken and identification numbers
- Name and signature of person making log book entries
- Inspections and results of inspections

8.2 Field Equipment Log Book

A field equipment log book will be kept on site to document the proper use, maintenance, and calibration of field testing equipment. Accompanying the field equipment log book will be a three-ring binder containing operator manuals, specifications, and calibration requirements and procedures for all field testing equipment. Information to be recorded in the field equipment log book includes the following:

- Equipment calibration status
- Equipment decontamination status
- Equipment nonconformance
- Equipment inspection and repair records
- Name and signature of person making entry
- Date of entry
- Name of equipment and its identifying number
- Nature of work conducted
- List or reference of procedures used for calibration or maintenance
- Manufacturer, lot number, and expiration date of calibration standards
- Measurement results

8.2.1 Sample Collection Log

A sample collection log form (i.e., Field Sampling Report) will be completed for each sample collected during the investigation. An example of the Field Sampling Report form is included in Attachment A. Information to be included on the form includes the following:

- Date and time of sample collection
- Sample location
- Sample type (i.e., surface soil, sediment, groundwater, etc.)
- Name of person collecting samples
- Sample volumes and container types

9.0 References

Air Force Center for Environmental Excellence (AFCEE), 1993, Handbook for the Installation Restoration Program (IRP) for Remedial Investigations and Feasibility.

Air Force Center for Environmental Excellence (AFCEE), 1996, AFCEE's Model Field Sampling Plan.

American Geological Institute Data Sheets, 1989, 3rd Edition.

American Society for Testing and Materials, 1990, Standard Practice for Description and Identification of Soils (D-2488-90)

CH2M HILL, 1996, Interim Draft Base-Wide Quality Assurance Project Plan, NAS Fort Worth JRB, Carswell Field, Texas.

CH2M HILL, 1996c, Site Characterization Summary - Informal Technical Information Report, NAS Fort Worth JRB, Carswell Field, Texas.

CH2M HILL, 1997, Final Basewide Groundwater Sampling and Analysis Program, Quarterly Monitoring Report, January 1997 Event for NAS Fort Worth JRB, Texas.

CH2M HILL, 1998, Draft RCRA Facility Investigation Report, Area of Concern 2, NAS Fort Worth JRB, Texas.

HydroGeoLogic, Inc., 1998, Basewide Quality Assurance Project Plan, NAS Fort Worth JRB, Texas.

Jacobs Engineering Group, 1998, Final Basewide Background Study, Volume 1, NAS Fort Worth JRB, Texas.

Ohio Environmental Protection Agency, 1993, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring Programs.

Swanson, R.G., 1981, Sample Examination Manual, American Association of Petroleum Geologists.

Tennissen, A.C., 1983, Nature of Earth Materials, 2nd Edition.

Texas Natural Resource Conservation Commission, 1997. Texas Administrative Code, Environmental Quality, Chapter 238 Well Drillers and Water Well Pump Installers.

U.S. Air Force Occupational and Environmental Health Laboratory Human Systems Division, 1989, Hazardous Waste Technical Assistance Survey, Carswell AFB, Texas.

U.S. Air Force, 1993, Closure Plan for Ninety Day Hazardous Waste Storage Facilities, Carswell AFB, Texas.

U.S. Environmental Protection Agency (EPA), 1986, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, 3rd Edition.

U.S. Environmental Protection Agency (EPA), Nov. 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance.

U.S. Environmental Protection Agency (EPA), 1993, Data Quality Objectives Process for Superfund, Interim Final Guidance.

U.S. Environmental Protection Agency (EPA) Research Paper, Apr. 1996, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures

Urquhart, L.C., 1962, Civil Engineering Handbook 4th Edition, Water Measurement Manual, Bureau of Reclamation.

ATTACHMENT A

Field Forms

Monitor Well Boring Log
Well Development Record
Monitor Well Water Level Measurements
Groundwater Field Sampling Data Sheet
Field Sampling Report
ph / Conductivity / Turbidity Calibration Form
Sample Chain of Custody Form

Ellis Environmental Group LC

Monitor Well Boring Log

Page ____ of ____
Date. ____
Day: ____

Well Boring I.D.:

Drilling Subcontractor				Driller.	Geologist.
Drill Make and Model:				Drilling Method.	
Total Depth Drilled:	ftbgs	Bottom of Well:	ft-bgs	Date Drilled:	
Casing Material:		Screen Interval.	ft-bgs	Date Completed:	
Screen Material:		Sandpack Interval:	ft-bgs	Date Developed:	
Grout Material.		Seal Interval	ft-bgs	Develop. Mthd:	
Well Stick Up:	ft-ags	Grout Interval	ft-bgs	Depth to Water:	ft-btoc
TOC Elevation	ft-msl	Casing Dia.:	inches	Date Measured.	
Ground Elevation	ft-msl	Annulus Dia.:	inches		

Depth (feet bgs)	Sample Type	Sample I.D.	Blows / 6"	Sample Recovery (in)	Headspace Reading (ppm)	Well Details	Sample Description	Remarks
1								
2								
3								
4								
5								
6								
7								
8								
9								

Well Legend: Bentonite ☒ Well Screen ▤ Grout ■ Lithology change —— Gradational change.....

WELL DEVELOPMENT RECORD

WELL/PIEZOMETER ID _____
SHEET _____ of _____

AFIID: _____ LOCID: _____ SITEID: _____

PROJECT NAME. _____ PROJECT NO : _____ DATE. _____

LOCATION: _____ DATE INSTALLED: _____

TOTAL DEPTH (FTOC) _____ CASING DIAMETER _____ LOGCODE: HGL-H

METHODS OF DEVELOPMENT

☐ Swabbing ☐ Bailing ☐ Pumping ☐ Deseribe _____

Equipment decomtaminated prior to development ☐ Yes ☐ NO

Describe _____

EQUIPMENT NUMBERS:

pH Meter _____ EC Meter _____ Turbidity Meter _____ Thermometer _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3 0	4 0	4 3	5 0	6 0	7 0	8 0
Unit Casine Volume (A) (gal/ft)	0 04	0 09	0 16	0 2	0 37	0 65	0 75	1 0	1 5	2 0	2 6

PURGING INFORMATION.

Measured Well Depth (B) _____ ft

Static Water Level Depth (C) _____ ft

Length of Staue Water Colume (D) _____ (B) - _____ (C) = _____ ft

Casing Water Volume (E) + _____ (A) x _____ (D) = _____ gal

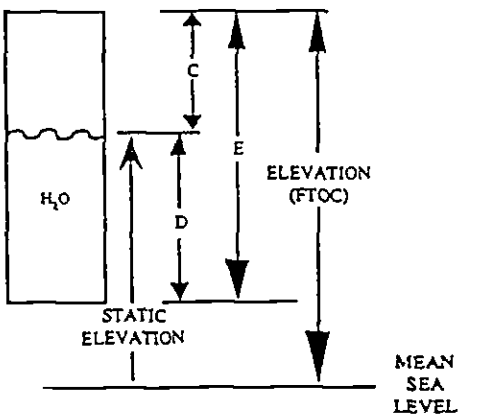
Total Purge Volume = _____ (gal)

Pumping/Purge Rate (PRODRATE) = _____ (gal/mun)

Pumping Depth (PUMPDEP) = _____ (ft)

Water Level Recovery Depth (DEPWAT) = _____ (ft)

Recovery Time (LECTIME) = _____ (min)



Date	Time	Water Level (FTOC)	Volume Removed (gal)	pH	EC	Temperature °F or °C	Turbidity (NTU)	Comments

Ellis Environmental Group, LC

Monitor Well Water Level Measurements

Top of Well Casing_____
Ground Surface_____
Page _____ of _____
Date: _____
Day. _____

Well	Date	Time	Held Length	Wet Length	Depth to Water	Comments

Recorded By:_____ Date:_____

Reviewed By:_____ Date:_____
Quality Control Representative

GROUNDWATER FIELD SAMPLING DATA SHEET

Well No.:	Location: NAS Fort Worth JRB, Texas
Sampler (s)	Project Name: Semi-Annual Sampling
Well Depth:	Project #: AFC001-33 Date: Time:
DTW (ft): DTP (ft):	Courier: __X__FedEx ____UPS ____Hand ____Othe
MP Ht. Above/Below GS:	Sampling Method : Low Flow
Condition of Bottom of Well	Type of Pump: Bladder
Screen Interval (ft):	Weather (sun/clear, overcast/rain, wind direction, ambient temperature).
Well Diameter (in)	
Placement of Pump Inlet (ft):	

Field Parameters

Time	Depth to Water (ft)	Flow Rate (L/min)	Total Volume (L)	pH	Temp. (C)	Cond. (umhos/cm)	ORP (mv)	DO (mg/L)	Turb. (NTU)	Type, Size, and Amount of Sediment Discharged

Observations

Color: Clear Other (describe)

Odor: None Low Medium High Very Strong H2S Fuel-like

Notes:

Signed/Sampler(s).

FIELD SAMPLING REPORT

720 92

LOCATION: NAS Fort Worth JRB, Texas PROJECT NAME:

SITE. _____ PROJECT NAME·

SAMPLE INFORMATION

SAMPLE ID. DATE:_____ TIME:_____

MATRIX TYPE: WG WG

SAMPLING METHOD: Low Flow

LOT CONTROL #: ___ ___ ___ ___

(Ambient Blank # - Equipment Blank # - Trip Blank # - Cooler

CHAIN-OF-CUSTODY #.

SAMPLE BEG. DEPTH (FT) N/A

SAMPLE END DEPTH (FT)· N/A

GRAB (X) COMPOSITE ( )

ENTER SAMPLE NUMBERS FOR QC SAMPLES/ BLANKS ASSOCIATED WITH THIS SAMPLE:

MATRIX SPIKE (MS) _____

MATRIX SPIKE DUP (SD) _____

FIELD DUP (FD) _____

AMBIENT BLANK (AB) _____

EQUIPMENT BLANK (EB) _____

TRIP BLANK (TB) _____

CONTAINER SIZE/TYPE	#	PRESERVATIVE/ PREPARATION	ANALYTICAL METHOD	ANALYSIS

NOTABLE OBSERVATIONS

PID READINGS	SAMPLE CHARACTERISTICS	MISCELLANEOUS
1st	COLOR:	
2nd	ODOR.	
	OTHER.	

pH _____ Temperature _____(C) Dissolved Oxygen _____(mg/L) Conductivity _____(umhos/cm)

Iron _____(mg/L) Oxidation/Reduction Potential _____(mv) Turbidity_____ (NTU)

GENERAL INFORMATION

WEATHER SUN/CLEAR _____ OVERCAST/RAIN _____ WIND DIRECTION _____ AMBIENT TEMPERATURE

SHIPMENT VIA FEDEX __x___ HAND DELIVER _____ COURIER _____ OTHER _____

SHIPPED TO STL -Chicago

COMMENTS

SAMPLER _____ OBSERVER _____

MATRIX TYPE CODES		SAMPLING METHOD CODES	
DC=DRILL CUTTINGS	SL=SLUDG	B=BAILER	G=GRAB
WG=GROUND WATER	SO=SOIL	BP=BLADDER PUMP	HA=HAND AUGER
LH=HAZARDOUS LIQUID WAST	GS=SOIL GAS	BR=BRASS RING	H=HOLLOW STEM AUGER
SH=HAZARDOUS SOLID WAST	WS=SURFACE WATE	CS=COMPOSITE SAMPLE	HP=HYDRO PUNC
SE=SEDIMENT	SW=SWAB/WIPE	C=CONTINUOUS FLIGHT AUGER	SS=SPLIT SPOON
		DT=DRIVEN TUBE	SP=SUBMERSIBLE PUMP

Ellis Environmental Group, LC	**pH/Conductivity/Turbidity Calibration Form**	Instrument Serial No._____ Battery(voltage)_____Vdc. Page _____ of _____ Date: _____ Day: _____

Parameter:			
TEMPERATURE:	Standard Concentration	Initial Reading	Final Reading
CONDUCTIVITY:	Standard Concentration	Initial Reading	Final Reading
High Concentration			
Middle Concentration			
Low Concentration			
pH:	Standard Concentration	Initial Reading	Final Reading
High			
Middle			
Low			
TURBIDITY:	Standard Concentration	Initial Reading	Final Reading
High Concentration			
Middle Concentration			
Low Concentration			
Comments:			

Having performed a full calibration of this instrument, I certify that to the best of my knowledge this unit is completely operational and accurate. The only exceptions are those explicitly defined.

Recorded By._____ Date:_____

Reviewed By:_____ Date:_____

Quality Control Representative

SEVERN TRENT SERVICES

STL Chicago
2417 Bond Street
University Park, IL 60466
Phone: 708-534-5200
Fax: 708-534-5211

Report To:

Contact _____
Company _____
Address _____
_____
Phone _____
Fax _____
E-Mail _____

Bill To:

Contact _____
Company _____
Address _____
_____
Phone _____
Fax _____
PO# _____ Quote _____

Shaded Areas For Internal Use ____ of ____

Lab Lot#

Package Sealed	Samples Sealed
Yes No	Yes No
Received on Ice	**Samples Intact**
Yes No	Yes No

Temperature °C of Cooler

Sampler Name: | **Signature:**

Project Name: | **Project Number:**

Project Location:

Lab PM:

Date Required
Hard Copy: ____/____/____
Fax: ____/____/____

Refrg #											
# / Cont.											
Volume											
Preserv											
Matrix											
Comp/Grab											

Within Hold Time	Preserv. Indicated
Yes No	Yes No NA
pH Check OK	**Res Cl_2 Check OK**
Yes No NA	Yes No NA

Sample Labels and COC Agree
Yes No COC not present

Laboratory ID	MS-MSD	Client Sample ID	Sampling Date	Sampling Time	Additional Analyses / Remarks

RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME
RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME

Matrix Key

WW	- Wastewater	SE	- Sediment
W	- Water	SO	- Solid
S	- Soil	DS	- Drum Solid
SL	- Sludge	DL	- Drum Liquid
MS	- Miscellaneous	L	- Leachate
OL	- Oil	WI	- Wipe
A	- Air	O	_____

Container Key

1 Plastic
2 VOA Vial
3 Sterile Plastic
4 Amber Glass
5 Widemouth Glass
6 Other
_____

Preservative Key

1 HCl, Cool to 4°
2. H2SO4, Cool to 4°
3 HNO3, Cool to 4°
4 NaOH, Cool to 4°
5 NaOH/Zn, Cool to 4°
6 Cool to 4°
7 None

COMMENTS

Date Received / /

Courier: **Hand Delivered**

Bill of Lading

TAB

APPENDIX B

720 96

FINAL

Health and Safety Plan

Paluxy Wells Installation and Sampling *at* Naval Air Station Fort Worth Joint Reserve Base, TX

Contract No. F41624-00-D-8032
Delivery Order No. 0009

Prepared for
Air Force Center for Environmental Excellence
Brooks Air Force Base, TX

Prepared by
Ellis Environmental Group, LC
414 SW 140th Terrace
Newberry, FL 32669
(352) 332-3888

March 2002

FINAL

Health and Safety Plan
Paluxy Wells Installation And Sampling
NAS Fort Worth JRB, Texas

Project:	U.S. Air Force Center for Environmental Excellence
Project Number:	Contract No. F41624-00-D-8032, Delivery Order No. 0009
Project Site Location:	NAS Fort Worth JRB, Texas
Project Manager:	Rick Levin, PG
Health and Safety Director:	Jason Shannon
Site Safety and Health Officer:	Mark Webster, PG
Plan Preparer:	Jason Shannon
Preparation Date:	March 2002

Approved By:

Jason P. Shannon 3/27/02

Jason P. Shannon Date
Ellis Environmental Group, LC
Health and Safety Director

3/27/02

Rick Levin, PG Date
Ellis Environmental Group, LC
Project Manager

Contents

Figures

Tables

Attachment A. Field Forms

Abbreviations & Acronyms

dB(A)	decibel A – weighted scale
ft-bgs	feet below ground surface
mg/m^3	milligrams per cubic meter
O_2	oxygen
ppm	parts per million
T	air temperature
T_{aj}	adjusted air temperature
°C	degrees Celsius
°F	degrees Fahrenheit
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ANSI	American National Standards Institute
AOC	area of concern
CAFB	Carswell Air Force Base
CFR	Code of Federal Regulations
COR	contracting officer's representative
CPC	chemical protective clothing
CPR	cardiopulmonary resuscitation
DRMO	Defense Reutilization and Marketing Office
EEG	Ellis Environmental Group, LC
EPA	Environmental Protection Agency
FAR	Federal Acquisition Regulation
FSP	Field Sampling Plan
HAZWOPER	Hazardous Waste Site Operations
HCS	hazard communication standard
HEPA	high-efficiency particulate air
HSD	health and safety director
HASP	Health and Safety Plan
ITC	International Technology Corporation
JRB	Joint Reserve Base
LEL	lower explosive limit
MEK	methyl ethyl ketone
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OVM	organic vapor monitor
OWS	oil/water separator
PEL	permissible exposure limit
PG	professional geologist
PM	Project Manager
POC	point of contact

PPE	personal protective equipment
PVC	polyvinyl chloride
RCO	responsible corporate officer
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RV	recreational vehicle
SSHO	Site Safety and Health Officer
SWMU	solid waste management unit
TCE	trichloroethene
TLV	threshold limit value
UEL	upper explosive limit
USCG	United States Coast Guard
WAA	waste accumulation area
WP	Work Plan

1.0 Introduction

This Health and Safety Plan (HASP) has been adapted from a HASP prepared by HydroGeoLogic, Inc. for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the waste accumulation areas (WAAs) at Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB), Texas.

1.1 Purpose

This HASP is designed to assign responsibilities, establish personnel protection standards, specify mandatory operating procedures, and provide for emergency contingencies with respect to health and safety issues that may arise while Ellis Environmental Group, LC (EEG) personnel and subcontractor personnel are engaged in Paluxy Wells installation and sampling activities within the area referred to as the Northern Lobe Trichloroethene (TCE) Plume.

This site is located within the former Carswell Air Force Base (CAFB), now referred to as NAS Fort Worth JRB, located in Fort Worth, Texas.

This HASP conforms to the requirements of Occupational Safety and Health Administration (OSHA) Standard 29 Code of Federal Regulations (CFR) 1910 and 1926. Detailed OSHA requirements for hazardous waste operations are contained in OSHA Standard 29 CFR 1910.120 and OSHA Standard 29 CFR 1926.65, "Hazardous Waste Operations and Emergency Response." Additional guidance for hazardous waste operations may be found in the U.S. Environmental Protection Agency (EPA) publication "Standard Operating Safety Guides" (June 1992), the National Institute of Occupational Safety and Health (NIOSH)/OSHA/United States Coast Guard (USCG)/EPA publication "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (October 1985), and Federal Acquisition Regulation (FAR) clause 52.236-13, Accident Prevention.

This HASP is based on available background information regarding possible chemical, physical, and biological hazards that may exist at the site. If more information concerning the nature and/or concentrations of contaminants becomes available, this HASP will be amended accordingly.

1.2 Applicability

The provisions of this HASP are mandatory for all official visitors, EEG employees, and subcontractors while Paluxy Wells installation and sampling is being conducted at NAS Fort Worth JRB. Inadequate health and safety precautions on the part of visitors or subcontractors, or the belief that personnel on the site are or may be exposed to an immediate health hazard, can be cause for EEG to suspend on-site activities and require all personnel to evacuate the area.

1.3 Project Organization, Personnel, and Responsibilities

This section outlines EEG's personnel organization for this project and establishes the roles and responsibilities of various project personnel regarding site health and safety. The authority and responsibilities of each EEG official utilized for this project are presented in the following sections.

1.3.1 Health and Safety Officer

The EEG Health and Safety Director (HSD) is Jason Shannon. The HSD has the authority to:

- Suspend work or otherwise limit exposure to personnel if health and safety plans appear to be unsuitable or inadequate
- Direct personnel to change work practices if existing practices are deemed to be hazardous to their health and safety
- Remove personnel from projects if their actions or conditions endanger their health and safety or the health and safety of coworkers
- Approve the qualifications of employees to work at hazardous waste sites
- Approve health and safety plans

The HSD responsibilities for this project will include the following:

- Interfacing with the Project Manager (PM) in matters of health and safety
- Keeping the PM informed on the status of the site health and safety plan
- Developing or reviewing and approving project health and safety plans prior to submittal
- Appointing or approving the Site Safety and Health Officer (SSHO)
- Monitoring compliance with health and safety plans and conducting site audits as necessary
- Assisting in obtaining required health and safety equipment if needed
- Approving personnel to work on hazardous waste management projects with regard to medical examinations and health and safety training
- Maintaining records pertaining to medical surveillance, training, fit testing, chemical exposure, and accidents/incidents
- Providing industrial hygiene/chemical safety guidance

1.3.2 Project Manager

The PM for this project will be Rick Levin, Professional Geologist (PG). The PM has the authority to:

- Coordinate with the HSD on health and safety matters
- Assign an HSD-approved SSHO to the project and, if necessary, assign a suitably qualified replacement
- Temporarily suspend field activities if health and safety of personnel are endangered, pending an evaluation by the HSD
- Temporarily suspend an individual from field activities for infractions of the health and safety plan, pending an evaluation by the HSD

The PM responsibilities for this project will include the following:

- Ensuring that the project is performed in a manner consistent with the health and safety program
- Ensuring that the project health and safety plan is prepared, approved, and properly implemented
- Providing the HSD with the information needed to develop health and safety plans
- Ensuring that adequate funds are allocated to fully implement project health and safety plans

1.3.3 Site Safety and Health Officer

The SSHO will direct all on-site health and safety training and daily safety inspections. A qualified EEG employee who has performed these functions previously (Mark Webster, PG) will be the designated SSHO. The SSHO has the authority to temporarily suspend field activities if the health and safety of personnel are endangered, pending further consideration by the HSD, and to temporarily suspend an individual from field activities for infractions of the health and safety plan, pending an evaluation by the HSD.

The SSHO will report any problems or concerns to the EEG HSD and PM. The HSD will also review accident reports and air monitoring data sheets; however, because these reviews are necessarily conducted after the fact, the SSHO remains the person responsible for on-site safety. At the facilities, the SSHO has primary responsibility for:

- Directing health and safety activities on the site
- Ensuring that appropriate personal protective equipment (PPE) is available and properly utilized by EEG personnel, visitors, and subcontractor personnel

- Ensuring that personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are aware of planned procedures for dealing with emergencies

- Ensuring that personnel are aware of the potential hazards associated with investigation activities

- Monitoring the safety performance of all personnel to ensure that required work practices are followed

- Monitoring the physical condition of site workers for heat and cold stress

- Correcting any work practices or conditions that may result in injury or exposure to hazardous substances

- Ensuring the completion of the site-specific HASP forms presented in Section 14.1 (e.g., Compliance Agreement, Accident/Incident Reports, Site Safety Briefing Form, etc.)

- Ensuring that a copy of the HASP is maintained on the site during all investigation activities

- Ensuring that all air monitoring and equipment calibrations required by the HASP are preformed and recorded, and that logs/forms that include these activities are maintained (Section 14.1)

- Ensuring that the subcontractor's medical monitoring program is adequate per OSHA Standard 29 CFR 1910.120 and this document

- Verifying OSHA 40-hour health and safety training before admitting official site visitors (Air Force and regulatory representatives) in the exclusion zone and verifying medical certification and fit-testing for respirator use for visitors requesting admittance into a Level C PPE exclusion zone (per OSHA Standard 29 CFR 1910.120)

1.3.4 Project Field Personnel

Personnel working on this project will be approved by the PM and the HSD and will meet the qualifications outlined in OSHA Standard 29 CFR 1910.120, and this HASP. The project personnel involved in on-site investigations and operations are responsible for:

- Taking all reasonable precautions to prevent injury to themselves and to their fellow employees

- Implementing the HASP and reporting any deviations from the anticipated conditions described in the plans to the SSHO

- Performing only those tasks that they believe they can do safely, and immediately reporting any accidents and/or unsafe conditions to the SSHO

1.3.5 Subcontractor Responsibilities

It is the responsibility of each EEG subcontractor to ensure compliance with all applicable federal and state regulations, including OSHA Standard 29 CFR, Parts 1900 through 1910, and Part 1926, and the contents of this HASP. Specifically contained within these OSHA regulations is OSHA Standard 29 CFR 1910.120, which includes requirements for training and medical surveillance for employees engaged in certain hazardous waste operations. Subcontractors are required to have a corporate health and safety plan at least as strict as the EEG Corporate Health and Safety Plan and provide a copy of it to the EEG HSD on request.

2.0 Site Description Information

A description of the NAS Fort Worth JRB site where wells are to be installed and sampled is presented in Section 2.0 of the Work Plan (WP). Please refer to that section for detailed site description information.

2.1 Description of Northern Lobe TCE Plume

The TCE plume is alleged to have resulted from operations at Air Force Plant 4 and migrated to the east through the Terrace Alluvium. TCE concentrations exist up to 2,500 micrograms per liter (µg/L) within the Terrace Alluvium at Carswell. No potable water supply wells are completed in the Terrace Alluvium within 0.5 mile of NAS Fort Worth JRB. TCE contamination in groundwater at NAS Fort Worth JRB is generally described as one plume. The portion of the TCE plume that is migrating west to east in the flightline area, or northern portion of the Base, is referred to as the northern lobe; the portion migrating west to east in the landfill area, or southern portion of the Base, is referred to as the southern lobe. Although the major contaminant in the groundwater plume is TCE, TCE-related compounds, mainly cis-1,2-dichloroethene (cis-1,2-DCE), but including trans-1,2-dichloroehtene (trans-1,2-DCE), tetrachloroethene, and vinyl chloride, are also present in groundwater beneath the Base.

3.0 Paluxy Wells Installation and Sampling Activities

The well installation activities to be conducted at the NAS Fort Worth JRB will include the following:

- Clear site for utilities.
- Drill with mud-rotary drilling through the plume.
- Insert and grout casing.
- Drill with core into bedrock.
- Install screen.
- Develop well.
- Sample well.

4.0 Hazard Assessment

This section identifies and evaluates potential site hazards that may be encountered during well installation and sampling activities. Control measures to protect site personnel from these potential hazards are incorporated throughout this HASP but are mainly contained in the following sections:

- Section 6.0, Air Monitoring
- Section 7.0, Personal Protective Equipment
- Section 11.0, Standard Work Practices

4.1 Chemical Hazards

Based upon the information obtained from previous site investigations (groundwater and soil), the primary chemicals of concern at the site have been listed in **Table 4-1**.

The primary concerns from a chemical exposure standpoint are inhalation, ingestion, and absorption by direct skin contact with contaminants in locations expected to be source areas. The specific contaminants, their exposure limits, and their recognition qualities are presented in **Table 4-1**. The acute and chronic symptoms of overexposure to these chemical contaminants and first aid procedures are presented in **Table 4-2**. If additional contaminants are identified at the site, this HASP will be amended accordingly.

4.2 Decontamination Solutions and Preservatives

Chemicals used to decontaminate sampling equipment and to preserve environmental sampling also present hazards to the project personnel who use them. The chemicals likely to be brought to the site for use in this manner include the following:

- Nitric Acid
- Hydrochloric Acid
- Methanol
- Hexane

Although overexposure to these chemicals is unlikely, the acute and chronic symptoms and first aid procedures are also presented in **Table 4-2**.

In order to communicate the hazards of these chemicals to site personnel, Material Safety Data Sheets (MSDSs) for each of these chemicals will be maintained on-site and presented as part of the site-specific training (Section 10.2).

Table 4-1. Exposure Limits and Recognition Qualities

Compound	Permissible Exposure Limit (PEL)[a]	IDLH Level[b]	Recognition Qualities			Odor Warning Concentration (ppm)	LEL[c] (%)	UEL[d] (%)	Ionization Potential (eV)
			Color	Odor	State				
Gasoline	ND	ND	Clear	Gasoline	Liquid	ND	1.4	7.6	ND
Hydrochloric Acid	C 5 ppm	50 ppm	Colorless to light yellow	Irritating	Gas	NA	NA	NA	12.74
Methanol	200 ppm	6,000 ppm	Colorless	Pungent	Liquid	100	6.0	36.0	10 84
Nitric Acid	2 ppm	25 ppm	Colorlessred or yellow	Acnd, suffocatng	Liquid	NA	NA	NA	11.95
Sulfuric Acid	1 mg/m3	15 mg/m3	Colorlessyellow, or brown	Odorless	Solution	NA	NA	NA	ND
Trichloroethylene	100 ppmf	1,000 ppme	Colorless	Chloroform-like	Liquid	28.0	8 0	10 5	9.45

a = OSHA permissible exposure limit or the American Conference of Governmental Industrial Hygienists' threshold limit value (both 8-hour time weighted averages).

b = Immediately dangerous to life or health.

c = Lower explosive limit

d = Upper explosive limit.

e = To be treated as a carcinogen.

f = The value presented is the OSHA PEL, which is not necessarily the most conservative of the available exposure limits. The air monitoring screening levels in Table 6 1 are based upon the most conservative values.

C = Ceiling value, a 15-minute Time Weighted Average that shall not be exceeded at any time during the workday.

eV = Electron volts.

mg/m^3 = Milligrams per cubic meter.

NA = Not applicable

ppm = Parts per million

Table 4-2. Acute and Chronic Effects, Symptoms of Overexposure, and First Aid Treatment

Compound	Symptoms of Overexposure	First Aid Treatment	
Gasoline	Irritation to eyes, skin, mucous membranes; dermatitis, headaches, fatigue, blurred vision, dizziness, slurred speech, confusion, convulsions, chemical pneumonia (aspiration); possible liver, kidney damage; carcinogen	Eye: Skin: Inhalation: Ingestion:	Irrigate immediately Soap flush immediately Respiratory support Medical attention immediately
Hexane	Eye and nose irritation, nausea, headache, dermatitis	Eye: Skin: Inhalation: Ingestion.	Irrigate immediately Soap wash promptly Respiratory support Medical attention immediately
Hydrochloric Acid	Inflammation of the nose, throat, laryngeal; cough, burns throat, choking; burns eyes, skin, dermatitis	Eye: Skin. Inhalation: Ingestion:	Irrigate immediately Water flush immediately Respiratory support Medical attention immediately
Methanol	Eye irritant, headache, drowsiness, lightheadedness, nausea, vomiting, visual disturbances, blindness	Eye: Skin: Inhalation: Ingestion:	Irrigate immediately Water flush immediately Respiratory support Medical attention immediately
Nitric Acid	Irritation of eyes, mucous membranes, and skin; delayed pulmonary edema, pneuitis, bronchitis, dental erosion	Eye: Skin: Inhalation. Ingestion.	Irrigate immediately Water flush immediately Respiratory support Medical attention immediately
Sulfuric Acid	Irritation to eyes, nose, and throat, pulmonary edema; bronchitis; emphysema, conjunctivitis, stomitis, dental erosion; thracheobronchitis, eye and skin burns, dermatitis	Eye. Skin: Inhalation: Ingestion:	Irrigate immediately Water flush immediately Move to fresh air; respiratory support Medical attention immediately
Trichloroethylene	Headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, irritation of the eyes, dermatitis, cardia arrhythmias, paresthesia, carcinogen	Eye Skin: Inhalation. Ingestion:	Irrigate immediately Soap wash promptly Respiratory support Medical attention immediately

4.3 Physical Hazards

The following section titles identify physical hazards that may be encountered. They include, but are not limited to:

- Hot or Cold Work Environments (Thermal Stress)
- Noise Hazards
- Materials Handling
- Utility Hazards
- Fall, Trip, and Slip Hazards (Section 11.0)
- Flammable/Explosive Atmospheres (Section 6.0)
- Heavy Equipment/Vehicular Activity (Section 11.0)

Control measures to help protect site personnel from these potential hazards are incorporated in the following subsections and throughout this HASP, specifically Section 11.0, Standard Work Practices, for safety hazards associated with drilling rigs and support vehicles.

4.3.1 Heat Stress

Heat stress can be a problem especially if personnel must perform site activities while wearing PPE in warm, humid weather conditions. The four types of heat illness in increasing order of severity include heat rash, heat cramps, heat exhaustion, and heat stroke.

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include muscle spasms and pain in the hands, feet, and abdomen.
- Heat exhaustion occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include pale, cool, and moist skin; heavy sweating; dizziness, fainting and nausea.
- Heat stroke is the most serious form of heat stress. Temperature regulation fails, and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occurs. When heat stroke is suspected, professional medical help must be obtained immediately. Signs and symptoms include red, hot, and unusually dry skin; lack of or reduced perspiration; dizziness and confusion; strong, rapid pulse; and coma.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important, because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional injuries. To avoid heat stress, the following steps should be taken.

- Work schedules should be adjusted. The following guidelines of rest and cooling of the body will be followed to minimize the effects of heat stress:
  —If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
  —If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
  —Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (see **Table 4-3**). The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Table 4-3. Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers

Adjusted Temperature[1]	Normal Work Ensemble[2]	Impermeable Ensemble
90°F or above	After each 45 minutes of work	After each 15 minutes of work
87 5°F - 90°F	After each 60 minutes of work	After each 30 minutes of work
82 5°F - 87 5°F	After each 90 minutes of work	After each 60 minutes of work
77 5°F - 82 5°F	After each 120 minutes of work	After each 90 minutes of work
72 5°F - 77.5°F	After each 150 minutes of work	After each 120 minutes of work

1 = Calculate the adjusted air temperature (T_a) by using the equation. T_a (°F) = T (°F) + (13 x % sunshine). Measure air temperature (T) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows).

2 = A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

Source: NIOSH/OSHA/USCG/EPA, 1985.

- Shelter (air conditioners and other cooling devices, if possible) or shaded areas should be provided to protect personnel during rest periods.
- Workers' body fluids should be maintained at normal levels to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water perspired, which will vary from day to day. The normal thirst mechanism is not sensitive enough to ensure that water intake is sufficient to replace water lost through perspiration. When heavy sweating occurs, workers should be encouraged to drink more. Have workers drink fluid (preferably water or diluted drinks) before beginning work. Urge workers to drink a cup or two at each scheduled break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day is recommended but will depend on actual fluid replacement needs, which will vary depending on the sweat rate.
- The drinking water temperature should be maintained at 50°F to 60°F (10°C to 15.6°C).
- Disposable cups that hold about 16 ounces should be provided.
- Workers should be encouraged to maintain an optimal level of physical fitness. Where indicated, acclimatize workers to site work conditions.
- Workers should be trained to recognize, identify, and treat heat stress.

When heat stress is suspected, the following steps should be taken:

- Move the victim out of the heat.
- Loosen tight clothing.
- Remove perspiration-soaked clothing.
- Apply cool, wet cloths to the skin.

- Fan the victim.

- If the victim is conscious, give cool water to drink. Do not give electrolyte solutions (i.e., those containing salt) to victims of heat stress because it can cause nausea and vomiting. Only small sips of cool water should be administered to heat stress victims.

- Call for an ambulance if the victim refuses water, vomits, or starts to lose consciousness.

4.3.2 Cold Stress

If site work is to be conducted during the winter, cold stress is a concern to the health and safety of personnel. Special concern must be taken with regard to the wearing of Tyvek™ suits in cold weather. Such disposable clothing does not "breathe," perspiration does not evaporate, and the suits can become wet. Wet clothes combined with cold temperatures can lead to hypothermia. If the air temperature is less than 40°F and an employee perspires, the employee must change to dry clothes.

The following are the five degrees of cold stress in increasing order of severity:

- Incipient frostbite is a mild form of cold stress characterized by sudden blanching or whitening of the skin.

- Chilblain is an inflammation of the hands and feet caused by exposure to cold moisture. It is characterized by a recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears. Such a sequence produces severe spasms, accompanied by pain.

- Second-degree frostbite is manifested by skin with a white, waxy appearance that is firm to the touch. Individuals with this condition are generally not aware of its seriousness because the underlying nerves are frozen and unable to transmit signals to warm the body. Immediate first aid and medical treatment are required.

- Third-degree frostbite will appear as blue, blotchy skin. The tissue is cold, pale, and solid. Immediate medical attention is required.

- Hypothermia develops when body temperature falls below a critical level. In extreme cases, cardiac failure and death may occur. Immediate medical attention is warranted when the following symptoms are observed: involuntary shivering, irrational behavior, slurred speech, and sluggishness.

To care for any frostbite, handle the area gently. Never rub an affected area because rubbing causes further damage to soft tissues. Warm the affected area gently by soaking the affected part in water no warmer than 105°F. Keep the frostbitten part in the water until it looks red and feels warm. Loosely bandage the affected area with a dry, sterile dressing. If fingers or toes are frostbitten, place cotton or gauze between them. Do not break any blisters caused by frostbite. Obtain professional medical attention as soon as possible.

To treat hypothermia, start by caring for any life-threatening problems and call for emergency medical assistance. Remove any wet clothing and dry the victim. Warm the body gradually by wrapping the victim in blankets or putting on dry clothing and moving him or her to a warm place. If available, apply heat pads or other heat sources to the body, but be sure to keep a barrier such as a blanket, towel, or clothing between the heat source and the victim to avoid burning the victim. If the victim is alert, give warm liquids to drink. Do not warm the victim too quickly, such as by immersing the victim in warm water, because rapid rewarming can cause dangerous heart problems. In cases of severe hypothermia, when the victim may be unconscious, give rescue breathing when necessary and be prepared to administer cardiopulmonary resuscitation (CPR).

4.3.3 Noise Hazards

The SSHO or designee will monitor high noise levels when equipment or machinery (e.g., backhoe, drill rig, etc.) is being used on-site. Field personnel working in areas where noise levels can be expected to reach or exceed 85 decibels A-weighted (dB[A]) will be issued hearing protection to reduce the level below the 85 dB(A) threshold.

4.3.4 Materials Handling

The most common type of materials handling accident involves fingers or toes of field personnel being caught between two objects. Special precautions must be implemented during the moving, shifting, or rolling of materials and should never be attempted by a single individual. Workers are required to use proper lifting techniques for handling materials, and oversize or heavy loads require "team lift" procedures.

4.3.5 Utility Hazards

The locations of all underground utilities must be identified and marked prior to initiating any subsurface investigations. In addition, drilling within 20 feet in any direction of overhead power lines will not be permitted.

4.4 Biological Hazards

The biological hazards that could be encountered by site personnel include, but are not limited to, the following:

- Poisonous Snakes and Spiders
- Stinging Insects
- Ticks and Chiggers
- Poisonous Plants (e.g., poison sumac, poison ivy, poison oak)

Control measures to protect site personnel from these biological hazards are included in the following sections.

4.4.1 Poisonous Snakes and Spiders

Reactions from a snakebite are aggravated by acute fear and anxiety. Other factors that affect the severity of local and general reaction from a poisonous snakebite include the amount of venom

injected and the speed of absorption of venom into the victim's circulation; the size of the victim; protection from clothing, including shoes and gloves; quick anti-venom therapy; and location of the bite.

Spiders in the United States are generally harmless, with two notable exceptions: the black widow spider (Latrodectus Mactans) and the brown recluse or violin spider (Lox Osceles Reclusa). The symptoms of a black widow spider bite are slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. The symptoms of a brown recluse spider bite can be mild to severe. In the mildest form, the bite can cause pain and swelling like a bee sting or ant bite. If the reaction is severe, the bite area may become swollen, painful, and weep fluid. Swelling and reddening may spread to an entire limb, and if left untreated, the bite may cause necrosis of surrounding tissue and infection. Diarrhea, stomach cramps, and hot/cold flashes may also occur. Victims of poisonous spider bites recover in almost all cases, but an occasional death is reported.

Field personnel should exercise caution when lifting logs, rocks, covers to manholes, sumps, etc.

4.4.1.1 First Aid Procedures (Snakebite)

The objective of first aid is to reduce the circulation of blood through the bite area, to delay absorption of venom, to prevent aggravation of the local wound, and to sustain respiration. Several steps are listed to properly care for a snakebite victim. The most important step is to get the snakebite victim to the hospital quickly. Meanwhile, take the following first aid measures:

- Keep the victim from moving around.
- Keep the victim as calm as possible and preferably in a lying position.
- Immobilize the bitten extremity and keep it at or below heart level. If the victim can reach a hospital within 4 to 5 hours, and if no symptoms develop, no further first aid measures need to be applied.
- If mild-to-moderate symptoms develop, apply a constricting band 2 to 4 inches above the bite, but not around a joint (the elbow, knee, wrist, or ankle) and not around the head, neck, or trunk. The band should be 3/4 to 1-1/2 inches wide, not thin like a rubber band. The band should be snug but loose enough for a finger to be slipped underneath. Watch for swelling and loosen the band if it becomes too tight, but do not remove it. Periodically check the pulse in the extremity beyond the bite to insure that the blood flow has not stopped.

Several other factors must be considered in cases of snakebite:

- Shock. Keep the victim lying down and comfortable, and maintain his or her body temperature.
- Breathing and heartbeat. If breathing stops, give mouth-to-mouth resuscitation. If breathing stops and there is no pulse, perform CPR if you have been trained to do so.

- Identifying the snake. If you can kill the snake without risk or delay, bring it to the hospital for identification, but exercise extreme caution in handling the snake.

- Cleaning the bitten area. You may wash the bitten area with soap and water and blot it dry with sterile gauze. You may apply dressings and bandages, but only for a short period of time.

- Medicine to relieve pain. Do not give the victim alcohol, sedatives, aspirin, or any medicine containing aspirin. Consult a doctor or other medical personnel for specific medications that may be used.

- Snakebite kits. Keep a kit accessible for all outings in primitive areas or areas known or suspected to be snake infested.

It is not recommended that cold compresses, ice, dry ice, chemical ice packs, spray refrigerants, or other methods of cold therapy be used in the first aid treatment of a snakebite.

4.4.1.2 General First Aid for Poisonous Insect Bites

For minor bites and stings use cold applications and soothing lotions, such as calamine. For more severe reactions, take the following first aid measures.

- Apply a constricting band above the injection site on the victim's arm or leg (between the site and the heart). Do not apply tightly. You should be able to slip your index finger under the band when it is in place. Give artificial respiration if necessary.

- Keep the affected part below the level of the victim's heart.

- If medical care is ready available, leave the band in place; otherwise, remove it after 30 minutes.

- Apply ice contained in a towel or plastic bag, or cold cloths, to the site of the sting or bite.

- Give home medicine, such as aspirin, for pain.

- If the victim has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.

- In case of a bee sting, remove and discard the stinging apparatus and venom sac.

Workers who have had severe allergic reactions to bee/wasp stings in the past will inform the SSHO when they arrive at the site for the first time.

4.4.2 Ticks and Chiggers

Field personnel should be aware of the presence of ticks (i.e., deer tick) and chiggers at the site. Common carriers of ticks and chiggers are the white-footed mouse and white-tailed deer, both of which are prevalent in the area. The deer tick is about the size of a sesame seed, as distinguished from the dog tick, which is significantly larger. The deer tick is principally found along the Atlantic coast, living in grassy and wooded areas, and feeds on mammals such as mice, shrews, birds, raccoons, opossums, deer, and humans. Common diseases caused by ticks are presented in the following subsections.

Removal of ticks is best accomplished using small tweezers. Do not squeeze the tick's body. Grasp it where the mouth parts enter the skin and tug gently, not firmly, until it releases its hold on the skin. Save the tick in a jar labeled with the date, body location of the bite, and the place where it may have been acquired. Wipe the bite thoroughly with an antiseptic Seek medical attention in the event tick-related disease symptoms develop.

When in an area suspected of harboring ticks (grassy, bushy, or woodland area) the following precautions can minimize the chances of being bitten by a tick:

- Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists.
- Wear light colored clothing so ticks can be easily spotted.
- Wear tick repellents.
- Inspect clothing frequently while in tick habitat.
- Inspect your head and body thoroughly when you return from the field.
- Remove any attached ticks by tugging with tweezers where the tick's mouth parts enter the skin Do not squeeze or crush it.

4.4.2.1 Lyme Disease

Lyme disease is an illness caused by a bacterium that may be transmitted by the bite of a tick (Ixodes Dammini), commonly referred to as the deer tick. Not all ticks are infected with the bacterium, however. When an infected tick bites, the bacterium is passed into the bloodstream of the host, where it multiplies. The various stages and symptoms of the disease are well recognized and, if detected early, can be treated with antibiotics.

The illness typically occurs in the summer and is characterized by a slowly expanding red rash, which develops a few days to a few weeks after the bite of an infected tick. This may be accompanied by flu-like symptoms along with headache, stiff neck, fever, muscle aches, and/or general malaise. At this stage treatment by a physician is usually effective, but, if left too long, these early symptoms may disappear and more serious problems may follow. The most common late symptom of the untreated disease is arthritis. Other problems that may occur include meningitis and neurological and cardiac abnormalities. It is important to note that some people do

not get the characteristic rash but progress directly to the later manifestations. Treatment of later symptoms is more difficult than early symptoms and is not always successful.

4.4.2.2 Rocky Mountain Spotted Fever

In the eastern and southern United States, this tick-borne disease is transmitted by the infected dog tick (Dermacentor Variabilis). It is important to note that the dog tick is significantly larger than the deer tick. Nearly all cases of infection occur in the spring and summer, generally several days after exposure to infected ticks. The onset of illness is abrupt and often accompanied by high fever, headache, chills, and severe weakness. After the fourth day of fever, victims develop a spotted pink rash that usually starts on the hands and feet and gradually extends to most of the body. As with Lyme disease, early detection and treatment significantly reduces the severity of illness. The disease responds to antibiotic therapy with tetracycline or chloramphenicol.

4.4.2.3 Other Diseases

Ticks transmit several other diseases, most of which are rare and occur only in specific areas. Babesiosis occurs mainly in the Cape Cod area and eastern Long Island. Colorado tick fever is similarly regional and occurs only among those who live or work at altitudes above 4,000 feet.

4.4.3 Poisonous Plants

The majority of skin reactions following contact with offending plants are allergic in nature and are characterized by general symptoms of headache and fever, itching, redness, and rash.

Some of the most common and most severe allergic reactions result from contact with plants of the poison ivy group including poison ivy, poison oak, and poison sumac. The most distinctive features of poison ivy and poison oak are their leaves, which are composed of three leaflets each. Both plants also have greenish-white flowers and berries that grow in clusters. Such plants produce a severe rash characterized by redness, blistering, swelling, and intense burning and itching. The victim can also develop a high fever and become very ill. Ordinarily, the rash begins within a few hours after exposure, but it may be delayed for 24 to 48 hours.

4.4.3.1 First Aid Procedure

- Remove contaminated clothing.
- Wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.
- Apply calamine or other soothing skin lotion if the rash is mild.
- Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

5.0 Hazard Communication

The EEG Hazard Communication Program is located within the EEG Corporate Health and Safety Plan and complies with the OSHA hazard communication standard (HCS) found in OSHA Standard 29 CFR 1910.120 and 1926.59, which applies to any chemical present in the workplace in such a manner that employees may be exposed to under normal conditions of use in a foreseeable emergency. Although waste materials are excluded from the OSHA requirements, decontamination chemicals for sampling equipment or protective clothing and calibration standards require MSDSs.

The principle of communicating the hazards of materials used in the workplace applies to company-wide activities, from informational programs on the conduct of hazardous waste activities to the company's insistence upon adequate health and safety training. It is also important for personnel to have an awareness of client concern for hazard communication due to Federal, state, and local regulations directly affecting certain client activities.

In order to comply with the HCS, EEG has made the following determinations:

- All containers of hazardous chemicals must be appropriately labeled or tagged to identify the hazard and provide information on effects and appropriate protective measures.
- Labels, tags, or signs must be properly affixed and visible at all times while a hazard is present and removed promptly when the hazard no longer exists.
- Written information (i.e., MSDSs) on hazardous chemicals in the workplace must be available to employees working with the substances.
- Appropriate MSDSs will be available to any contractor or subcontractor employee working on projects under EEG's control.

When investigation results indicate potential imminent health risks to contracted or Federal personnel, or the public at large, the contracting officer's representative (COR) and the base point of contact (POC) will be notified as soon as practicable. Written notification and supporting documentation will be provided within three days of finding potential imminent health risks during investigation activities.

6.0 Air Monitoring

This section presents requirements for the use of real-time air monitoring instruments during site activities involving potential for exposure to site contaminants. It establishes the types of instruments to be used, the frequency of their use, the techniques for their use, the action levels for upgrading/downgrading levels of protection, and the methods for instrument maintenance and calibration.

6.1 Instruments and Use

An organic vapor monitor (OVM) will be utilized for detecting the presence of chemicals of concern. A Draeger pump and colorimetric tubes will be used to confirm any detections observed with the OVM in accordance with **Table 6-1**. Additionally, lower explosive limit/oxygen (LEL/O_2) detectors will be used during all drilling activities to detect the presence of flammable/explosive atmospheres. Visual observation will be used to detect the presence of airborne particulates.

The OVM/Draeger pump will be used throughout the execution of this activity:

- Well installation

6.2 Air Monitoring Requirements

6.2.1 Organic Vapor Monitor

Air monitoring with the OVM will be initiated at potential sources of vapor emissions (source monitoring) at specified frequencies. The frequencies will be increased where concentrations of constituents are measured.

If source monitoring indicates the presence of airborne emissions, air monitoring will then be initiated in the breathing zones of those workers who could be affected by the emissions. Air monitoring will also occur upon the request of site workers who notice unusual site odors or an increase in their intensity. If work is to be performed downwind of a site, air monitoring will be conducted to determine what type of PPE, if any, is required to protect workers and to determine the potential for an imminent threat to public health.

The presence of elevated readings in the worker's breathing zone as identified in **Table 6-1** requires amendments to the HASP before workers are allowed to enter the exclusion zone. Depending on the air monitoring readings, air-purifying respirators may not be acceptable because some contaminants of concern have poor warning properties and/or cannot be filtered from inspired air with chemical cartridges (**Table 6-1**). Elevated readings will be based on confirmation sampling using a Draeger pump and colorimetric tubes in accordance with **Table 6-1**.

Table 6-1. Hazard Monitoring Methods, Action Levels, and Protection Measures

Hazard	Monitoring Method	Action Level	Protective Measures	Monitoring Schedule
Toxic Vapors (as identified in Table 4-1)	OVM	0 0 to <0.5 ppm above background based on judgment of SSHO	Level D (see Table 7-1)	Continue with regular monitoring of breathing zone
		0.5 ppm above background based on judgment of SSHO	Level D (see Table 7-1)	Confirm/deny reading with vinyl chloride and benzene colorimetric tubes If confirmed as vinyl chloride and/or benzene, then see vinyl chloride/benzene hazard identified below If denied as vinyl chloride and benzene, then continue with regular monitoring of breathing zone
		≥0.5 ppm to <25 ppm above background based on judgment of SSHO (if denied as vinyl chloride and benzene)	Level D (see Table 7-1)	Confirm/deny reading with vinyl chloride and benzene colorimetric tubes If confirmed as vinyl chloride and/or benzene, then see vinyl chloride/benzene hazard identified below If denied as vinyl chloride and benzene, then continue with regular monitoring of breathing zone Confirm/deny reading with tetrachloroethylene and TCE colonmetnc tubes If confirmed, then see hazard identified below If denied as tetrachloroethylene or TCE, then continue with regular monitoring of breathing zone
		≥25 to <250 ppm above background based on judgment of SSHO (if denied as vinyl chloride, benzene, and tetrachloroethylene)	Level C (see Table 7-1)	Continue with regular monitoring of breathing zone Contact HSD and Project Manager Continue use of tubes, attempt to identify unknown air contaminants
Flammable/ Explosive Gases and/or Vapors	LEL/O_2 Detector	0 0 to 5.0 percent LEL	Notify sampling team of readings	Prior to and during sampling activities, monitor all areas suspected of containing flammable/explosive gases and/or vapors Continue with regular monitoring of breathing zone
		5 0 to <10 0 percent LEL	Use spark proof equipment/tools	Continue with regular monitoring of breathing zone Notify HSD and Project Manager
		>10.0 percent LEL	STOP WORK, EVACUATE AREA, NOTIFY PROJECT MANAGER	Requires HASP amendments unless readings subside

6.2.2 Draeger Pump and Tubes

A hand-operated Draeger pump with colorimetric tubes will be used to confirm the results of OVM testing. If the results of the OVM tests show concentrations greater than 0.5 parts per million (ppm) above background concentrations in the breathing zone, then the colorimetric tubes will be used to identify the contaminants in the breathing zone. Colorimetric tubes to be utilized in the event of elevated OVM readings will include trichloroethylene in accordance with **Table 6-1**. The colorimetric tube utilized will depend on the chemical anticipated to be present at the site.

6.2.3 LEL / O_2 Detectors

Air monitoring with the LEL/O_2 detectors will be conducted during all drilling and excavation activities within boreholes, and immediately over drill cuttings at every 5-foot depth interval. If elevated (above background) LEL readings are observed, personnel must be advised of the potential explosive nature and must initiate the use of spark proof tools in accordance with **Table 6-1**. LEL readings in excess of 10 percent require cessation of drilling and abandonment of the drilling location until readings subside.

6.2.4 Visual Observations

If airborne particulate are observed and air monitoring results (as indicated in **Table 6-1**) warrant, personnel must don air-purifying respirators equipped with organic vapor cartridges and high efficiency particulate air (HEPA) filters. If airborne particulates are observed due to intrusive activities at these sites, dust control measures will be implemented.

6.3 Modification of Air Monitoring Requirements

The action levels and protection measures presented in **Table 6-1** are based upon the assumption that the contaminants listed in **Table 4-1** are the only contaminants that pose a reasonable health risk to site workers. In the event that this assumption is found to be invalid through analysis of samples collected, or by some other means, the action levels will be modified as necessary.

6.4 Instrument Maintenance and Calibration

Air and noise monitoring instruments will be calibrated before being brought on site. Field maintenance will consist of daily cleaning of the instruments using a damp towel or rag to wipe off the instrument's outer casing, and overnight battery recharging. Procedures for accomplishing instrument maintenance are contained in the user's manual provided with each instrument. The user's manual provided with each instrument will be followed to field calibrate the instrument prior to each day of use under the environmental conditions (temperature and humidity) that sampling will occur. Field equipment will also be calibrated at the end of each day to account for instrument drift and ensure reliability.

6.5 Record Keeping

Instrument calibrations and readings will be recorded on the Air Monitoring Log Sheet provided in Section 14.1 of this HASP. Copies of these log sheets will be maintained on-site until field activities covered by this HASP have been completed. The log sheets will be transmitted to the EEG HSD and to the project file at the completion of the field work.

LEL/O_2 readings will not be recorded unless flammable/explosive or oxygen deficient/enriched atmospheres are detected, in which case entries will be made in the field log book.

LEL/O_2, detector, and the OVM will undergo daily operational checks. These checks will be recorded in the field log book and Equipment Calibration Log (Section 14.1).

7.0 Personal Protective Equipment

This section presents requirements for the use of PPE for each of the activities being conducted. This section includes anticipated levels of protection for each of the activities, the criteria used for selecting various levels of protection, and criteria for modifying levels of protection based on monitoring instrument readings, and personal observations.

7.1 Anticipated Levels of Protection

All work is anticipated to be performed in Level D protection, as defined in Appendix B of OSHA Standard 29 CFR 1910.120. Many activities may require the use of chemical resistant coveralls, gloves, and boot covers as presented in **Table 7-1**.

The items of PPE anticipated to be used for each activity are presented in **Table 7-1**. Where overlap in activities occurs, the more protective requirement will apply.

Table 7-1. Protective Equipment for On-Site Activities

Activity	Level	Protective Equipment
Well Installation Groundwater Sampling	D	• Street clothes or overalls (long sleeves) • Impermeable safety boots/shoes (steel-toed) • Safety glasses/goggles (if hazard to eyes exists) • Hard hat (if hazard to head exists) • Gloves (nitrile, neoprene) • Ear plugs (if hazard exists)
If increased protective measures are required	D (modified)	• Rubber boots; chemically-resistant with steel toe • Gloves (nitrile, neoprene) • Tape for sealing ankle and wrist openings • Hard hat (if hazard to head exists) • Safety glasses/goggles (if hazard to eyes exists) • Unbolted Tyvek™ or equivalent • Ear plugs (if hazard exists)
If increased protective measures are required	C	• Coated Tyvek™ or equivalent • Rubber boots; chemically resistant with steel toe • Rubber boot covers • Latex inner gloves • Tape for sealing ankle and wrist openings • Chemical resistant outer gloves (nitrile, neoprene) • Full-face respirator (organic vapor cartridges) • Additional items may be required (site-specific) • Ear plugs (if hazard exists)

7.2 PPE Selection Criteria

Respiratory protection is not anticipated for use during the initial stages of work until detectability of site contaminants with air monitoring instruments warrants the donning of respirator protection in accordance with **Table 6-1**. See Section 7.3 for modification criteria of respiratory protection. Basic requirements for field personnel using respiratory protection include the following:

- All field personnel will be medically certified to wear a full-face respirator and have the proper fit test documentation within the past 12 months prior to assignment.
- Only NIOSH-approved respirators are to be used on-site. The respirators are to be properly cleaned, inspected, and maintained prior to and at the conclusion of the workday.
- Cartridges for air-purifying respirators will be disposed of at the end of each workday and when increased breathing resistance or breakthrough occurs.
- Field personnel will be clean-shaven in areas that might prevent the seal of the respirator to the face.

Hard hats, safety glasses, and steel-toe work boots will be used as minimum protection to reduce the potential for injury resulting from exposure to the physical hazards associated with on-site investigations.

Boot covers, disposable nitrile gloves, and Tyvek™ coveralls will be used to minimize contamination of work clothes and to prevent direct skin contact with low level contamination. Nitrile gloves of 11 mil thickness or greater will be worn for activities that may involve direct contact with appreciable concentrations of contaminants thought to be present as site contaminants.

Polyvinyl chloride (PVC) or Serinus™ coveralls, hoods, and/or splash shields will be worn to prevent saturation of work clothes during activities involving large volumes of liquids and/or saturated soils/equipment.

7.3 PPE Modification Criteria

This section presents criteria for upgrading and downgrading chemical protective clothing (CPC) and/or respiratory protection. When uncertainties arise, the more protective requirement will apply.

7.3.1 CPC Modification Criteria

Tyvek™ coveralls and boot covers must be worn anytime there is a reasonable potential for contamination of street clothes.

Disposable nitrile gloves must be worn anytime there is a reasonable potential for contact with unsaturated soils or equipment that may contain trace contamination.

Nitrile gloves (11 mil or greater) must be worn anytime there is a reasonable potential for contact with groundwater, saturated soils, and/or soils producing elevated PID readings.

PVC or Serinus™ coveralls must be worn anytime there is a reasonable potential for saturation of work clothes.

8.0 Decontamination

This section describes the steps site personnel will follow to prevent the spread of site contaminants into areas that may affect unprotected, unsuspecting site personnel or the public. It includes requirements for decontamination of personnel, sampling equipment, and augering/drilling equipment.

8.1 Personnel Decontamination

The decontamination of personnel and their protective clothing will be performed within the decontamination zone. **Table 8-1** presents the six stages for decontamination for Modified Level D protection.

Table 8-1. Six Stages for Decontamination in Modified Level D Protection

Stage	Procedure
Stage 1. Segregated Equipment Drop	Deposit equipment used on-site on plastic drop cloths or in assigned containers with plastic liners
Stage 2. Boot Cover and Glove Wash	Scrub outer boot covers and gloves with decontamination solution, and rinse with water
Stage 3· Tape Removal	Remove tape around boots and gloves and deposit in container with plastic liner
Stage 4. Remove boots, gloves, and disposable clothing	Deposit in appropriate plastic-lined container. Discard disposable clothing
Stage 5 Field Wash	Wash hands and face with soap and water.
Stage 6· Redress	Put on clean clothes.

Washtubs containing an appropriate decontamination solution and soft-bristle brushes will be used to wash reusable PPE and boots. Clean water will be used for the final rinse. The choice of decontamination solution is dependent upon the type of materials that must be removed from reusable protective equipment. Based on the current understanding of potential site contaminants, a detergent and water solution is recommended for general-purpose decontamination. Acceptable detergents include laboratory-grade cleaners (e.g., Alconox™ or equivalent), or a high-strength consumer detergent such as Liquid Tide™.

Alternative decontamination solutions may be called for if the contaminants encountered are different or in a more concentrated state than anticipated. Alternative solutions include the following:

- Dilute acids for removal of basic (caustic) compounds, amines, and hydrazines
- Dilute bases (soaps and detergents) for removal of acidic compounds, phenols, thiols and some nitro and sulfonic compounds
- Organic solvents for removal of nonpolar compounds (organic)

Gloves and other PPE should be inspected frequently for integrity, and manufacturers' data for breakthrough times should be considered if concentrated contaminants are encountered.

The decontamination of personnel and their protective clothing will be performed in 18 stages for Level C protection, if necessary. The 18 stages are presented in **Table 8-2.**

Table 8-2. Eighteen Stages for Decontamination in Level C Protection

Stage	Procedure
Stage 1: Segregated Equipment Drop	Deposit equipment used on-site on plastic drop cloths or in different containers with plastic liners Segregation at the drop reduces the probability of cross-contamination During hot weather operations, a cool-down station may be set up within this area
Stage 2 Boot Cover and Glove Wash	Scrub outer boot covers and gloves with decon solution of detergent and water.
Stage 3 Boot Cover and Glove Rinse	Rinse off decon solution from Stage 2 using copious amounts of water
Stage 4. Tape Removal	Remove tape around boots and gloves and deposit in container with plastic liner
Stage 5. Boot Cover Removal	Remove boot covers and deposit in container with plastic liner
Stage 6 Outer Glove Removal	Remove outer gloves and deposit in container with plastic liner
Stage 7 Suit, Glove, and Boot Wash	Wash splash suit, gloves, and safety boots. Scrub with long-handle scrub brush and decon solution.
Stage 8· Suit, Glove and Boot Rinse	Rinse off decon solution using water. Repeat as many times as necessary.
Stage 9· Canister or Mask Change	Perform last step in the decontamination procedure (if worker is leaving exclusion zone to change canister or mask) Worker's canister is exchanged, new outer gloves and boot covers donned, and joints taped, worker returns to duty
Stage 10· Safety Boot Removal	Remove safety boots and deposit in container with plastic liner.
Stage 11· Splash Suit Removal	Remove splash suit with assistance of helper. Deposit in container with plastic liner
Stage 12· Inner Glove Wash	Wash inner gloves with decon solution
Stage 13. Inner Glove Rinse	Rinse inner gloves with water.
Stage 14: Face Piece Removal	Remove face piece Deposit in container with plastic liner Avoid touching face with fingers Note Certain parts of contaminated respirators, such as the harness assembly and leather or cloth components are difficult to decontaminate If grossly contaminated, they may need to be discarded Rubber components can be soaked in soap and water and scrubbed with a brush Use a final rinse of water and allow to air dry before using again. Inspect the respirator for damage and signs of wear before and after each use.
Stage 15: Inner Glove Removal	Remove inner gloves and deposit in lined container
Stage 16· Inner Clothing Removal	Remove clothing soaked with perspiration and place in lined container Do not wear inner clothing off the site since there is a possibility that small amounts of contaminants might have been transferred when removing the disposal coveralls
Stage 17. Field Wash	Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available
Stage 18· Redress	Put on clean clothes

All decontamination fluids generated will be contained and disposed of as specified in the WP. The decontamination area will be physically identified with rope or flagging and will be sufficiently equipped to be conducive for completion of the stages listed above.

8.1.1 Closure of the Personnel Decontamination Station

All disposable clothing and plastic sheeting used during the operation will be double-bagged and contained on-site prior to removal to an approved off-site disposal facility as identified in the WP. Decontamination and rinse solution will be contained on-site prior to disposal. Reusable rubber clothing will be dried and prepared for future use. If contamination of non-disposable clothing has occurred, the item will be discarded. All washtubs, pail containers, etc., will be thoroughly washed, rinsed, and dried prior to removal from the site.

8.1.2 Disposal of Decontamination and Other Wastes

All PPE, polyethylene sheeting, and sampling support materials (e.g., paper towers, Ziploc bags) will be collected at the end of each work day, placed in plastic trash bags, and left at the site overnight. The following day, the air within the plastic trash bag will be tested using a PID. If the air within the bag does not show significant concentrations of organic vapors (greater than 10 ppm above background), the plastic trash bag will be double-bagged and placed in the municipal waste dumpster for disposal.

All other wastes generated during decontamination other than decontamination fluids will be placed into 55-gallon drums; each drum will have a removable top cover fitted with a top cover bung (type 17E/H) as identified in the FSP. The drums will be filled partially or completely, depending upon the difficulty of transporting them from the work site. All containers will be numbered and clearly labeled with the boring/well number and date of filling. The mixing of solid and liquid wastes will be avoided. The containers will be stored at a pre-designated site until the analytical results from each boring/well can be reviewed in order to determine the waste classification for handling, transportation, and disposal.

8.2 Equipment Decontamination

All sampling equipment will be decontaminated prior to use, between sampling locations, and at the end of sampling activities to avoid cross-contamination, and to decrease contact between personnel and contaminated materials, and to reduce the probability of removing contamination from the site. The procedures for decontaminating equipment are presented in Section 5.8 of the FSP.

9.0 Medical Surveillance

9.1 Requirements for Hydrogeologic Personnel

All employees involved in field activities will be active participants in the EEG medical surveillance program. All medical examinations and procedures will be performed by or under the supervision of a licensed occupational physician. The examination will include the tests, procedures, and frequencies that comply with the requirements of OSHA Standard 29 CFR 1910.120(f) and American National Standards Institute (ANSI) Z-88.2, and will be medically qualified to perform hazardous waste site work under respiratory protection. Medical surveillance documents confirming the worker's fitness to perform hazardous waste operations on this project are on file at EEG's headquarters in Newberry, Florida, and can be made available upon request.

9.2 Requirements for Subcontractors

Subcontractors are also required to obtain a certificate of their ability to perform hazardous waste operations work and to wear respiratory protection. Subcontractors, that have a company medical surveillance program meeting the requirements of OSHA Standard 29 CFR 1910.120(f) will be required to submit a letter, on company letterhead, confirming that all on-site workers to be utilized for this project are medically qualified to perform the activities. In addition, medical surveillance documents for personnel assigned to this project must be made available upon request.

10.0 Training Requirements

10.1 Initial Training

10.1.1 Requirements for EEG Personnel

All investigation personnel to be utilized are currently enrolled in EEG's continuous training program in accordance with OSHA Standard 29 CFR 1910.120. Individuals working on a site have successfully completed an approved 40-hour Hazardous Waste Site Operations (HAZWOPER) course including 24 hours of actual field experience under the direction of a trained supervisor, and any subsequent annual 8-hour refresher courses. In addition, the on-site field leader will have completed an 8-hour supervisory course, and a majority of EEG's field investigation personnel are also current in first aid/CPR training requirements. EEG employee records are on file in the company's home office in Newberry, Florida.

10.1.2 Requirements for Subcontractors

All EEG subcontractor personnel must also have completed a 40-hour HAZWOPER training course or the equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) prior to performing work at the site. In addition, subcontractor personnel must also have successfully completed any subsequent annual 8-hour refresher training.

EEG subcontractors must certify that each subcontractor employee who will perform work at the site has had training meeting the requirements of OSHA Standard 29 CFR 1910.120(e). This certification can be accomplished by submitting a letter to EEG, on company letterhead, containing such information

10.1.3 Requirements for Site Visitors

No person will be allowed in the work zones (exclusion and decontamination) unless they have completed the necessary health and safety training as required by OSHA Standard 29 CFR 1910.120(e) and are wearing the necessary protective equipment as required by this HASP.

10.2 Site-Specific Training

EEG will provide site-specific training to all EEG employees and subcontractor personnel who will perform work at the site. Daily health and safety meetings will be held prior to beginning field activities to discuss each day's activities, potential hazards, and any new health and safety issues not previously discussed. Personnel who do not participate in training will not be permitted to perform work at the site. Site-specific training will include the following:

- Contents of the HASP
- Names of personnel and alternates responsible for site health and safety
- Safety, health, and other hazards present on the site

- Use of PPE
- Work practices by which the employees can minimize risks from hazards
- Safe use of engineering controls and equipment on the site
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazards
- Decontamination procedures
- Emergency response procedures

EEG and subcontractor personnel will be required to sign a statement indicating receipt of site-specific training and understanding of site hazards and control measures. This form is presented in Section 14.1.

11.0 Standard Work Practices

All site investigation activities will follow these appropriate health and safety standard work practices.

11.1 General Requirements / Prohibitions

- A copy of this HASP will be available on-site for all field personnel, including visitors, to reference during investigation activities.
- No running or horseplay will be permitted.
- Eating, drinking, chewing gum or tobacco, taking medication, applying cosmetics, and/or smoking are prohibited in the exclusion and decontamination zones, or any location where a possibility for contact with site contaminants exists.
- The minimum required level of PPE to be worn by all on-site personnel will include steel-toed safety boots, safety glasses, and hard hat, if necessary.
- Upon leaving the exclusion zone, each worker's hands and face must be thoroughly washed. Any protective outer clothing is to be decontaminated and removed as specified in this HASP and left at a designated area prior to entering the clean area.
- Contact with potentially contaminated substances must be avoided. Contact with the ground or with contaminated equipment must also be avoided. Air monitoring equipment must not be placed on potentially contaminated surfaces.
- Facial hair that interferes with a satisfactory fit of the mask-to-face seal is not permitted on personnel required to wear respiratory protective equipment.
- All personnel must satisfy medical monitoring procedures.
- No flames or open fires will be permitted on-site.
- All personnel must be aware of and follow the action levels presented in this HASP for upgrading respiratory protection.
- Any new analytical data must be promptly conveyed via telephone to the project HSD by the laboratory technician or field leader.
- Personnel must develop hand signals with users of heavy equipment (e.g., drillers, Geoprobe operators, etc.). Standard hand signals to be used by personnel for nonverbal communication include:

  Stop—With arm extended to the side and palm down, hold position rigidly.

  Hoist—With forearm and forefinger pointing up, move hand in small horizontal circle.

Lower—With forearm extended and forefinger pointing down, move hand in a small horizontal circle.

Travel—With palm up, fingers closed, and thumb pointing in the direction of motion, jerk hand horizontally.

Slow Move—Use one hand to give any motion signal, and place the other hand motionless in front of the hand giving the motion signal.

Emergency—With arm extended to the side and palm down, move hand rapidly right and left.

Standard hand signals will be discussed during each daily health and safety meeting when the use of heavy equipment is anticipated.

- A copy of the OSHA "Job Safety and Health Protection" poster must be prominently posted at each site.

- Only equipment that has been approved by the manufacturer may be used in conjunction with site equipment.

- Medicine and alcohol can potentiate the effects from exposure to toxic chemicals Prescribed drugs should not be taken by personnel on operations where the potential for absorption, inhalation, or ingestion of toxic substances exists, unless specifically approved by a qualified physician. Alcoholic beverage intake will not be allowed at anytime, including during breaks.

- No person will enter the exclusion zone alone.

- Safety devices on equipment must be left intact and used as designed.

- Equipment and tools will be kept clean and in good repair and used only for their intended purpose.

- Eye protection must be worn when any hammering or pounding is performed that may product flying particles or slivers.

- Field personnel are not allowed to lift more than 60 pounds. Rules to remember when attempting to lift heavy objects include:
  —Size up the load before trying to lift it, test the weight, and get help if needed.
  —Bend the knees and look up to keep the neck and back straight.
  —Do not twist or turn your body once you have made the lift.
  —Make sure you can carry the load where you need to go before lifting it.
  —Set the load down properly; lower slowly by bending the knees.
  —Always push, not pull, the object when possible.

- Heavy lifting (more than 60 pounds per worker) must be accomplished using mechanical lifting equipment. Mechanical lifting equipment that will be available on-site will include forklifts, hoists, dollies, backhoe/trackhoe, and other types of equipment that can be easily rented from an off-site location.

- Leather gloves must be worn when handling objects that may produce slivers (e.g., driving wood stakes, handling drill rods/augers).

- No person shall climb the drill mast without the use of ANSI-approved fall protection (i.e., approved belts, lanyards, and a fall protection slide rail) or a portable ladder that meets the requirements of OSHA standards.

- The SSHO must make an entry into the site field logbook at least daily to include the following:
  —Weather conditions
  —Site personnel
  —New arrivals and their clearance for site work
  —Air monitoring data summary
  —Monitoring instrument calibration
  —Indications of inhalation exposure
  —PPE used per task
  —Deviations from HASP
  —Inspection and cleaning of respiratory equipment
  —General health and safety problems/corrective actions

- If personnel note any warning properties of chemicals (irritation, odors, symptoms, etc.) or even remotely suspect the occurrence of exposure, they must immediately notify the SSHO for further direction.

11.2 Drilling Activities

Prior to the commencement of drilling activities, all locations will be surveyed and marked for underground utilities. In addition, a hand auger or probe will be used to a depth of 3 feet to ensure the absence of underground utilities at the location of interest. If any uncertainties exist, the location will be moved to an adjacent area.

The following general drilling practices must be adhered to during investigation activities:

- All drilling equipment (i.e., rigging, derrick, hoists, augers, etc.) must be inspected by the drilling crew and SSHO prior to starting work. Defective equipment will be removed from service and replaced.

- No drilling within 20 feet in any direction of overhead power lines will be permitted. The locations of all underground utilities must be identified and marked prior to initiating any subsurface activities.

- All drill rigs and other machinery with exposed moving parts must be equipped with an operational emergency stop device. Drillers and geologists must be aware of the location of this device. This device must be tested prior to job initiation and periodically thereafter. The driller and helper shall not simultaneously handle moving augers or flights unless there is a standby person to activate the emergency stop.

- Prior to raising the mast, the drill rig operator shall ensure that the proper stabilization measures have been taken. The drill rig shall not be moved while the mast is in the raised position.

- The driller must never leave the controls while the tools are rotating unless all personnel are clear of the rotating equipment.

- Drillers must wear hearing protection unless the employer can provide documentation that noise exposures are less than a dose of 50 percent as required by OSHA Standard 29 CFR 1910.95.

- Drilling activities shall immediately cease when inclement weather (e.g., heavy rains, lightning) and high winds occur at the site. All site personnel should immediately seek shelter.

- To maintain a clean operation, drill cuttings shall be promptly containerized as they are generated. A long-handled shovel or equivalent must be used to clear drill cuttings away from the hole and from rotating tools. Hands and/or feet are not to be used for this purpose.

- A remote sampling device must be used to sample drill cuttings if the tools are rotating Samplers must not reach into or near the rotating equipment. If personnel must work near any tools, that could rotate, the driller must shut down the rig prior to initiating such work.

- Drillers, helpers, and samplers must secure all loose clothing when in the vicinity of drilling operations.

- Only equipment that has been approved by the manufacturer may be used in conjunction with site equipment Pins that protrude from augers will not be allowed.

A variety of additional work practices (i.e., hoisting, cat line, pipe and auger handling, etc.) are to be adhered to by the drilling crew, but will not be addressed in this HASP. If the on-site field team leader or site supervisor observes any operations or actions that are perceived as threatening to the health and safety of site personnel, drilling operations will be temporarily suspended until a mutual understand of the action(s) in question are addressed and/or corrected.

Soil borings have the potential for releases to the environment and exposure to personnel. Gases and vapors that have a vapor density of less than 1.0 are lighter-than-air and tend to migrate upward in the atmosphere and disperse (e.g., methane). Heavier-than-air gases and vapors tend to stay close to the ground and may migrate to low-lying areas (e.g., hydrogen sulfide). In general, the only containment for a release to the air is termination of the release at the source (e.g., plug the boring). Depending on the contaminant encountered, it may be necessary to evacuate persons downwind of the area of the release. Emergency response personnel should be notified (Section 13.6) if air concentrations at the perimeter of the exclusion zone exceed threshold limit values (TLVs) or permissible exposure limits (PELs).

11.3 Housekeeping

Housekeeping will be strongly stressed in all aspects of field work. Good housekeeping plays a key role in occupational health protection and is a way of preventing dispersion of dangerous contaminants. All work areas will be kept as clean as possible at all times and spills will be cleaned up immediately. Housekeeping will be the responsibility of all employees.

EEG will implement a housekeeping program for the well installation activities to minimize the spread of contamination beyond the work site. The program will include the following:

- Daily scheduling to police the area of debris including paper products, cans, and other materials brought on-site
- Changing of wash and rinse water for hands, face, and equipment as needed
- Periodic (daily minimum) removal of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing

11.4 Work Limitations

All investigation activities will be performed during normal daylight hours.

11.5 Confined Space Entry

Site personnel are not to undertake any activity that could be considered a confined-space entry.

11.6 Spill Containment

The procedures defined in this section comprise the spill containment activities in place at the site.

- All drums and containers used during the cleanup will meet appropriate United Nations, OSHA, and EPA regulations for the waste that they will contain.
- Drums and containers will be inspected and their integrity ensured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions will be positioned in an accessible location and inspected prior to further handling.
- Operations on-site will be organized so as to minimize the amount of drum or container movement.
- Employees involved in the drum or container operations will be warned of the hazards associated with the containers.
- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent, pillows, etc.) will be stationed in the immediate area. The spill

containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.

- Drums or containers that cannot be moved without failure will be emptied into a sound container.
- Fire extinguishing equipment meeting 29 CFR Part 1910.Subpart 1 shall be on hand and ready for use to control fires.

12.0 Site Control

12.1 Work Zones

Each well location will be physically barricaded with rope flagging or caution tape to control entry to and exit from the area. These barricaded areas will be referred to as the exclusion zones. The exclusion zone will be identified by the site supervisor and consist of a 20-foot radius surrounding the drilling location. Each person leaving an exclusion zone will proceed directly to the decontamination zone, which will be located adjacent to the exclusion zone and identified by physical barriers. The decontamination zone will consist of a low-lying area covered with a plastic sheeting. At the completion of decontamination procedures at each location, the debris will be enclosed in the plastic sheeting and deposited into 55-gallon type 17 E/H drums for later disposal as identified in the WP and FSP. Only personnel who are cleared by the EEG field leader and SSHO will be permitted in the exclusion zones and/or decontamination zones. Clearance for accessing these areas will only be given to personnel who meet the training and medical surveillance requirements of OSHA Standard 29 CFR 1910.120 and are wearing the appropriate PPE required for the work activity.

The support zone—where the administrative, communications, and other support services will be based—will be in a controlled area off the site or on the far end upwind of potential site contamination or areas of potential exposure. Only persons and equipment that are free of contamination will be permitted in the support zone.

12.2 On-Site / Off-Site Communications

Communications will consist of a centrally located telephone within the designated support zone (i.e., trailer, office) in addition to a mobile phone stationed within the on-site vehicle utilized for transportation. Field personnel may also utilize telephones located at NAS Fort Worth JRB in emergency situations.

13.0 Emergency Response

This HASP has been developed in an attempt to prevent the occurrence of situations that may jeopardize the health and safety of on-site personnel. However, supplemental emergency procedures must be identified in the event that an unforeseen health and safety accident or incident occurs. In general, EEG will evacuate their employees and subcontractors from the workplace if an emergency involving chemical spills, chemical fires, chemical exposure, and/or chemical emissions occurs. For this reason, emergency response planning will be in accordance with OSHA Standard 29 CFR 1910.38(a).

13.1 Preplanning

Upon initial arrival at the site, the EEG field leader and SSHO will visit the base's fire department to determine the status of emergency response services. This meeting will include a determination as to the need for further coordination with local rescue and police services.

Another aspect of preplanning for emergencies includes completion of the Medical Data Sheet (Section 14.1). This sheet must be completed by all EEG personnel and subcontractors so that, in the event of personal injury or illness, the examining physician has background information readily available on the injured/ill party.

13.2 Emergency Procedures and Assignments

Upon notification of a site emergency requiring evacuation, all EEG personnel and subcontractors will proceed directly to the support zone (i.e., trailer, office). If personnel cannot reach the support zone without endangering life or health, an alternate meeting point will be specified by the EEG SSHO. Emergency egress routes and meeting points will be discussed at each daily health and safety briefing.

In the event of an emergency, the following procedures will be implemented:

- The site supervisor will evaluate the incident, assess the need for assistance, and call the appropriate contacts, if necessary.
- The site supervisor will act as the point of contact for outside emergency personnel and on-site personnel.
- The site supervisor will advise emergency response and emergency room personnel as to the types of contamination potentially contacted by injured workers receiving emergency care.
- The site supervisor will ensure that the SSHO promptly notifies the EEG PM and HSD of the incident.

13.2.1 Chemical Inhalation

It is not anticipated that chemicals of concern will be present at the site in concentrations to cause immediate danger to life and health. However, any field personnel exhibiting or complaining of symptoms of chemical exposure as described in Section 4.1 will be removed from the work zone and transported to the designated medical facility for examination and treatment.

13.2.2 Eye and Skin Contact

Field personnel who have come into contact with contaminants while in the exclusion zone will proceed immediately to the decontamination zone, where an eye wash station will be located. At the eyewash station the following procedures will be followed:

- Do not decontaminate prior to using the eye wash.
- Remove necessary PPE to perform the eye wash procedures.
- Flush the eye with the clean water for at least 15 minutes.
- Arrange for prompt transport to the designated medical facility.

Unless skin contact with contaminants is severe, personnel should proceed through the decontamination zone. Field personnel should remove any contaminated PPE and wash the affected area for at least 15 minutes. If the personnel show signs of skin irritation, they will be transported to the designated facility.

13.3 Procedures for Personnel Remaining On-Site

No EEG or subcontractor personnel will remain on-site to operate critical site emergency operations.

13.4 Procedures to Account for Site Personnel

The EEG and subcontractor work force will be small enough so that accounting for site personnel will not be a problem. The EEG field leader and SSHO will ensure that the whereabouts of all personnel are known.

13.5 Rescue and Medical Duties

Only those persons who have been trained by the American Red Cross, or equivalent, will be permitted to perform rescue, first aid, and/or CPR treatment. Outside emergency services and medical facilities will be the primary providers of such services. At least one person who is currently certified in first aid and CPR will be on-site at all times during field activities. An ANSI-approved first aid kit, an ANSI-approved eye wash station with 15 minutes of free-flowing freshwater, and a Class ABC fire extinguisher will be readily available on-site.

Any EEG employee who shows signs or symptoms of overexposure must immediately be examined by a licensed physician. Subcontractor personnel who show signs or symptoms of overexposure will be encouraged to visit a licensed physician as well. **Figure 13-1** illustrates the directions to the nearest medical facility.

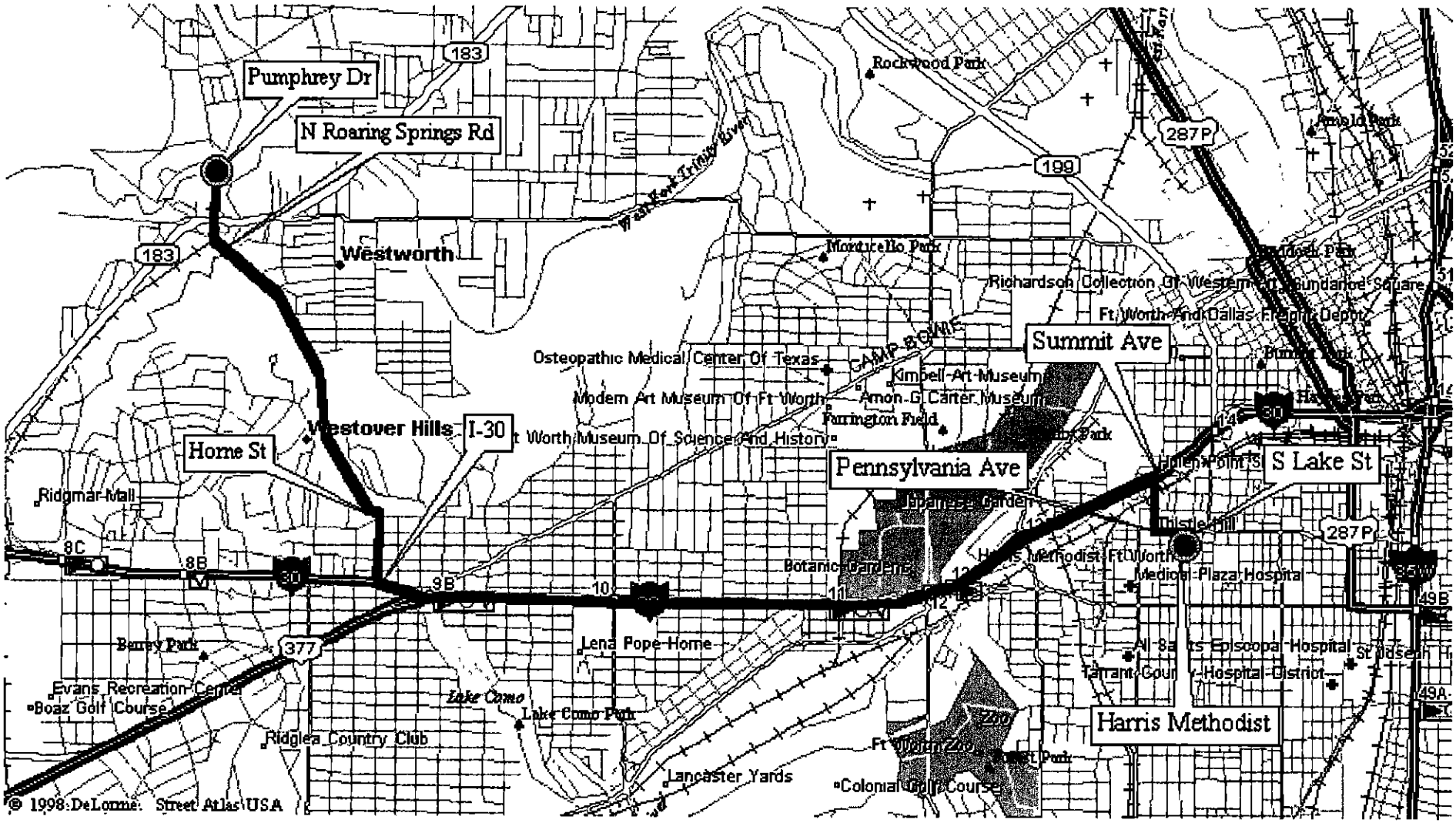


Figure: 13-1

Hospital Route Map

ELLIS ENVIRONMENTAL GROUP, LC

NAS Fort Worth JRB, Texas

Client: U.S. Air Force Center Environmental Excellence

13.6 Emergency Communication Procedures, Contacts, and Phone Numbers

Persons who observe an emergency situation must immediately notify the EEG field leader and/or SSHO. The field leader or SSHO will then immediately assess the emergency and appoint someone to telephone appropriate outside emergency services and will coordinate site evacuation. Emergency telephone numbers and directions to the nearest medical facility are included as **Table 13-1**, a copy of which will be posted at the nearest telephone. In addition, **Figure 13-1** illustrates the directions to the nearest medical facility.

Table 13-1. Emergency Telephone Numbers, Contacts, and Directions to Nearest Medical Facility

Key Personnel	Number
Rick Levin – Project Manager	(352) 332-3888
Jason Shannon – Health and Safety Director	(352) 332-3888
Mark Webster, Site Safety and Health Officer	(817) 732-4160
Michael Dodyk – Base Point of Contact (AFCEE/ERD)	(817) 782-7167
Don Ficklen– AFCEE/ERD Team Chief	(210) 536-5290
Emergency Phones Numbers	
Ambulance	911 or (817) 922-3150
Fire Department	911 or (817) 246-1741
Poison Control	911 or (800) 441-0040
Hospital – Harris Methodist – Fort Worth 1301 Pennsylvania Avenue	911 or (817) 882-2000
Directions to Nearest Medical Facility	
Exit NAS Fort Worth JRB on Pumphrey Rd heading south. Turn left on Roaring Springs Rd heading southeast for 2.0 miles Roaring Springs Rd turns into Horne St prior to I-30. Turn left on I-30 heading east for 4.0 miles Turn right on Summit Ave heading south for 0 3 miles. Turn left on Pennsylvania Ave. heading east for 0.2 miles. Turn right on South Lake St. heading south to 1301 Pennsylvania Ave Emergency entrance is located on the right	

13.7 Accident / Incident Follow-Up and Reporting

Upon receiving a report of an incident (or near-incident), the SSHO shall immediately investigate the circumstances and make appropriate recommendations to prevent recurrence. The HSD shall also be immediately notified by telephone on occurrence of a serious accident or incident. The HSD, at their individual discretion, may also participate in the investigation.

Details of the incident shall be documented on the Accident/Incident/Near Miss Investigation form (Section 14.1) within 24 hours of the incident and shall be distributed to the PM, HSD, and COR. A copy of this report shall also be sent to the appropriate administrative contact for inclusion into the OSHA Form 101 and 200 log. Incident report forms will be available at site support facilities.

14.0 Documentation and Equipment

This section summarizes the documentation and equipment needs for the project as specified in the HASP. Its purpose is to serve as a partial checklist to help ensure all of the necessary resources are available to carry out the requirements of the HASP.

14.1 Documentation and Forms

The following documents are presented in the following pages for use during site operations:

- Site Safety Briefing Form
- HASP Compliance Agreement Form
- HASP Amendments Form
- Accident/Incident/Near Miss Investigation Form
- Medical Data Sheet
- Daily Equipment Calibration Log
- Air Monitoring Log

In addition, the following documentation will be present on-site during site operations:

- Approved HASP (signed copy)
- OSHA poster
- MSDSs
- Employee training and medical surveillance certificates
- Subcontractor training and medical surveillance certificates

14.2 Emergency Health and Safety Equipment

- First aid kit
- Eye wash
- Inner latex or vinyl gloves
- Outer nitrile gloves (disposable and 11 mil thick)
- Boot covers
- Hard hats and safety glasses
- Tyvek™ suits
- PVC and/or Saranex™ suits (with hoods)
- Ear plugs or muffs
- Decontamination kit
- Fire extinguisher
- Fall protection devices (body harness and lanyard)
- Duct tape
- LEL/O_2 meter
- PID

The site supervisor and/or SSHO shall be responsible for maintaining first aid kits and fire extinguishers at each site where field activities are taking place. The location of first aid kits and fire extinguishers will be discussed during each daily health and safety meeting.

15.0 References

A.T. Kearney, 1989, RCRA Facility Assessment, Preliminary Review/Visual Site Inspection.

Federal Acquisition Regulation, FAR Clause 52.236-13, Accident Prevention.

International Technology Corporation, 1997, Draft RCRA Facilities Investigation, Sanitary Sewer System, NAS Fort Worth JRB, Texas.

NIOSH/OSHA/USCG/EPA, October 1985, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, (DHHS (NIOSH) Publication No. 85-115); EPA, June 1992, Standard Operating Safety Guides, (NTIS Publication No. 9285.1-03).

Occupational Safety and Health Administration (OSHA) General Industry Standards, 29 CFR 1910, and Construction Industry Standards, 29 CFR 1926; especially 29 CFR 1910.120/29 CFR 1926.65, Hazardous Waste Site Operations and Emergency Response.

U.S. Air Force Occupational and Environmental Health Laboratory Human Systems Division, 1989, Hazardous Waste Technical Assistance Survey, Carswell AFB, Texas.

U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health (NIOSH), June 1994, Pocket Guide to Chemical Hazards

ATTACHMENT A

Field Forms

Site Safety Briefing Form
HASP Compliance Agreement Form
HASP Amendments Form
Accident / Incident / Near Miss Investigation Form
Medical Data Sheet
Daily Equipment Calibration Log
Air Monitoring Log

Site Safety Briefing Form

Project _____

Date _____ Time _____ Job no. _____

Location _____

Type of work _____

_____

_____

Safety Topics Presented

Protective clothing/equipment _____

_____

Chemical hazards _____

_____

Physical hazards _____

_____

Emergency procedures _____

_____

Hospital/clinic _____ Phone _____

Hospital address _____

Special equipment _____

_____

Other _____

_____

_____

_____

Attendees

Name (printed)	Signature

Meeting conducted by: _____

Site Safety and Health Officer: _____

Health and Safety Plan
Compliance Agreement Form

PROJECT: Paluxy Wells Installation and Sampling

CLIENT: U.S. Air Force Center for Environmental Excellence

LOCATION: NAS Fort Worth JRB, Texas

I, _____, have received a copy of the Health and Safety Plan for the above-referenced project. I have read the plan, understand it, and agree to comply with all its provisions. I understand that I can be prohibited from working on the project for violating any of the safety requirements specified in the plan.

_____

Signature Date

_____

Company

Health and Safety Plan
Amendments Form

Change in field activities or hazards: _____

_____

_____

_____

_____

_____

_____

Proposed amendments: _____

_____

_____

_____

_____

_____

_____

Proposed by: _____ Date: _____

Approved by: _____

Accepted by: _____ Declined: _____ Date: _____

Amendment number:

Amendment effective date:

Accident / Incident / Near Miss Investigation Form

Employee's name: _____
Address: _____
SS# _____
Job title: _____ Supervisor's name: _____
Office location: _____
Location at time of incident: _____
Date/time of incident: _____

Describe clearly how the accident occurred: _____

_____

_____

_____

Was incident: Physical _____ Chemical _____
Parts of body affected _____ Exposure: _____

Witnesses: 1) _____ 2) _____

Conditions/acts contributing to this incident _____

_____

_____

Managers must complete this section:
Explain specifically the corrective action you have taken to prevent a recurrence: _____

_____

_____

Did injured go to doctor: _____ Where and when: _____
Did injured go to hospital: _____ Where and when: _____

Signatures:

_____

Employee Reporting Manager Health & Safety Officer

_____

Date Date Date

Accidents must be reported immediately; this form must be completed and returned to the Health and Safety Director within **24 hours**.

Medical Data Sheet

This brief Medical Data Sheet will be completed by all onsite personnel and will be kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project _____

Name _____ Home telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of next of kin _____

Drug or other allergies _____

Particular sensitivities _____

Do you wear contacts? _____

Provide a checklist of previous illnesses or exposure to hazardous chemicals.

_____

_____

What medications are you presently using? _____

_____

_____

Do you have any medical restrictions? _____

_____

_____

Name, address, and phone number of personal physician: _____

_____

_____

_____

_____

I am the individual described above. I have read and understand this HASP:

_____

Signature Date

Daily Equipment Calibration Log

Project name:

Project no:

Date/Time	*Initials*	*Instrument*	Calibration Solution or Gas Concentration	Adjustments Required / Comments

Air Monitoring Log

Date: _____ Logged by: _____

Weather: _____
Field tasks: _____

EEG personnel (or subs) working on the site (name and affiliation):

EEG personnel (or subs) working in restricted zone:

EEG site visitors:

Air quality monitoring measurements:

Time	Instrument	Parameter	Concentration	Locations

Background:

Exclusion zone:

Level of PPE:

Comments on other safety-related matters:

(including infractions, accidents, injuries, unusual occurrences, physical complaints)

TAB

APPENDIX C

APPENDIX C

Well Construction Details of Existing Walnut / Paluxy Monitoring Wells

720 158

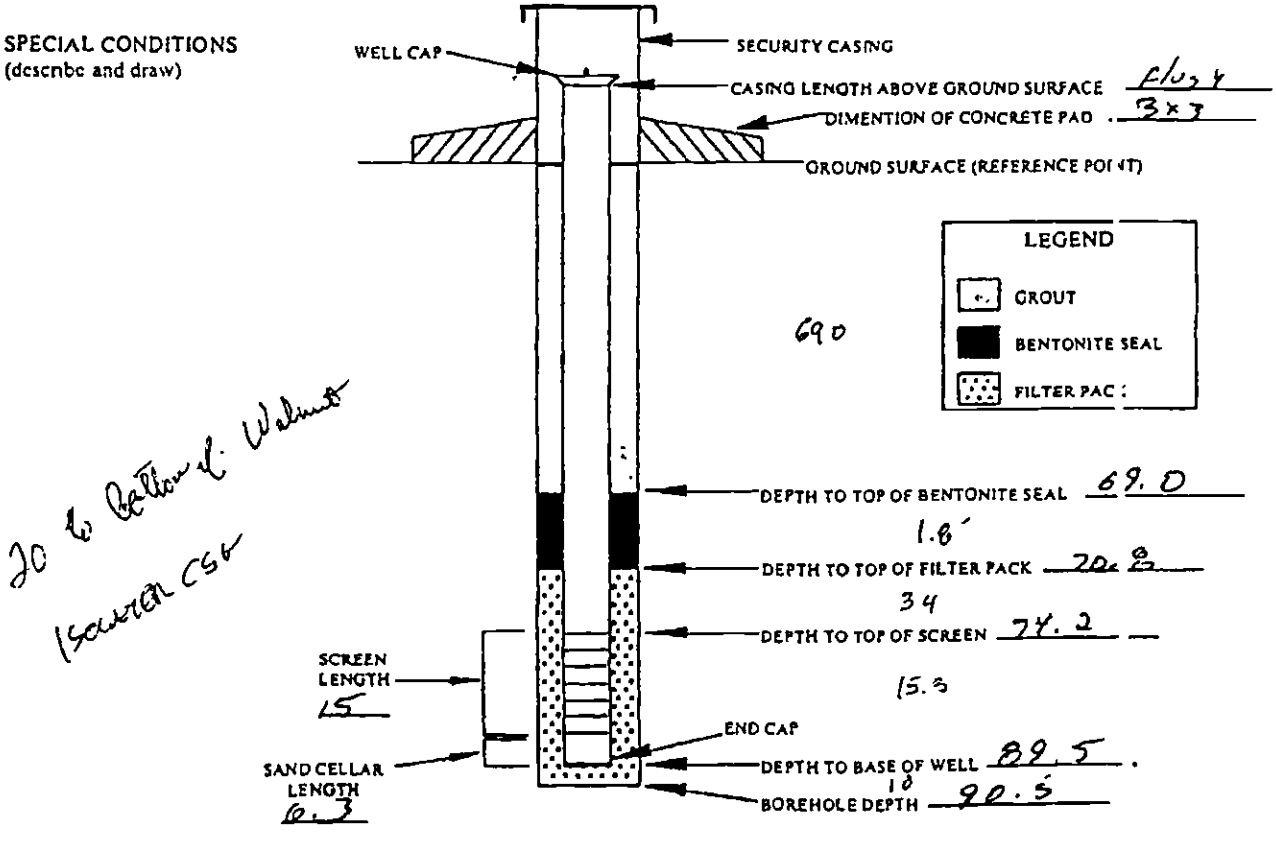
WHGCPU001

HYDRO Geologic WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: Brad Weber
DRILLING CONTRACTOR: Cascade Drilling
DRILLING TECHNIQUE: Mud rotary
AUGER SIZE AND TYPE: 6 inch drag bit
BOREHOLE IDENTIFICATION: WHGCPU001
BOREHOLE DIAMETER: 6 inch
WELL IDENTIFICATION: WHGCPU001
WELL CONSTRUCTION START DATE: 10/6/00
WELL CONSTRUCTION COMPLETE DATE: 10/14/00
SCREEN MATERIAL: 0.01 slot sched 40 PVC
SCREEN DIAMETER: 2.0"
STRATUM-SCREENED INTERVAL (FT): 74.2-89.2
CASING MATERIAL: sched 40 PVC
CASING DIAMETER: 2 inch

TYPE OF FILTER PACK: silica sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 4 bags
TYPE OF BENTONITE: chips
AMOUNT BENTONITE USED: 1 bag
TYPE OF CEMENT: portland
AMOUNT CEMENT USED: 40 gallons
GROUT MATERIALS USED: bentonite powder
DIMENSIONS OF SECURITY CASING: 8.0" flush
TYPE OF WELL CAP: expanding
TYPE OF END CAP: threaded
COMMENTS: Outer casing from 0 to 36.0" bgs.

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

10 to Bottom of Walnut
(Source CSG

INSTALLED BY: Tosc Londeras
INSTALLATION OBSERVED BY: Brad Wolsey

DISCREPANCIES:

- 3 ISO White CSGs + cement in

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU001
Date: 10/02/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			Remarks
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	
1		***Drill Mud Rotary***						
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Drilled By: GeoProjects
Drill Method: Mud Rotary
Drilling Equipment. CME75

HydroGeoLogic, Inc.
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

Hole Size: 6.0"
Total Depth Drilled. 90'

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU001
Date: 10/02/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	Remarks
26								
27								
28								
29								
30								
31								
32								
33								Set surface casing at 36' bgs
34								
35			-35					
36		***Bedrock reached at 35'***						Continued drilling at 37' on 10/4/00
37			-37					
38		***Limestone*** 2 Gley 5/5 PB 37-37.8 bluish gray LIMESTONE, fossiliferous (Gryphea), dense, looks like some pyrite at 37'. 37'-37.8', same but much less fossiliferous						Possible fractures in limestone between 37' - 39', contacts between broken pieces do not connect well and are darker gray or weathered more
39					95%			
40								
41			-41					
42		***Limestone*** 5 Y 7/1 Light gray Carbonate mudstone, 2 Gley 5/5 PB bluish gray LIMESTONE, at 42' fossiliferous, dense, 42 8'-43.5' (same as 41'-42'), 43.5'-45.2' fossiliferous mudstone, hard, dense, 45.2'-45.4' same as 37'-41', 45.7'-46.6' same as 43.5'-45.2', 46.6'-46.8' same as 41'-42'						Layer of moist shale (soft) at 42.2' - 42.5' and 43.5' - 43.8'
43								
44					95%			
45								
46								
47			-47					Lens of dark grey clay and gravel at 47.2' - 47.5' and 48.1' - 48.3' (fractures)
48		***Limestone*** 2 Gley 5/5 PB bluish gray, fossiliferous, dense carbonate mudstone						
49					80%			
50								Lens with dark grey clay

Drilled By: GeoProjects
Drill Method Mud Rotary
Drilling Equipment: CME75

HydroGeoLogic, Inc
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

Hole Size: 6.0"
Total Depth Drilled. 90'

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU001
Date: 10/02/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	Remarks
			-51					
51-53		***Carbonate Mudstone*** 5Y 5/1 gray, fossiliferous, dense	-54					
54-61		***Limestone*** 5Y 7/1 gray GREYWACKE, friable, trace fossils, irregular nodules, Top .2', 5YR 4/1 gray, either a biosparite or biomicrite (fossils held together with carbonate mud), 56.8'-57' 80% fossils, 20% matrix, 57'-59.4', hard, carbonate packstone, 5Y 7/1 gray, oyster fossils at 58.6', more fossils noted from 59.4'-59.8', same packstone as 57'-59.4' to 62'	-62		70% 85%			Losing water between 61' - 66'
62-66		***Carbonate Mudstone*** CALCAREOUS MUDSTONE 61.8'-62.2', pyrite present in v.low quantities, missing 62.2'-63 2', dolomite with calcareous mudstone and pyrite 63.2'-63.7'	-67		10%			Top of Paluxy between 61.5' - 65 8', sand is moderately to poorly cemented
67-71		***Sandstone*** 2 Gley 7/5 PB light bluish gray, clacareous SANDSTONE, dense to loose, well-sorted, hard, gray	-72		5%			
72-75		***No Recovery*** No recovery, cuttings are fine grained sand, light gray			0%			Drilling was "soft" through this interval

Drilled By: GeoProjects
Drill Method: Mud Rotary
Drilling Equipment CME75

HydroGeoLogic, Inc
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

Hole Size: 6.0"
Total Depth Drilled: 90'

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU001

Date: 10/02/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	Remarks
76			-77					
77		***No Recovery*** No recovery, cuttings are fine grained sand, light gray						Drilling was "soft" through this interval
78								
79					0%			
80								Stop drilling at 81.8' on 10/4/00
81			-82					
82		***No Recovery*** No recovery, cuttings are fine grained sand, light gray						Continue drilling at 81.8' on 10/5/00
83								
84					0%			Drilling was "soft" through this interval
85								
86			-87					
87		***No Recovery***						
88								
89					0%			
90			-90					Total depth 90'
91								
92								
93								
94								
95								
96								
97								
98								
99								
100								

Drilled By: GeoProjects
Drill Method. Mud Rotary
Drilling Equipment: CME75

HydroGeoLogic, Inc.
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

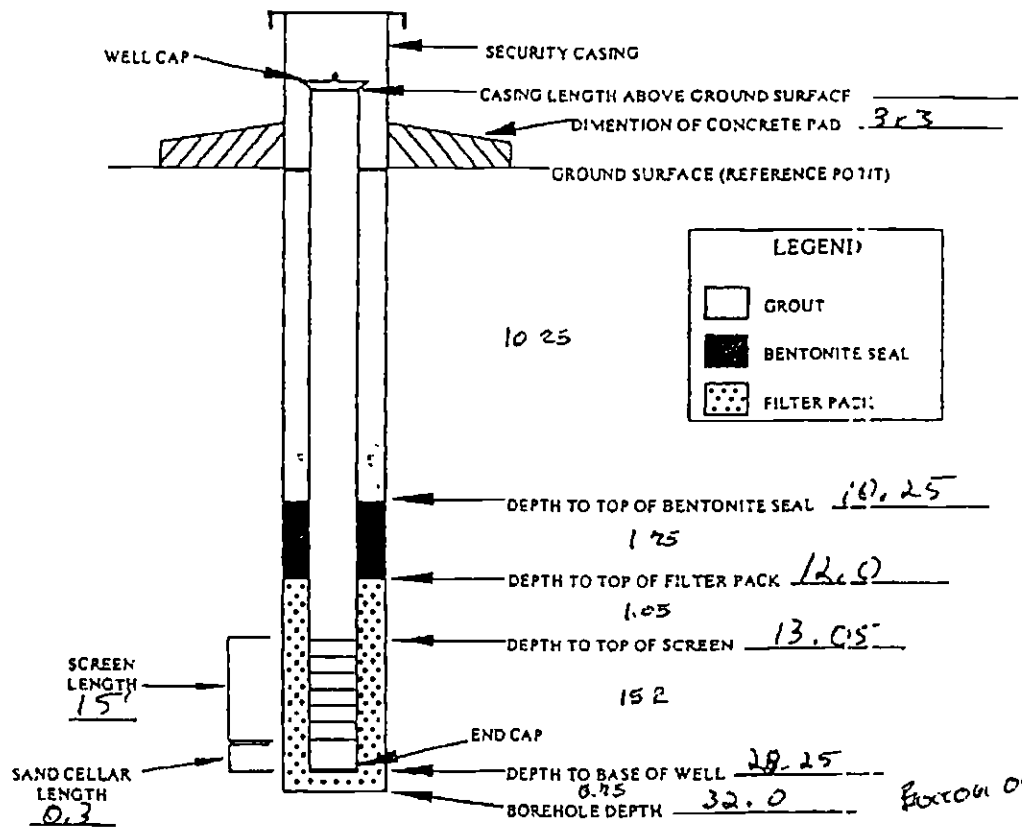
Hole Size. 6 0"
Total Depth Drilled: 90'
Sheet· 4 of 4

HYDRO GeoLogic WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: Brad Nielsen
DRILLING CONTRACTOR: Geoprobe
DRILLING TECHNIQUE: Air/ultrasonic
AUGER SIZE AND TYPE: 6 inch triple WN002
BOREHOLE IDENTIFICATION: WHG-AA002
BOREHOLE DIAMETER: 6 inch
WELL IDENTIFICATION: WHG-AA002 WN002
WELL CONSTRUCTION START DATE: 10/6/00
WELL CONSTRUCTION COMPLETE DATE: 10/9/00
SCREEN MATERIAL: 0.01 slot Sched 40 PVC
SCREEN DIAMETER: 2.0
STRATUM-SCREENED INTERVAL (FT): 13.05-28.25
CASING MATERIAL: Sched 40 PVC
CASING DIAMETER: 2.0

TYPE OF FILTER PACK: Silica Sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 6 x 50 lbs
TYPE OF BENTONITE: chips
AMOUNT BENTONITE USED: 2 bags
TYPE OF CEMENT: Portland cement
AMOUNT CEMENT USED: 20 gallons
GROUT MATERIALS USED: 20 lbs type III cement, bentonite gel
DIMENSIONS OF SECURITY CASING: 8.0'
TYPE OF WELL CAP: expanding
TYPE OF END CAP: threaded PVC
COMMENTS: Bentonite coming from 0 to 7.5' bgs

SPECIAL CONDITIONS (describe and draw)



NOT TO SCALE

INSTALLED BY: Jose Landeros
INSTALLATION OBSERVED BY: Brad Nielsen

DISCREPANCIES:

HYDRO GeoLogic INC.

Project No: AFC001-36EBA
Project: NAS Fortworth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLWN002
Date: 10/3/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	Remarks
1-8		***Drill Mud Rotary*** No samples taken	-9					Set 6" PVC outer casing at 7.8'
9-12		***Limestone*** 2 Gley 4/5 PB dark bluish gray BIOSPARITE/BIOMICRITE, fossiliferous (Gryphea), 80% fossils/ 20% matrix, dense, good cementation	-13		10%			Breaks at 11' (possible fractures)
13-18		***Limestone*** 2 Gley 4/5 PB dark bluish gray MUDSTONE with 5% sand grains and fossils, dense, v-hard, 14'-15' same as 8'-12.5', 15'-17' same as 12 5'-14'	-18		85%			Some thin shale lenses form darker colored swirled layers Mudstones with <5% fossils from 18.0' - 18.3', 19 5' - 20.2' and 21.0' - 22.0'
19-23		***Limestone*** 2 Gley 4/5 PB dark bluish gray MUDSTONE, fossiliferous, with shale layers	-23		80%			
24-27		***Limestone*** 2 Gley 4/5 dark bluish gray MUDSTONE with 20% fossils	-28		80%			
28-31		***Limestone*** 29' - 29.5' grades to grainstone, no fossils, v-fine sand sized grains, calcareous, breaks off easily, at 29', 5 mm piece (cube) of pyrite, good 90 degree faces (crystal)	-32		50%			Very soft drilling at 31.5' (Paluxy formation) Total depth 32.0'
32-35		***Sand*** 2 Gley 6/5 PB bluish gray SAND moderately to poorly cemented, fine quartz sand	-35					
36-38								

Drilled By: GeoProjects
Drill Method: Mud Rotary
Drilling Equipment: CME75

HydroGeoLogic, Inc
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

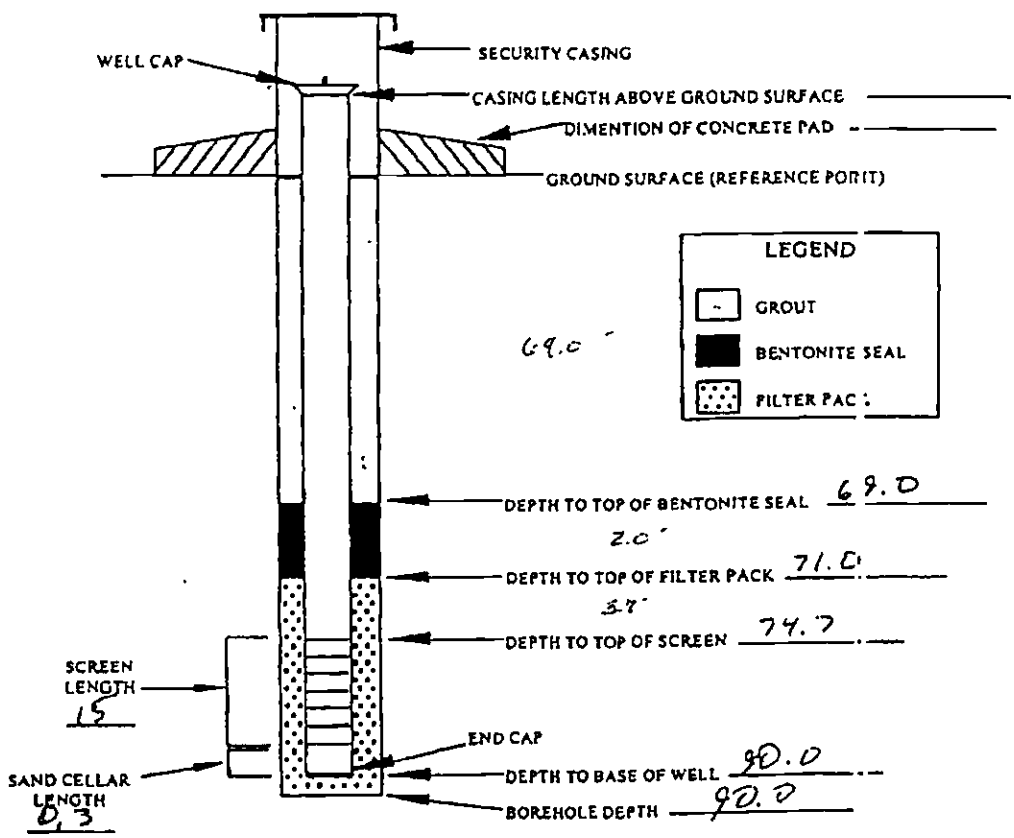
Hole Size: 6 0"
Total Depth Drilled 32'
Sheet. 1 of 1

HYDRO Geologic WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: Brad Nielsen
DRILLING CONTRACTOR: Geo Probe
DRILLING TECHNIQUE: Mud rotary
AUGER SIZE AND TYPE: Tri cone
BOREHOLE IDENTIFICATION: WHGL PA003
BOREHOLE DIAMETER: 6.0"
WELL IDENTIFICATION: WHGL PA003
WELL CONSTRUCTION START DATE: 10/3/00
WELL CONSTRUCTION COMPLETE DATE: 10/4/00
SCREEN MATERIAL: 0.01 slot schedule 40 PVC
SCREEN DIAMETER: 2.0"
STRATUM-SCREENED INTERVAL (FT): 75-90
CASING MATERIAL: schedule 40 PVC
CASING DIAMETER: 2.0"

TYPE OF FILTER PACK: silica sand
GRADIATION: 20/40
AMOUNT OF FILTER PACK USED: 5 bags
TYPE OF BENTONITE: chips
AMOUNT BENTONITE USED: 1 bag
TYPE OF CEMENT: Portland cement
AMOUNT CEMENT USED: 60 gallons
GROUT MATERIALS USED: tremie / bentonite seal
DIMENSIONS OF SECURITY CASING:
TYPE OF WELL CAP: expanding
TYPE OF END CAP: threaded PVC
COMMENTS:

PECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Jaye Lundgren
INSTALLATION OBSERVED BY: Brad Nielsen
DISCREPANCIES: outer casing installed to 35.8' & grout outside annular space

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU003
Date: 10/3/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			Remarks
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	
1		***Drill Mud Rotary*** No samples collected until goodland/ walnut contact						
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

Drilled By: GeoProjects
Drill Method: Mud Rotary
Drilling Equipment: CME 75

HydroGeoLogic, Inc
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

Hole Size: 6.0"
Total Depth Drilled: 90'

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU003
Date: 10/3/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	Remarks
31								
32								
33								Bedrock reached at 34.5'
34			-35					
35		***Limestone*** 2 Gley 4/PB dark bluish gray MUDSTONE, 36'-36.4' fossiliferous, dense, 36.4'-36.8' same with 25% fossils, 36.8'-37 same as 36'-36.4'						Install 6" PVC outer casing at 35.8 bgs Resume drilling at 36' on 10/05/00 at 1540 Some pyrite
36					80%			
37			-37					
38								
39		***Limestone*** 2 Gley 4/PB dark bluish gray BIOSPARITE/BIOMICRITE, very fossiliferous, dense, layer of calcareous mudstone 41.8' - 42.0'			90%			
40								
41								
42			-42					Marl layer at 42.2' - 43.0' , 43 5' - 43.7', and 44.3' - 47.0'
43		***Limestone*** Calcareous MUDSTONE 10-20% fossils, dense, with some marl layers, fossil content varies						
44					90%			
45								
46								
47			-47					
48		***Limestone*** Calcareous MUDSTONE 25% fossils with marl lenses (thin) and fossils (gryphea), oysters, some pyrite from 52.0'-52.7', marl at 52.7'-57', (crumbly, nodules of mudstone, not many fossils)						
49					60%			
50								Layer of marl at 50 1' - 50.3' and 51.5' - 52.0'
51								
52								
53								
54					30%			
55								
56								
57			-57					Micro fossils at 57.0'
58		***Limestone*** PACKSTONE, fossiliferous, dense (some pyrite)						
59					20%			
60								

Drilled By. GeoProjects
Drill Method: Mud Rotary
Drilling Equipment: CME 75

HydroGeoLogic, Inc.
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

Hole Size: 6 0"
Total Depth Drilled 90'

HYDRO GeoLogic INC.

Project No: AFC001-36EAB
Project: NAS Fort Worth JRB
Client: AFCEE
Location:
Northing:

Borehole ID: WHGLPU003
Date: 10/3/00
Geologist: Nielsen
Ground Surface Elevation:
Easting:

SUBSURFACE PROFILE					SAMPLE			
Depth	Symbol	Description	Elevation	ASTM	Recovery	Moisture	PID (ppm)	Remarks
61								Soft from 61 0' - 62.0', sand in cuttings
62			-62					
63		***Sand*** SAND, loose, no recovery (Paluxy)						
64					0%			
65								Soft
66								
67			-67					Stop drilling at 67.0', will continue with air rotary
68								
69					0%			
70								
71								
72								
73			-73					
74		***Sandstone*** Hard layer between 73.0' - 73.3' (SANDSTONE)			0%			
75			-75					
76		***Sandstone*** Hard layer between 75.0' - 75 3' (SANDSTONE)						
77								
78								
79		***Same as above***			0%			
80								
81								
82								
83								
84					0%			
85								
86								
87								
88								
89					0%			
90			-90					Total depth 90.0'

Drilled By: GeoProjects
Drill Method Mud Rotary
Drilling Equipment: CME 75

HydroGeoLogic, Inc.
1155 Herndon Pkwy, Suite 900
Herndon, VA 20170
(703) 478-5186 FAX (703) 471-4180

Hole Size· 6.0"
Total Depth Drilled· 90'
Sheet. 3 of 3

TAB

APPENDIX D

APPENDIX D

EPA Comments
Final RCRA Facility Investigation Report, Area of Concern 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

JAN 29 2001

Ray Risner
Corrective Action Section
Remediation Division, MC-127
Texas Natural Resource Conservation Commission
P. O. Box 13087
Austin, TX 78711-3087

Dear Mr. Risner:

The Environmental Protection Agency (EPA) has reviewed the following document, "Final RCRA Facility Investigation Report, Area of Concern 2, NAS Fort Worth JRB, Texas." The following comments are provided:

1. General - The report does not adequately address previous comments submitted in a letter dated February 25, 1999. Specifically the report does not address comments related to nature and extent of the TCE plume and comments related to the Risk Assessment

2. RFI Objectives - The plume is not fully delineated.

   a. The information presented indicates the plume could reach the Trinity River. Further delineation of the southeastern tip of the plume, in the vicinity of monitoring wells MW-6, MW-7 and BSS-B and the area to the northeast along the boundary with the prison is needed. The monitoring wells in this area are spread far apart and monitoring well GMI-22-05 is used to delineate the plume along this eastern boundary however, this there is no completion data to show if this well is adequate. Additional monitoring wells should be installed and existing monitoring wells sampled to verify nature and extent of the plume.

   b. As stated in the recommendations, additional information on the Terrace Alluvial Aquifer is needed and all recommendations should be implemented.

   c No sampling information on the Paluxy Aquifer is included. Contamination is present in the Paluxy Aquifer at Air Force Plant 4. No information is presented to show that the contamination has not moved to Carswell. A base wide sampling of monitoring wells screened in the Paluxy Aquifer should be conducted.

   d. Temporary monitoring point PCHMHTAOE3 contained 250 mg/L of PCE and no additional information is presented to explain the high concentration of PCE this far from Air Force Plant 4. Close-by this point is monitoring well GMI-22-03 which also has several PCE detections during sampling events.

3. General Comments on the Risk Assessment:

a The TCE plume is growing or not adequately characterized with 3 lobes running under Carswell AFB. The report considers the plume to be from Air Force Plant 4. The plume is anticipated to reach the West Fork of the Trinity River in 4 years. The model predicts that MCLs will not be met. Potential ecological effects on the river inhabitants and aquatic-dependant organisms were not evaluated. Who is in charge of doing something about this plume?

b. Inhalation of volatiles from the soil and groundwater is considered for the construction worker only. This pathway could also be significant for indoor inhabitants. Are there buildings located on top of a contaminated groundwater plume or contaminated subsurface soils? If so, I would strongly suggest that risk due to indoor air be evaluated.

4. Specific Comments:

a. The references listed on page 7-2 are all related to human health risk assessments. Both EPA-Superfund and TNRCC have guidance documents available addressing ecological risk assessments. Some of these documents should be referenced and utilized.

b. Section 7.4 is entitled, "Potential Threats to Ecological Receptors and Recreational Users of the Trinity River" but does not evaluate these pathways. This paragraph states that table 7-8 is a compilation of the Texas Water Quality Standards and would serve as future potential surface water quality criteria in the event that groundwater should impact the West Fork Trinity River. I do not find that table 7-8 is adequate to evaluate the potential ecological risk and it may also not be adequate to evaluate risk to the recreational user.

c. Table 7-3 projects the surface water concentrations should the groundwater make it to the West Fork Trinity River. Several chemicals (TCE, vinyl chloride, and benzene) will exceed their MCL when this happens. I find this to be of concern now, not when the plume reaches the Trinity.

d Table 7-8 should reference chronic criteria where available. It is not clear whether this is the case as most of the chemical values are listed for acute.

Please contact me at (214)665-8306 should you wish to discuss this further.

Sincerely,

Gary W. Miller
Senior Project Manager
Base Closure Team

cc: Mark Weegar, TNRCC
Charles Pringle, AFCEE
Ruben Moya, EPA 6SF
Luda Voskov, TNRCC

TAB

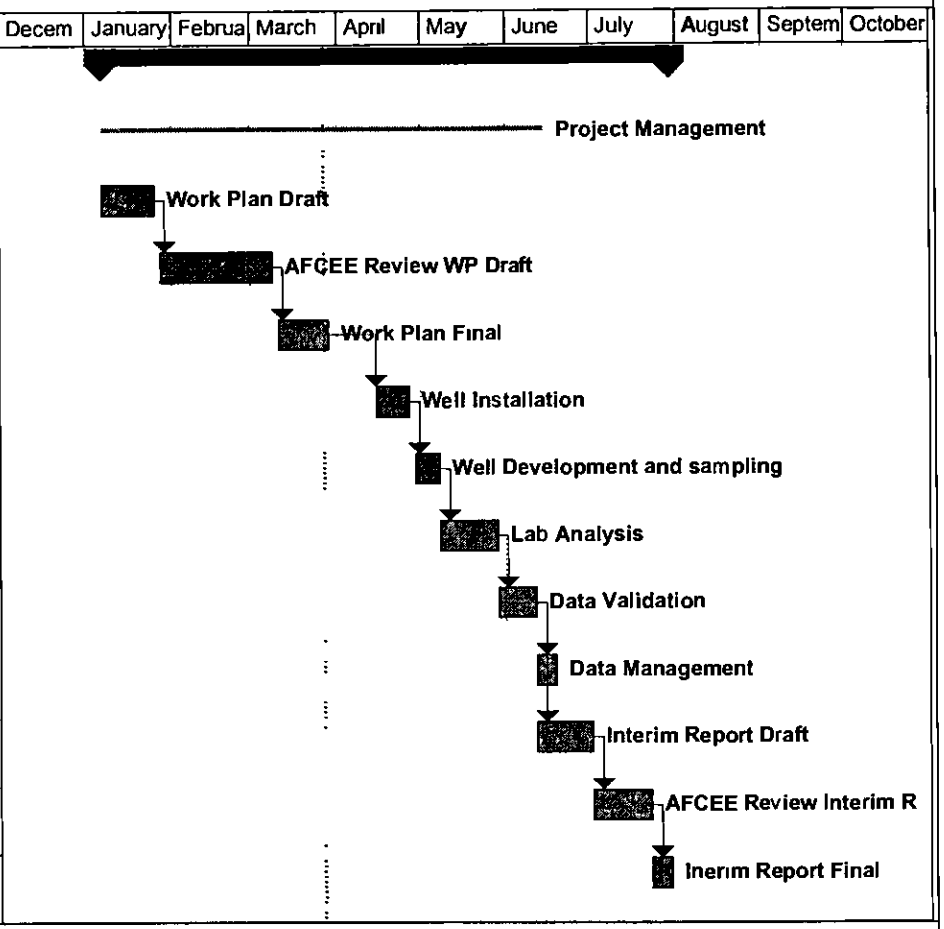
APPENDIX E

APPENDIX E

Schedule

NAS Fort Worth JRB - Paluxy Wells Installation Schedule

ID	Task Name	Duration	Start	Finish
1	**Paluxy Wells**	**146 days**	**Mon 1/7/02**	**Mon 7/29/02**
2	Project Management	115 days	Mon 1/7/02	Fri 6/14/02
3	Work Plan Draft	15 days	Mon 1/7/02	Fri 1/25/02
4	AFCEE Review WP Draft	30 days	Mon 1/28/02	Fri 3/8/02
5	Work Plan Final	14 days	Mon 3/11/02	Thu 3/28/02
6	Monitoring Well Installation	10 days	Mon 4/15/02	Fri 4/26/02
7	Well Development and sampling	7 days	Mon 4/29/02	Tue 5/7/02
8	Lab Analysis	15 days	Wed 5/8/02	Tue 5/28/02
9	Data Validation	10 days	Wed 5/29/02	Tue 6/11/02
10	Data Management	5 days	Wed 6/12/02	Tue 6/18/02
11	Interim Report Draft	14 days	Wed 6/12/02	Mon 7/1/02
12	AFCEE Review Interim Report Draft	15 days	Tue 7/2/02	Mon 7/22/02
13	Inerim Report Final	5 days	Tue 7/23/02	Mon 7/29/02



Project: Paluxy Well Schedule final
Date: Wed 3/27/02

Task
Split
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Split
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
External Milestone
Deadline

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE