N83447.AR.000231
NAS FORT WORTH
5090.3a

FINAL RCRA FACILITY INVESTIGATION FOR NAS FORT WORTH TX
10/1/1995
LAW ENGINEERING AND ENVIRONMENTAL

File: 17G
A.F.

269 0

NAVAL AIR STATION FORT WORTH JRB CARSWELL FIELD TEXAS

ADMINISTRATIVE RECORD COVER SHEET

AR File Number 269

11-3517-0111

INSTALLATION RESTORATION PROGRAM (IRP)
RCRA FACILITY INVESTIGATION REPORT

Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field
Fort Worth, Texas

October 1995

Final

PREPARED FOR

AIR FORCE BASE CONVERSION AGENCY (AFBCA/OL-H)
NAVAL AIR STATION FORT WORTH JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS 76127-5000

UNITED STATES AIR FORCE
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE/ERB)
BROOKS AIR FORCE BASE, TEXAS 78235-5328

CONTRACT NO.: F33615-90-D-4008

DELIVERY ORDER 0011

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

October 2, 1995

Mr. Charles A. Rice, Team Chief
Air Force Center for Environmental Excellence
HQ AFCEE/ERB
8001 Inner Circle Drive, Suite 2
Brooks Air Force Base, TX 78235-5328

Subject: **Final RCRA Facility Investigation Report**
Contract No. F33615-90-D-4008, Delivery Order No. 0011
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
LAW Project No. 11-3517-0111

Dear Mr. Rice:

Law Environmental, Inc. is pleased to submit the enclosed nine copies of the Final RCRA Facility Investigation Report to the Air Force Center for Environmental Excellence (AFCEE) for review and comment. Per your instructions, an additional copy has been sent to Mr. Olen Long, Site Manager, Carswell Field.

If you have questions or comments, please contact us at 404-499-6800.

Sincerely,

LAW ENVIRONMENTAL, INC.

James R. Forbes, P.E.
Project Manager

E. Fred Sharpe, Jr. P.E.
Principal

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
114 TOWNPARK DRIVE, SUITE 400 • KENNESAW, GA 30144-5569
(404) 499-6800 • FAX (404) 421-3593
ONE OF THE LAW COMPANIES

INSTALLATION RESTORATION PROGRAM (IRP)
RCRA FACILITY INVESTIGATION

FOR

NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS 76127-5000

OCTOBER 1995

Prepared by:

Law Environmental, Inc.
114 TownPark Drive
Kennesaw, Georgia 30144

United States Air Force
Air Force Center for Environmental Excellence (AFCEE/ERB)
Brooks Air Force Base, Texas 78235-5328

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

269 4

1. AGENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	OCTOBER 1995	DRAFT

4. TITLE AND SUBTITLE

INSTALLATION RESTORATION PROGRAM
RCRA FACILITY INVESTIGATION REPORT

5. FUNDING NUMBERS

CONTRACT NO.
F33615-90-D-4008/0011

6. AUTHOR(S)

LAW ENVIRONMENTAL, INC. (LAW)

7. PERFORMANCE ORGANIZATION NAME(S) AND ADDRESS(ES)

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
114 TOWNPARK DR.
KENNESAW, GA 30144

8. PERFORMING ORGANIZATION REPORT NUMBER

(N/A)

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
ENVIRONMENTAL RESTORATION DIVISION (AFCEE/ERB)
BROOKS AFB, TEXAS 78235-5328

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

(N/A)

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

LAW ENVIRONMENTAL, INC., (LAW) CONDUCTED A RCRA FACILITY INVESTIGATION AT TWO SITES AT NAVAL AIR STATION FORT WORTH JOINT RESERVE BASE, CARSWELL FIELD, UNDER THE AIR FORCE INSTALLATION RESTORATION PROGRAM (IRP). THE PROJECT WAS DESIGNED TO CHARACTERIZE ENVIRONMENTAL CONDITIONS AT THE TWO SITES AND TO ENSURE SUBSEQUENT REMEDIAL DESIGN AND REMEDIAL ACTION CONSISTENT WITH THE OBJECTIVES OF THE BASE REALIGNMENT AND CLOSURE (BRAC) PROGRAM. THE TWO SITES INVESTIGATED WERE THE UNNAMED STREAM (IRP SITE SD-13/SWMU 64) AND POL TANK FARM (IRP SITE ST-14/SWMU 68).

14. SUBJECT TERMS

RCRA FACILITY INVESTIGATION

15. NUMBER OF PAGES

200

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

DISCLAIMER NOTICE

This report has been prepared for the United States Air Force by Law Environmental, Inc., (LAW) for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives associated with this assessment and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and human health, must be considered when evaluating this document. Also, subsequent facts may become known which may make this document premature or inaccurate. Acceptance of this document in performance of the contract under which it is prepared does not mean that the United States Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

Government agencies and their contractors registered with the Defense Technical Information Center (DTIC) should direct their requests for copies of this report to:

Defense Technical Information Center
Cameron Station
Alexandria, VA 22304-6145

Nongovernment agencies may purchase copies of this document from:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161

PREFACE

Law Environmental, Inc., (LAW) was contracted by the U.S. Air Force Center For Environmental Excellence (AFCEE) to perform a RCRA Facility Investigation (RFI) at two sites on Naval Air Station Fort Worth Joint Reserve Base, Carswell Field. The two sites investigated were the Unnamed Stream (IRP Site SD-13/SWMU No. 64) and the POL Tank Farm (IRP Site ST-14/SWMU No. 68). The primary objective of this field investigation was to investigate the extent of soil and ground-water contamination at each site and assess the overall environmental status of the sites in order to support the recommendation of appropriate further actions. Project objectives were achieved through the use of the following methods of investigation: geophysical and geochemical surveys; soil borings and hand auger borings; installation of monitoring wells; soil and ground-water sampling for field screening and laboratory analyses; and surface water and sediment sampling for laboratory analyses.

This draft RFI Report was prepared by the LAW project team for Carswell Air Force Base and reviewed by Mr. James R. Forbes and Mr. E. Fred Sharpe, Jr.

James R. Forbes, P.E.
Project Manager

E. Fred Sharpe, Jr., P.E.
Principal

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF APPENDICES

LIST OF FIGURES

LIST OF FIGURES
(Continued)

LIST OF FIGURES
(Continued)

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
BTEX	benzene, toluene, ethylbenzene, xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CSM	Conceptual Site Model
DoD	Department of Defense
DQOs	data quality objectives
EM61	electromagnetic survey device
EO	Executive Order
ER-L	effects range-low
ER-M	effects range-medium
ESI	Expanded Site Investigation
F	Fahrenheit
FS	Feasibility Study
FSP	Field Sampling Plan
ft/min	feet per minute
gpd/ft	gallons per day per foot
gpm	gallons per minute
GWP-Ind	Industrial Soil-to-Ground Water Cross-Media Protection Concentration
ID	inner diameter
IDW	investigation-derived waste
IRP	Installation Restoration Program
LAW	Law Environmental, Inc.
LCS	laboratory control samples
LPSTs	leaking petroleum storage tanks
MCL	maximum contaminant levels
MEK	methyl ethyl ketone

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

mg/kg	milligrams per kilogram
ml/L	milliliters per liter
MS	matrix spike
MSCs	medium-specific concentrations
MSD	matrix spike duplicate
msl	mean sea level
NOAA	National Oceanic Atmospheric Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priority List
NTU	nephelometric turbidity unit
PA	Preliminary Assessment
PARCC	precision, accuracy, representativeness, completeness, and comparability
PID	photoionization detector
POL	petroleum, oils, and lubricants
ppm	parts per million
PQL	practical quantitation limit
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFI	RCRA Facility Investigation
RPD	relative percent difference
SAI-Ind	Soil/Air and Ingestion Standard for Industrial Land Use
SARA	Superfund Amendments and Reauthorization Act of 1986
SAP	Sampling and Analysis Plan
SOW	statement of work

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

SPT	standard penetration tests
TEG	Transglobal Environmental Geochemistry
TNRCC	Texas Natural Resource Conservation Commission
TOC	top of casing
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
µg/L	micrograms per liter
µm	micrometer
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

Law Environmental, Inc., (LAW) was contracted by the U.S. Air Force Center for Environmental Excellence (AFCEE) to perform a RCRA Facility Investigation (RFI) at the Petroleum, Oils, and Lubricants (POL) Tank Farm and Unnamed Stream areas of Naval Air Station Fort Worth Joint Reserve Base (NAS Fort Worth), Carswell Field, Tarrant County, Texas. The RFI was conducted in response to the Statement of Work dated October 29, 1993, under Delivery Order 0011, AFCEE Contract No. F33615-90-D-4008. The primary objectives of this investigation are listed below:

- Conduct a geophysical survey to assist in locating metallic utilities in the POL Tank Farm Area to assist in clearing utilities for subsequent ground-water screening at the site

- Conduct a geophysical survey in the Abandoned Gasoline Station vicinity of the Unnamed Stream Area to locate possible underground storage tanks (USTs) at the former gasoline station site

- Conduct ground-water screening in the area of the POL Tank Farm (Pipeline/Truck Loading Area)

- Collect surface-water and sediment samples for chemical analysis from the Unnamed Stream

- Install three ground-water monitoring wells and analyze three rounds of ground-water samples from the Unnamed Stream Area

LAW obtained information concerning the study sites through records review, interviews with base personnel, visual observations, and

analyses of soil, surface-water, sediment, and ground-water samples collected from the study areas. Samples were chemically analyzed for volatile organic compounds, fuel-related constituents, and metals to evaluate the environmental condition of the sites.

A risk evaluation was prepared to compare the appropriate Texas Natural Resource Conservation Commission (TNRCC) Risk Reduction Standards to the positive soil and ground-water sample results collected from the Unnamed Stream Area. The selection of appropriate Texas Risk Reduction Standards was based on available analytical data and the understanding that the land use associated with the study sites was currently, and would remain, industrial.

The ground-water screening in the Pipeline/Truck Loading Area of the POL Tank Farm, and in the Abandoned Gasoline Station vicinity of the Unnamed Stream Area, detected lead across the sampling grid and indicated that lead may be naturally occurring. Also, the ground-water screen indicated that the aboveground storage tanks in the POL Tank Farm Area are not a primary source of petroleum constituents in the ground water. However, the underground piping in the Pipeline/Truck Loading Area appears to be a major source of the petroleum constituents. Ground-water screening results downgradient of the Pipeline/Truck Loading Area indicated elevated levels of benzene, toluene, ethylbenzene, and xylene (BTEX).

The ground-water screening identified a second potential source of petroleum constituents at the Abandoned Gasoline Station and the geophysical survey identified a possible abandoned UST. The ground-water screening detected elevated concentrations of BTEX and gasoline-range total petroleum hydrocarbons (TPHs) in the area.

Surface soil samples analyzed from the Unnamed Stream Area contained lead and TPHs above the appropriate action levels.

Petroleum constituents were detected and were visible in the surface water of the stream. Sediment samples from the stream were found to contain arsenic and cadmium in excess of National Oceanic and Atmospheric Administration (NOAA) values.

The results of the three ground-water sampling episodes indicate that ground water in the vicinity of the Unnamed Stream Area contains metals and solvent-related compounds. Although the origin of the contaminants detected is uncertain, they may be the result of past maintenance operations at the site, or may have migrated from an upgradient source such as the french drain from the Abandoned Gasoline Station. In addition, free petroleum product was detected in the monitoring well in the Abandoned Gasoline Station Area.

Additional assessment activities are recommended to delineate the vertical and horizontal extent of petroleum constituents in soil and ground water. Also, metals and solvent contamination in ground water should be further assessed by continued monitoring.

Other specific recommendations include:

- Recovery activities to remove free product from the monitoring well in the Abandoned Gasoline Station Area
- Excavation in the vicinity of the Abandoned Gasoline Station Area, and possible removal of an abandoned UST
- A National Pollutant Discharge Elimination System (NPDES) permit for the oil/water separator, the effluent of which forms the Unnamed Stream which flows into Farmers Branch
- Collection and analysis of additional sediment samples from the Unnamed Stream and excavation of sediments if significant contamination is encountered

1.0 INTRODUCTION

Law Environmental, Inc., (LAW) was contracted by the U.S. Air Force Center For Environmental Excellence (AFCEE) to perform a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for two sites on Naval Air Station Fort Worth Joint Reserve Base, Carswell Field. The two sites investigated were the Unnamed Stream (IRP Site SD-13/SWMU Number 64) and the POL Tank Farm (IRP Site ST-14/SWMU Number 68). The overall objective of this field investigation was to further characterize site contamination and assess the overall environmental status in order to support the recommendation of appropriate further actions. Project objectives were achieved through the use of the following methods of investigation: geophysical and geochemical surveys, soil and hand auger borings, installation of monitoring wells, soil and ground-water sampling for field screening and laboratory analyses, and surface-water and sediment sampling for laboratory analyses.

The Unnamed Stream site is composed of two separate areas: the Abandoned Gasoline Station and the Unnamed Stream. The Abandoned Gasoline Station is a paved parking lot that was the former location of a gasoline station. The gasoline station building was removed, and the only visible evidence of the station is the concrete pump island. The former configuration of the Abandoned Gasoline Station is unknown, and underground fuel storage tanks and associated underground piping may still be present at this site. The second portion of the site is the Unnamed Stream, which is formed by the effluent from an oil/water separator. The Unnamed Stream originates at the oil/water separator and flows approximately 200 feet to Farmers Branch. The oil/water separator is apparently connected to a french drain. According to the Phase II, Stage 1 Confirmation/Quantification Report (Radian, 1986), the french drain was constructed to remove fuels from the ground water

flowing from either the POL Tank Farm or from the Abandoned Gasoline Station.

The POL Tank Farm is located along both sides of Knights Lake Road (recently renamed Desert Storm Drive). The POL Tank Farm consists of three aboveground fuel tanks located west of Knights Lake Road and the Pipeline/Truck Loading Area located east of Knights Lake Road.

1.1 INSTALLATION RESTORATION PROGRAM BACKGROUND

The U.S. Air Force (USAF) Installation Restoration Program (IRP) is designed to identify and evaluate suspected problems associated with past hazardous material disposal sites, to control migration of hazardous contamination from USAF facilities, and to reduce hazards to human health and welfare or to the environment that result from past operations. The IRP is the basis for assessment and response actions at USAF installations under the provisions of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA); the National Oil and Hazardous Substances Pollution Contingency Plan (NCP); and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The program was formally designated as the Department of Defense (DoD) Superfund program on November 21, 1981.

The current DoD IRP policy is contained in the Defense Environmental Quality Program Policy Memorandum (DEQPPM 81-5) which reissues, amplifies, and consolidates previous directives and memoranda on the IRP. The IRP takes further program definition from the following Executive Orders (EO):

- EO 12088, which directs the DoD to comply with substantive and procedural statutes

- EO 12316, which delegates responsibility for remedial actions at DoD sites to the Secretary of Defense

- EO 12580, which defines responsibilities of the U.S. Environmental Protection Agency (USEPA) and DoD under SARA for National Priority List (NPL) and non-NPL sites

Additional direction for the execution of this RFI is defined in the RCRA Permit, dated February 7, 1991, issued by the Texas Water Commission. The RCRA Permit, which is included as an annex to the Statement of Work (SOW), provides for use of RFI guidance documents as primary guidance for the work.

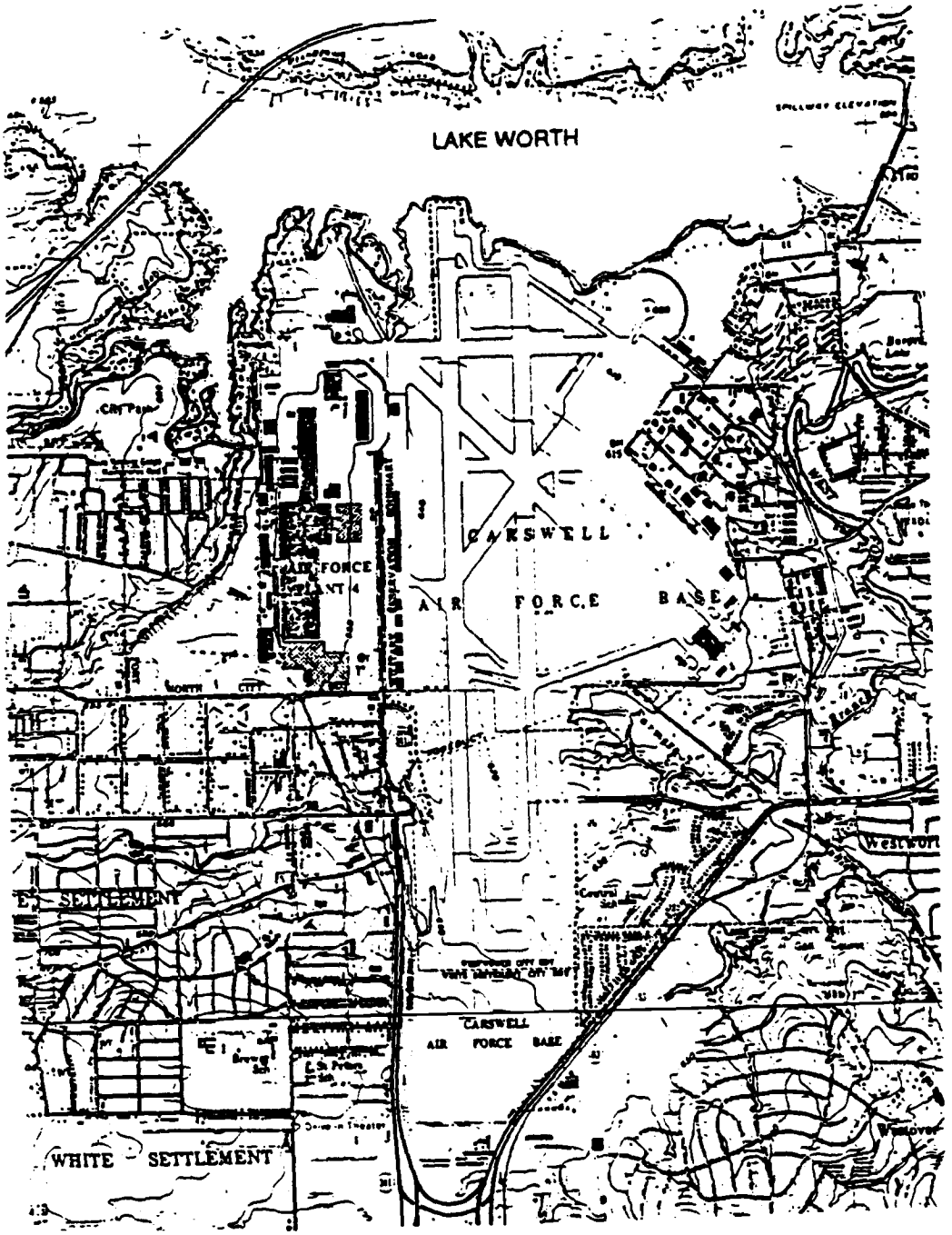
1.2 FACILITY AND SITE DESCRIPTION

NAS Fort Worth is located in Tarrant County, Texas, approximately 6 miles west of Fort Worth, Texas (Figure 1-1). The base covers approximately 25,000 acres and includes a flight line area, operations buildings; warehouses; Petroleum, Oils, and Lubricants (POL) Tank Farm; and base housing. The base is bounded to the north by Lake Worth, to the west by Air Force Plant Number 4, to the south by the community of White Settlement, and to the east by the West Fork of the Trinity River and the city limits of Fort Worth, Texas.

The Pipeline/Truck Loading Area is the underground piping network of the POL Tank Farm. The Pipeline/Truck Loading Area is enclosed by a chain link fence with a locking gate. The ground surface of the area is covered by either concrete or gravel (Figure 1-2). The Unnamed Stream is located along Farmers Branch in the southeastern section of the base. The stream emerges from an oil/water separator and flows approximately 200 feet to the east to Farmers Branch. The Unnamed Stream originates at this oil/water separator

269 24

N



UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH,
JOINT RESERVE BASE, CARSWELL FIELD

RCRA FACILITY INVESTIGATION

SITE VICINITY MAP

PREPARED BY/DATE: TDM 9/15/95	DRAWING NO. 1-1	FILE DATE: 15.SEP.95	
CHECKED BY/DATE: TDM 9/15/95		PLOT DATE: 15.SEP.95	
PROJECT NO. 11-35:7-0***		FILE NAME: sitvic.dwg	

Source: USGS Lake Worth, Texas Topographic Quadrangle, 1982
USGS Benbrook, Texas Topographic Quadrangle, 1981

269 25

NOTE:
LOCATION OF IRP SITES BASED ON DEPARTMENT OF THE AIR FORCE MASTER PLAN IRP SITES–SOIL CONTAMINATION CARSWELL AFB, FORT WORTH, TEXAS. REVISED 1985

LOCATION OF EXISTING MONITORING WELLS BASED ON REMEDIAL INVESTIGATION REPORT FOR THE EAST AREA, OCTOBER 1991.

LOCATION OF GROUND–WATER SCREEN GRID, BACKGROUND SOIL SAMPLES AND MONITORING WELLS ARE APPROXIMATE.

N

LEGEND

- BACKGROUND SOIL SAMPLING LOCATION
- A–1+00 GROUND–WATER SCREEN GRID LOCATION
- LAW MONITORING WELLS (1994)
- EXISTING MONITORING WELLS
- SURFACE WATER/SEDIMENT SAMPLE LOCATION

SD13–05(BG01)
SD13–02
SD13–04
SD13–01
SD13–03
OT12–15B
OT12–15C
SD13–07
SD13–06
SD13–SW1
SD13–SD1
SD13–SW2
SD13–SD2
SD13–SW3
SD13–SD3
ABANDONED GASOLINE STATION
UNNAMED STREAM
AIRFIELD GROUND WATER
WASTE OIL DUMP
HALE ROAD
POL TANK FARM
HOBBY SHOP ROAD
RONALD DRIVE
FARRIER BRANCH

0 200 400
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH,
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

SITE MAP

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY	FIGURE NUMBER 1–2	FILE DATE	26 SEPT 95
CHECKED BY 30 Sep 95		PLOT DATE	26 SEPT 95
PROJECT NO. 11–3517–0111		FILE NAME	SITE–MAP.DWG

which is connected to a french drain system that extends to the northwest to the vicinity of the Abandoned Gasoline Station. The Abandoned Gasoline Station site is located between Rogner Drive and the 1337 Building. Currently the Abandoned Gasoline Station site is a partially paved and graveled lot. Except for the concrete dispenser island, underground piping, and possibly abandoned underground storage tanks (USTs), the gasoline station has been removed. The former configuration of the station is unknown.

1.3 SITE HISTORY

Carswell AFB began operations in 1942 and was operated by the Air Force as a Strategic Air Command Base. Currently the base is undergoing realignment to become a joint reserve base and is now known as NAS Fort Worth Joint Reserve Base, Carswell Field. The POL Tank Farm has been an area of fuel storage during most of NAS Fort Worth's operating history. Currently, the POL Tank Farm consists of three aboveground storage tanks surrounded by concrete berms. During the 1960s, the POL Tank Farm was reported to have experienced leakages and underground piping was excavated.

The age of the oil/water separator at the Unnamed Stream is uncertain; however, an as-built drawing of the system is dated February 1964. Archived engineering drawings indicate that the oil/water separator replaced an earlier system consisting of an interceptor box and a pump house for pumping water from the french drain to the Unnamed Stream. The installation dates of the earlier system and the french drain are unknown.

The period of operation of the Abandoned Gasoline Station is not known. However, the archived as-built drawings for the oil/water separator dated February 1964 include a plot plan showing buildings which could be the gasoline station.

1.4 ORGANIZATION OF REPORT

This report has been generated to assemble and integrate data obtained during this RCRA Facility Investigation. The report is arranged according to the following sections:

EXECUTIVE SUMMARY - Summarizes the purpose, approach and results of the investigation.

1.0 INTRODUCTION - Discusses the project objectives, background of the IRP, the facility and the site, and report organization.

2.0 ENVIRONMENTAL SETTING - Describes the regional and facility hydrogeological setting and climate.

3.0 PROJECT ACTIVITIES AND METHODOLOGIES - Discusses the purpose of the field activities, outlines the field activities and methodologies, and describes the laboratory analyses and data acquisition activities.

4.0 INVESTIGATIVE RESULTS - Discusses the results of the investigation for the POL Tank Farm and the Unnamed Stream and describes the extent of contamination detected.

5.0 COMPARISON OF ANALYTICAL DATA WITH REGULATORY STANDARDS - Discusses regulatory background, exposure assessment, the comparison of site concentrations detected to risk reduction standards, and summary and conclusions.

6.0 CONCLUSIONS AND RECOMMENDATIONS - Provides a summary of conclusions and recommendations with respect to the environmental conditions based on information obtained from this RFI.

2.0 ENVIRONMENTAL SETTING

The following discussion of the NAS Fort Worth environmental setting is derived primarily from the Installation Restoration Program (IRP) Phase I Records Search Report (CH2M Hill, 1984). Information from that report is supplemented by information from the literature and from the general findings of studies conducted by the U.S. Army Corps of Engineers (USACE, 1991) and Radian Corporation (Radian, 1986; 1991a).

2.1 REGIONAL SETTING

2.1.1 Physiography

The majority of NAS Fort Worth is located within the Grand Prairie section of the Central Lowlands Physiographic Province. This area is characterized by broad terraces sloping gently to the east, divided by westward-facing escarpments. The land is typically grass covered and treeless, except for isolated stands of upland timber. The northwestern portion of NAS Fort Worth is within the Western Cross Timbers Physiographic Province which is characterized by rolling topography and a heavy growth of post and blackjack oaks (USACE, 1991).

2.1.2 Regional Hydrogeologic Setting

The following section summarizes the hydrogeologic aspects of the study area which influence the environment at NAS Fort Worth.

2.1.2.1 Geomorphology - The topography of the installation is fairly flat except for areas near Farmers Branch and the Trinity River. The

land surface slopes gently northeast toward Lake Worth and east toward the West Fork of the Trinity River. Elevations range from a high of approximately 690 feet above mean sea level (msl) near the southwest corner of the installation to a low of approximately 550 feet above msl near the east side of the installation. The elevation of Lake Worth usually approximates the elevation of the dam spillway, 594 feet above msl (USACE, 1991).

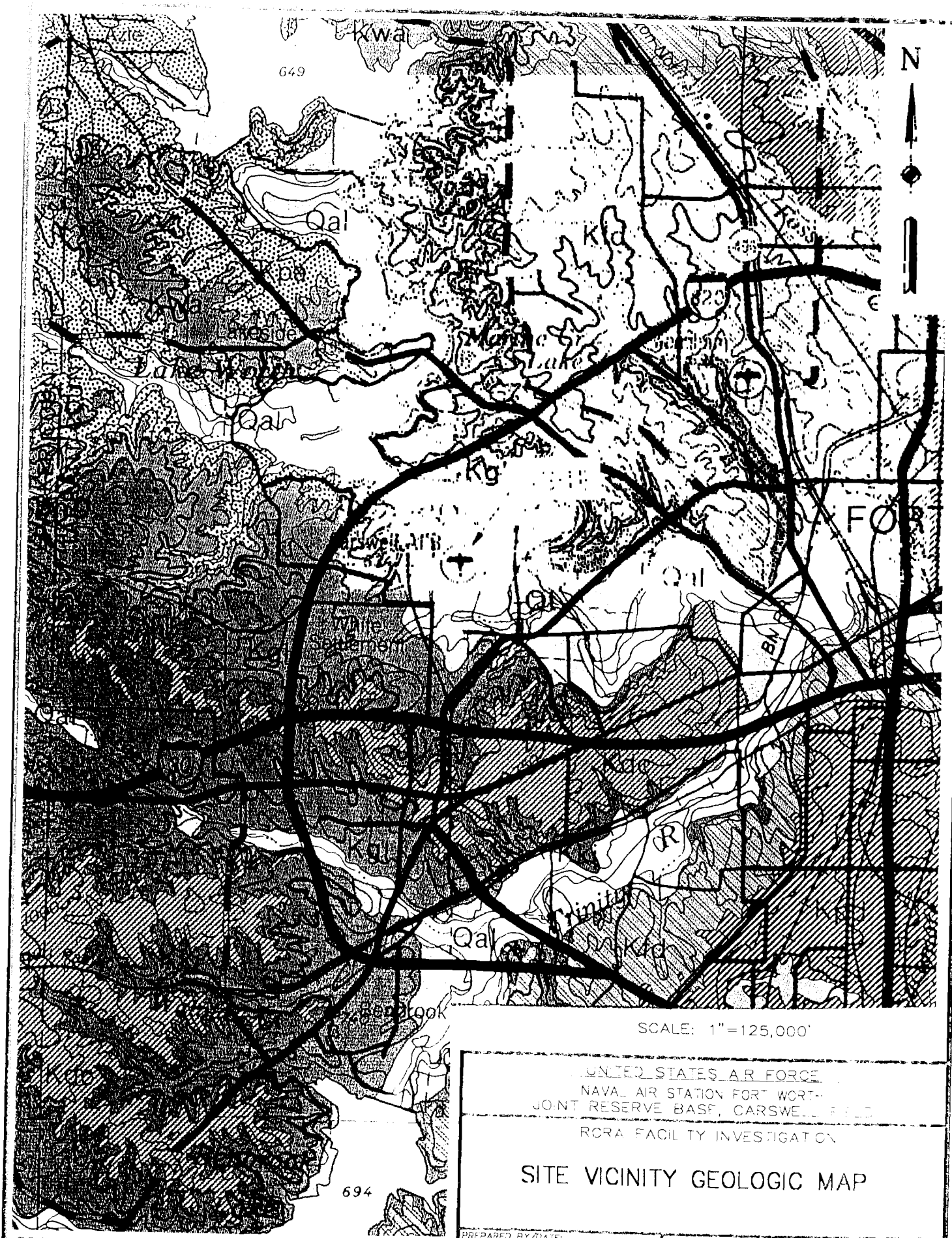
The principal drainage feature for NAS Fort Worth is the West Fork of the Trinity River. Farmers Branch drains the southern portion of the installation and discharges into the Trinity River. A small portion of the north end of the base drains into Lake Worth (USACE, 1991).

2.1.2.2 Stratigraphy - The geology of NAS Fort Worth can be characterized as a blanket of Quaternary clastic units overlying Cretaceous bedrock. From youngest to oldest, the geologic units of interest are as follows:

- Quaternary Alluvium/Terrace Deposits
- Cretaceous Goodland Limestone
- Cretaceous Walnut Formation
- Cretaceous Paluxy Formation
- Cretaceous Glen Rose Formation
- Cretaceous Twin Mountains Formation

The areas where these units outcrop in the area of NAS Fort Worth are shown on Figures 2-1 and 2-2.

NAS Fort Worth is located on the relatively stable Texas shelf, west of the faulting associated with the Ouachita Structural Belt. No major faults or fracture zones have been mapped near the base. The regional dip of the rocks at NAS Fort Worth ranges from 35 and 40 feet per mile in an easterly to southeasterly direction.



SCALE: 1"=125,000'

SOURCE: GEOLOGIC ATLAS OF TEXAS, DALLAS SHEET 1987, BUREAU OF ECONOMICS GEOLOGY, THE UNIVERSITY OF TEXAS – AUSTIN, TEXAS

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
RCRA FACILITY INVESTIGATION

SITE VICINITY GEOLOGIC MAP

PREPARED BY/DATE: TDM 22.SEPT.95	FIGURE NUMBER 2-1	FILE DATE: 22.SEPT.95	
CHECKED BY/DATE: TDM 22.SEPT.95		PLOT DATE: 22.SEPT.95	
PROJECT NO: 113517-0111		FILE NAME: sitvic.dwg	

LEGEND

QUATERNARY

Pleistocene Holocene

Qal | Qu

Alluvium and Quaternary deposits undivided

Qt

Fluviatile terrace deposits

Lower Cretaceous

Kpa Kwa Kdc

Pawpaw Formation, Weno Limestone, Denton Clay, Fort Worth Limestone, and Duck Creek Formation

Kkm

Kiamichi Formation

Kec Kgl

Edwards Limestone, Comanche Peak Limestone, and Goodland Limestone

Kwa

Walnut Clay

Kpa

Paluxy Sand

Kgr

Glen Rose Formation

Ktm

Twin Mountains Formation

SOURCE: GEOLOGIC ATLAS OF TEXAS, DALLAS SHEET 1987, BUREAU OF ECONOMICS GEOLOGY, THE UNIVERSITY OF TEXAS – AUSTIN, TEXAS

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD

RCRA FACILITY INVESTIGATION

GEOLGIC MAP LEGEND

PREPARED BY/DATE: TDM 22.SEPT.95	FIGURE NUMBER: 2-2	FILE DATE: 22.SEPT.95
CHECKED BY/DATE: TDM 22.SEPT.95		PLOT DATE: 22.SEPT.95
PROJECT NO: 113517-0111		FILE NAME: sitvic.dwg

2.1.2.3 Soils - The U.S. Department of Agriculture (USDA) Soil Conservation Service has identified four near-surface soil associations on or near NAS Fort Worth. The soils are described in Table 2-1 and their occurrences on the installation are shown on Figure 2-3. The surficial soils of the installation are primarily nearly level to gently sloping clayey soils of the Sanger-Purves-Slidell and Aledo-Bolar-Sanger Associations. Less widely distributed are the clayey soils of the Frio-Trinity Association and the loamy soils of the Bastil-Silawa Association which occur on the floodplain and stream terraces of the West Fork of the Trinity River (USACE, 1991).

2.1.3 Ground Water

Five hydrogeologic units have been identified at NAS Fort Worth. These units, listed from most shallow to deepest, are as follows:

- An upper perched-water zone occupying the alluvial terrace deposits of the Trinity River
- An aquitard consisting of predominantly unsaturated limestone of the Goodland and Walnut Formations
- The Paluxy Aquifer
- An aquitard of relatively impermeable limestone in the Glen Rose Formation
- A major aquifer in the sandstone of the Twin Mountains Formation

Upper Zone - Perched ground water occurs in lenses within the coarse alluvial sand and gravel deposits along the Trinity River. These lenses are limited in lateral extent and are surrounded by low-

TABLE 2-1

SOIL CHARACTERISTICS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

Association	Description	Texture	Thickness	Permeability
Sanger-Purves-Slidell	Clayey soils of nearly level to gently sloping uplands	Clay loam Clay over bedrock Silty clay	8-80 inches	4.2×10^{-5} to 3×10^{-4} cm/sec
Aledo-Bolar-Sanger	Loamy and clayey soils of gently sloping to moderately steep uplands	Clay loam over bedrock Clay loam	8-70 inches	$<4.2 \times 10^{-5}$ to 9×10^{-4} cm/sec
Frio-Trinity	Clayey soil on nearly level floodplains	Silty clay loam Clay	25-75 inches	$<4.2 \times 10^{-5}$ to 3×10^{-4} cm/sec
Bastil-Silawa	Loamy soils on nearly level to sloping stream terraces	Sandy clay loam	40-80 inches	9×10^{-4} to 3×10^{-3} cm/sec

Source: U.S. Department of Agriculture, Soil Conservation Service, 1981

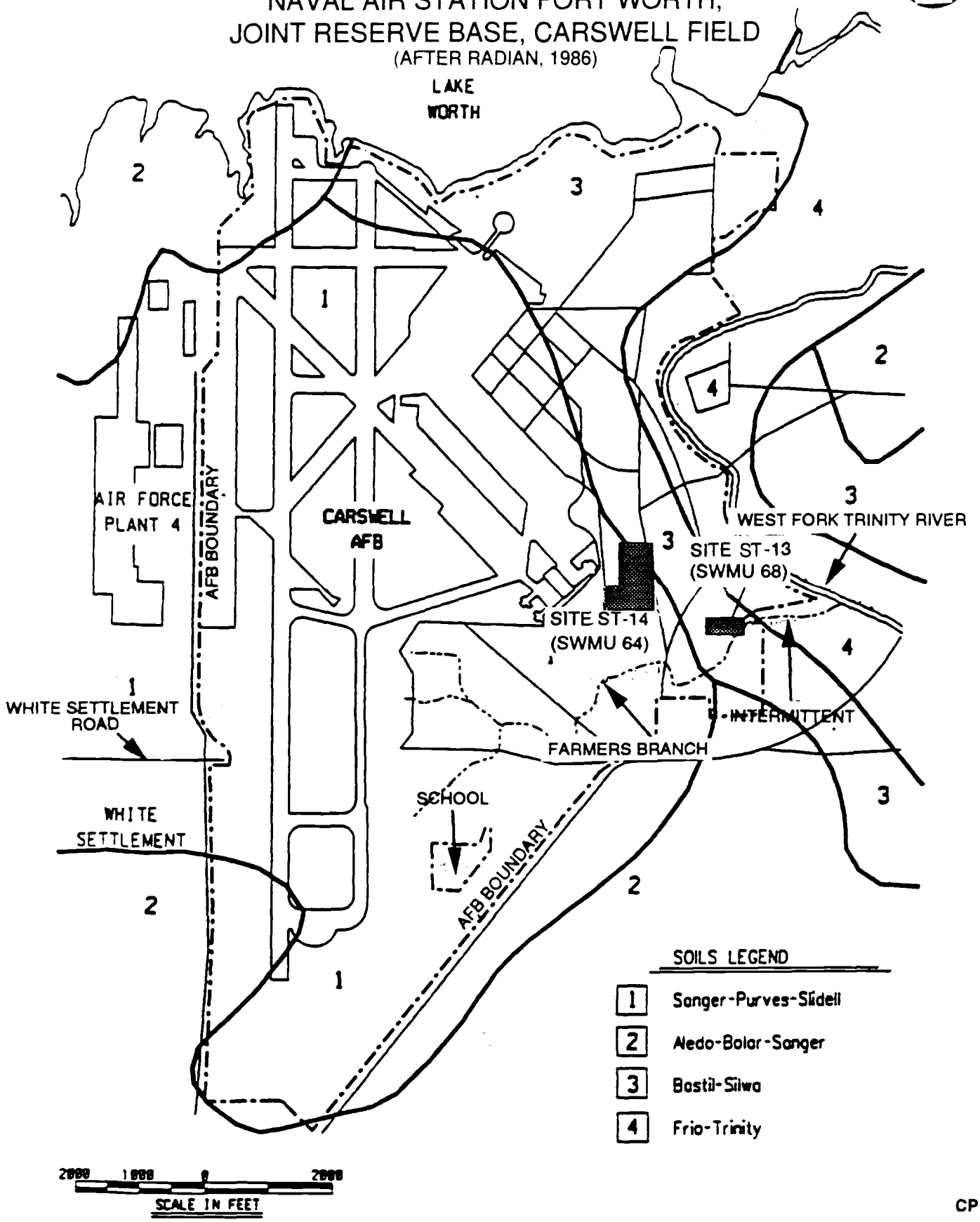
PREPARED/DATE: TM 11/10/94
CHECKED/DATE: JFO

FIGURE 2-3

SOILS ASSOCIATION MAP

NAVAL AIR STATION FORT WORTH, JOINT RESERVE BASE, CARSWELL FIELD

(AFTER RADIAN, 1986)



permeability clays and silts. Ground water in the upper zone occurs at depths ranging from 7 to 13 feet. Annual ground-water table fluctuations are typically on the order of 5 feet (USGS, 1993). Recharge to the water-bearing deposits is from rainfall and infiltration in stream channels and drainage ditches.

In parts of Tarrant County near the Trinity River, the upper zone is developed for irrigation and residential use. The community of River Oaks, immediately east of NAS Fort Worth, formerly utilized supply wells developed in alluvial deposits at a location near the former Carswell AFB hospital. The wells were abandoned when Carswell AFB purchased the property for hospital construction. In general, ground water in the upper zone is not economical to develop due to the zone's limited distribution and susceptibility to surface/storm-water pollution (USACE, 1991).

Goodland/Walnut Aquitard - The perched water present in the alluvium is separated from the underlying aquifers by the low permeability limestone and shale of the Goodland Limestone and Walnut Formations. The aquitard consists of moist clay and shale layers interbedded with dry limestone beds. Although the Walnut Formation is primarily dry, drillers in the area have reported small amounts of water in the Walnut Formation, suggesting that ground water may move through the Walnut along bedding planes. A previous soil boring at Air Force Plant 4, immediately west of NAS Fort Worth, indicated that the Goodland Limestone had been completely eroded and only 3 feet of the Walnut Formation was present. It has also been reported that the upper zone and Paluxy formation are in contact at the eastern boundary of Air Force Plant 4, where both the Goodland and Walnut formations have been removed by erosion. In areas of similar erosion, water in the upper zone could come in contact with water in the Paluxy aquifer (USACE, 1991).

Paluxy Aquifer - The Paluxy aquifer is the shallowest bedrock aquifer beneath NAS Fort Worth. Water in the Paluxy normally occurs under

confined conditions beneath the Goodland/Walnut aquitard except where the aquitard is absent due to erosion. The Paluxy Formation is divided into upper and lower sand members and the aquifer is likewise divided into upper and lower aquifers. The upper sand is fine-grained and shaley while the lower sand is coarser; therefore, most wells are completed in the lower section (USACE, 1991).

The Paluxy aquifer is recharged along outcrops west of NAS Fort Worth. Paluxy outcroppings also occur north of the base in the bed of Lake Worth. The lake bed represents a significant recharge source for the aquifer and creates a localized potentiometric high. Regional ground-water flow within the Paluxy is eastward, parallel to regional dip. Ground-water flow at NAS Fort Worth is influenced by the Lake Worth potentiometric high and by a potentiometric low induced by ground-water withdrawals by the community of White Settlement. This produces a generally southeasterly flow direction (USACE, 1991).

Transmissivities in the Paluxy aquifer range from 1,263 to 13,808 gallons per day per foot (gpd/ft), with an average of 3,700 gpd/ft. In Tarrant County, the Paluxy Formation ranges in thickness from 140 to 190 feet, with an average thickness of 160 feet. The actual water-bearing thickness in the NAS Fort Worth area probably approximates the formation thickness, but the aquifer is separated into two distinct water-bearing zones. In the vicinity of NAS Fort Worth, permeabilities range from 13 to 140 gpd/ft^2 (based on an approximate thickness for the aquifer of 100 feet). Well yields from the Paluxy aquifer range from 10 to 480 gallons per minute (gpm) averaging approximately 100 gpm (USACE, 1991).

The Paluxy aquifer represents a significant source of potable ground water in the Fort Worth area. Communities adjacent to NAS Fort Worth, especially White Settlement, develop municipal water supplies from the Paluxy, as well as from the deeper Twin Mountains aquifer.

As a result of extensive pumping, water levels in the Paluxy aquifer have declined significantly over the past several years. Water levels in the immediate NAS Fort Worth vicinity have not lowered to the same degree as in the Fort Worth area because the base does not produce water from the Paluxy (USACE, 1991).

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 varies from 250 to 450 feet. Although the sands in the Glen Rose Formation yield small supplies to wells in Fort Worth and western Tarrant County, the relatively impermeable limestone behaves as an aquitard, restricting water movement between the overlying Paluxy aquifer and the underlying Twin Mountains aquifer (USACE, 1991).

Twin Mountains Aquifer - The Twin Mountains Formation is the oldest formation used for water supply in the NAS Fort Worth area. The formation consists of a basal conglomerate of chert and quartz, grading upward into coarse to fine grained sand interbedded with shale. The formation varies in thickness from 250 to 430 feet. The Twin Mountains aquifer is recharged along outcrops west of NAS Fort Worth. Water movement is eastward in the direction of regional dip. Like water in the Paluxy aquifer, the Twin Mountains aquifer occurs under unconfined conditions in the recharge area, becoming progressively more confined in the downdip direction (USACE, 1991).

The Twin Mountains aquifer is the principal aquifer in Tarrant County and yields large water supplies for municipal (including human consumptive) and industrial purposes. In Tarrant County, transmissivities in the Twin Mountains aquifer range from 1,950 to 29,700 gpd/ft, with an average of 8,450 gpd/ft. Permeabilities range from 8 to 165 gpd/ft^2, with an averaging 68 gpd/ft^2 (USACE, 1991).

Ground-water withdrawals from the Twin Mountains aquifer, primarily for municipal water supply, have resulted in declining water levels. Between 1955 and 1976, the potentiometric surface of the aquifer dropped approximately 250 feet. Water quality in the Twin Mountains aquifer is acceptable for potable use throughout the Fort Worth area (USACE, 1991).

2.1.4 Surface Water

NAS Fort Worth is located within the Trinity River Basin immediately south of Lake Worth, a man-made reservoir on the Trinity River. A portion of the installation is drained by Farmers Branch, which discharges into the West Fork of the Trinity River just south of the cantonment area. Farmers Branch begins near the community of White Settlement and flows eastward. Immediately south of Air Force Plant 4, Farmers Branch flows under the runway through two large culverts (USACE, 1991).

Most of the installation's surface drainage is diverted through a series of storm drains and culverts. The water is in turn directed to oil/water separators and discharged to the West Fork downstream of Lake Worth. A small portion of the north end of the installation drains directly into Lake Worth.

2.2 NAS FORT WORTH HYDROGEOLOGIC SETTING

This section summarizes the general site setting of NAS Fort Worth, including the POL Tank Farm Area and Unnamed Stream Area.

2.2.1 Geology

The majority of the base is covered by Quaternary terrace deposits of the Trinity River (Figures 2-1 and 2-2). The terrace deposits are composed of sand, silt, clay, and gravels of variable thickness and

lateral extent. These deposits are underlain by Cretaceous limestones. The uppermost limestone formation in the southeastern portion of the base is the Goodland Formation. The Goodland Limestone is a chalky white fossiliferous limestone and marl. The Goodland Limestone outcrops approximately 200 feet east of the 1337 Storage Yard in Farmers Branch. Beneath the Goodland Limestone is the Walnut Formation, a coquinoidal limestone with variable quantities of clay and shale. Underlying the Walnut Formation is the Paluxy Formation, a fine- to coarse-grained sand with minimal quantities of clay, sandy clay, pyrite, lignite, and shale. The regional dip of the rocks in the vicinity of NAS Fort Worth ranges from 35 to 40 feet per mile to the east and southeast.

2.2.2 Hydrogeology

The three uppermost hydrogeological units identified at NAS Fort Worth are as follows:

- A perched water zone occupying the Quaternary terrace deposits of the Trinity River
- An aquitard consisting of predominantly unsaturated limestone of the Goodland Limestone and Walnut Creek Formations
- The Paluxy Aquifer

The Quaternary terrace deposits which form the perched-water zone are composed of sand, silt, clay, and gravel. Ground water is first encountered within the perched-water zone at depths ranging from approximately 5 to 15 feet below the ground surface. Annual ground-water fluctuations are typically on the order of 5 feet. Recharge to the perched-water zone is from rainfall and infiltration from stream channels and drainage ditches.

The perched-water zone in the Quaternary terrace deposits is separated from the underlying aquifers by the low-permeability limestone and shale of the Goodland Limestone and Walnut Formation. The thickness of the Goodland Limestone and Walnut Formation is approximately 25 feet or greater beneath most of the base. However, the tops of the formations are erosional surfaces and weathering may locally reduce the thickness of the formations. In areas of greater erosion, the Quaternary alluvium may be in contact with the Paluxy Formation.

The Paluxy Formation forms the shallowest bedrock aquifer beneath NAS Fort Worth. Ground water within the Paluxy Formation normally occurs under confined conditions beneath the aquitard of the Goodland Limestone and Walnut Formation, at depths of approximately 100 feet below ground surface (450 feet above mean sea level) along the eastern portion of the base. Extensive pumping of ground water in the Fort Worth area has lowered the potentiometric surface within the Paluxy Aquifer beneath the top of the formation, resulting in unconfined conditions of the aquifer in the area of NAS Fort Worth.

2.3 CLIMATOLOGY

NAS Fort Worth is located at approximately 33 degrees north latitude. The climate is humid subtropical with hot summers and dry winters. Tropical maritime air masses control the weather during much of the year; however, the passage of polar cold fronts and continental air masses create large variations in winter temperatures (USACE, 1991).

The average annual temperature for NAS Fort Worth is 66 degrees Fahrenheit and monthly mean temperatures vary from 45 degrees Fahrenheit in January to 86 degrees Fahrenheit in July (Table 2-2). The average daily minimum temperature in January is 35 degrees Fahrenheit, and the lowest recorded temperature is 2 degrees Fahrenheit. The average daily maximum temperature in July and August

3.0 PROJECT ACTIVITIES AND METHODOLOGIES

3.1 PURPOSE OF FIELD ACTIVITIES

The field activities described below were intended to improve site characterizations that would ultimately lead to remediation of the sites. The purpose of this RCRA Facility Investigation (RFI) was to collect assessment data from soil, surface water, sediment, and ground water at two sites on the base.

The primary objectives of the field work were as follows:

- Add to the data base at each site
- Improve understanding of spatial distribution of contaminants
- Improve understanding of contaminant migration
- Assess variations in shallow subsurface stratigraphy

3.2 FIELD ACTIVITIES AND METHODOLOGIES

The following sections describe the field activities and the methodologies used during the RFI. The field activities included field screening, soil boring and soil sampling, monitoring well installation and ground-water sampling, and surface-water and sediment sampling.

3.2.1 Field Screening Program

The field screening program included geophysical surveys of the Petroleum, Oils, and Lubricants (POL) Tank Farm Area and the

Abandoned Gasoline Station. Following the geophysical surveys, ground-water screening was conducted in the area of the POL Tank Farm.

3.2.1.1 Geophysical Survey - The objective of the geophysical surveys was to assess if steel underground storage tanks (USTs) are located in the vicinity of the Abandoned Gasoline Station and to locate metallic utilities prior to the soil and ground-water assessments.

Three geophysical instruments were used a Gem Systems GSM-19 magnetometer, a Geonics EM61 high-sensitivity metal detector, and a Metrotech pipe and cable locator. These instruments were chosen for their ability to detect shallow buried metallic objects. Multiple techniques were used to better resolve detected zones of buried metal. The GSM-19 magnetometer can detect buried ferromagnetic objects at varying depths depending on several factors such as survey orientation, target shape, target mass, and target composition. The EM61 can detect buried metallic objects in the upper 5 to 10 feet of the subsurface depending on the target's size and shape. The pipe and cable locator is useful for mapping near-surface utilities.

Geophysical surveys were conducted on March 7 and 8, 1994, at the Abandoned Gasoline Station and the POL Tank Farm Area. This section describes the general geophysical survey methods common to both sites and specific details and survey spacing for each site.

3.2.1.1.1 Geophysical Equipment - The magnetometer surveys were conducted using a GEM Systems GSM-19G magnetic gradiometer. The instrument measures and records the total magnetic field intensity, vertical magnetic gradient, time, and geophysical survey grid coordinates at each station. A base station away from anomalous

magnetic fields was periodically visited during each survey to allow detection of magnetic field drift and magnetic storms.

Other surveys were conducted using a Geonics EM61 high-sensitivity metal detector. The EM61 is a time-domain electromagnetic (EM) device that measures the decay in an induced secondary EM field with two sensors. The digital data recorder stores the two channels of data and the geophysics survey grid coordinates. Functionality checks of the EM61 were performed daily.

A pipe and cable locator was used at the Abandoned Gasoline Station site to trace underground pipes or cables by energizing exposed pipes.

3.2.1.1.2 Geophysical Survey of Abandoned Gasoline Station Site - Geophysical surveys were conducted at the Abandoned Gasoline Station Site in order to assess if steel USTs were located in the vicinity of the former station. An area approximately 210 feet by 280 feet was gridded using fiberglass measuring tapes and spray paint. An outline of the geophysical survey area is shown on Figure 3-1.

The magnetometer survey was conducted along north-south trending traverses spaced about 10 feet apart with a reading taken every 10 feet along each traverse. Approximately 5,800 linear feet of magnetic data were collected with a total of 582 data points.

The EM61 survey was conducted along north-south trending traverses spaced about 10 feet apart with readings taken less than a foot apart along each traverse. EM61 data were also collected along several east-west trending cross traverses. About 11,000 linear feet of EM61 data were collected with a total of about 16,000 data points.

FILE: CARSWELL/ .NOM DATE:04/01/94

269 N14

STREET

A

B

TRANSFORMER

LIGHT POLE

POLE

POLE

SD13-02

POLE

MANHOLE

GATE

CONCRETE PAD

PUMP ISLAND

POLE

SD13-04

POLE

POLE

POLE

SD13-03

SD13-01

SUBSTATION
&
TRANSFORMERS

REBAR

LEGEND

INTERPRETED ZONES OF BURIED METAL

INTERPRETED BURIED PIPE OR CABLE

SD13-01 MONITORING WELL

UTILITY POLE AND GUY WIRE

OVERHEAD LINE

CYCLONE FENCE

LIMITS OF GEOPHYSICAL SURVEY

0 30 60

APPROXIMATE SCALE IN FEET

NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

INTERPRETATION OF GEOPHYSICAL ANOMALIES ABANDONED SERVICE STATION SITE

JOB NO. 11-3517-0111 FIGURE 3-1

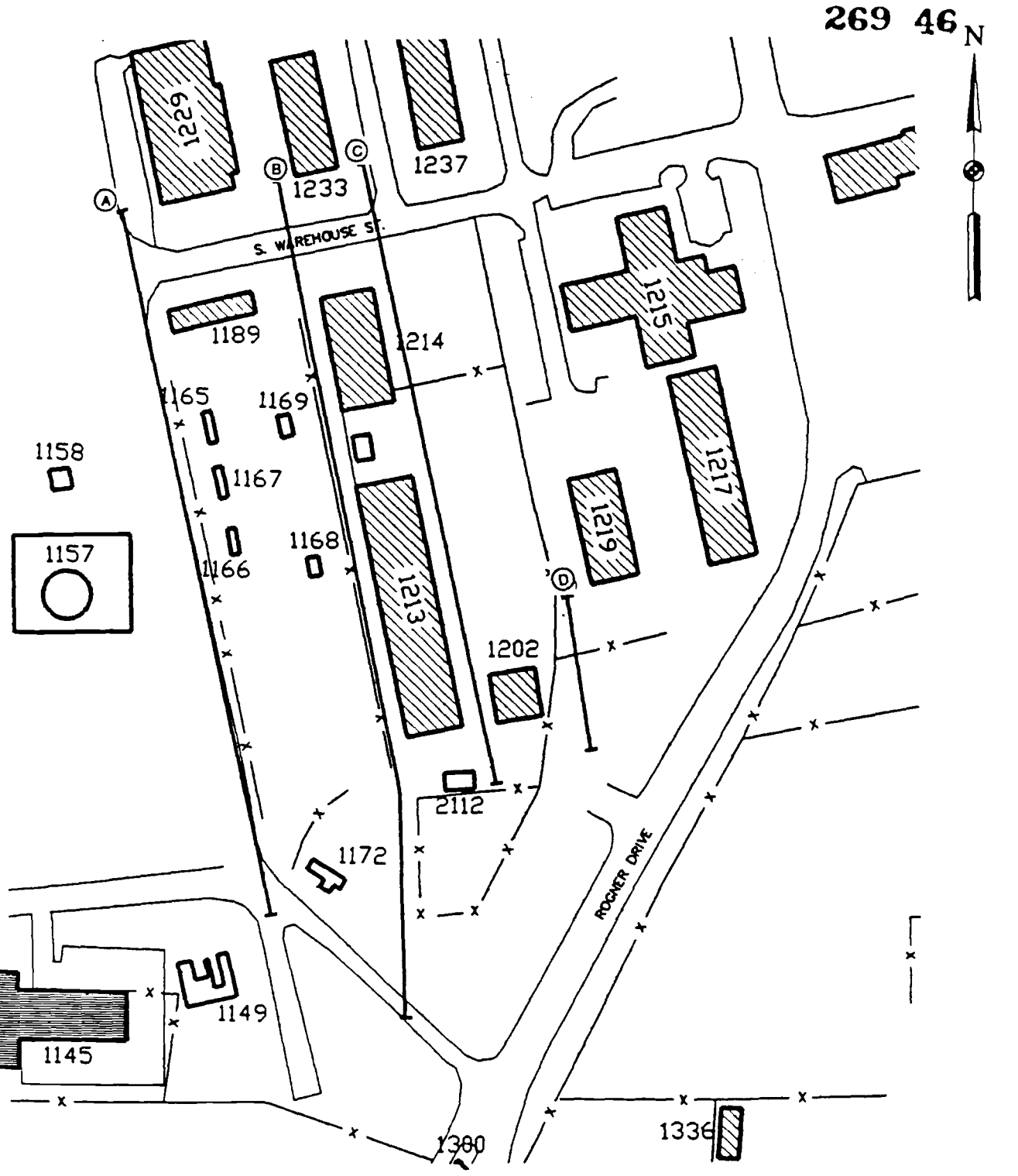
The pipe and cable locator was used to partially follow the path of pipes from where they protruded from the concrete pump island. This instrument was used in the conductive mode where the pipes were directly energized with electric current.

3.2.1.1.3 Geophysical Survey of POL Tank Farm Area - Geophysical surveys were conducted in the POL Tank Farm Area to detect buried metallic utilities that might interfere with the ground-water survey. EM61 surveys were conducted along four traverses in the POL Tank Farm Area where ground-water survey points were scheduled to be performed. The four north-south trending traverses were laid out using fiberglass measuring tapes and a painted dot every 100 feet. The approximate locations of the EM61 survey lines are shown on Figure 3-2.

3.2.1.2 Ground-Water Screening - The scope of services prepared by AFCEE in Delivery Order 0011 included the collection and analysis of up to 25 ground-water samples in the area of the POL Tank Farm to assess the extent of total lead and petroleum constituents in the ground water. On March 8, 1994, LAW personnel prepared a sample grid in the POL Tank Farm Area. The sample grid included 33 potential sample points located along four grid lines (Figure 3-2). The proposed sample points were marked on the ground with spray paint and/or wooden stakes to allow utility clearance. The proposed ground-water screening sample points were surveyed using a Geonics EM61 high-sensitivity metal detector to assist in the location of underground utilities and other potential obstructions.

From March 21 to March 24, 1994, 22 ground-water screening samples were collected by Transglobal Environmental Geochemistry (TEG) from locations in the POL Tank Farm Area. Initially, the area of investigation was confined to the area between Knights Lake Road (recently renamed Desert Storm Drive) and Building 1219. The sample grid consisted of four grid lines: A 0+00 through A 9+00, B

269 46



LEGEND

(A) EM61 TRAVERSE

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH,
JOINT RESERVE BASE, CARSWELL FIELD

LOCATION OF EM61 TRAVERSES – POL AREA

PREPARED BY: TDM 9/15/95	FIGURE NUMBER: 3-2	FILE DATE:	
CHECKED BY: TDM 9/15/95		PLOT DATE:	
APPROVED BY:		FILE NAME: CP	

0+00 through B 8+00, C 0+00 through C 10+00, and D 0+00 through D 2+00 (Figure 3-2). On the first day of the ground-water screening, petroleum constituents were detected on the perimeter of the study area. With the consent of the Air Force Center for Environmental Excellence (AFCEE), additional ground-water screening locations (E 0+10 through E 6+00, and F3+00) were located east of Rogner Drive, extending from the Building 1320 to the Abandoned Gasoline Station (Figure 3-3).

Ground-water samples were collected by TEG using a disposable tip, screen and tubing. A length of screen approximately 6 inches long was attached to the tubing and was then inserted into a hollow-stem steel rod. A disposable tip was installed on the end of the rod, and the rod was pushed into the ground using a truck-mounted hydraulic ram. Based on the depth to ground water measured in nearby monitoring wells, the screen was set at approximately 12 to 15 feet below the ground surface. Upon reaching the termination depth, the hollow stem steel rod was removed. The ground-water samples were then drawn to the surface using a peristaltic pump. The ground-water samples were placed into appropriate laboratory supplied sample containers and transported to the on-site laboratory for analysis. The results for the ground-water screening are included in Appendix A.

New sampling tubing and screens were used for each sample location. The steel rods were decontaminated prior to advancing to each sample location. Following collection of the ground-water samples, the tubing was removed from the ground, and the borehole was grouted to the ground surface. In paved areas, the pavement was patched with concrete.

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

GROUND–WATER SCREENING SAMPLING GRID

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:		FILE DATE:	10.OCT.94
CHECKED:	9 Oct 95	PLOT DATE:	02.OCT.95
PROJECT NO.	11-3517-0111	FILE NAME:	PETGRID1.DWG

FIGURE NUMBER: **3-3**

SCALE IN FEET

0 200 400

NOTE: GROUND–WATER SAMPLES COLLECTED IN MARCH/APRIL 1994.

PREVIOUS LOCATION OF RAILROAD

IRP SITE LOCATIONS BASED ON DEPARTMENT OF THE AIR FORCE MASTER PLAN IRP SITES–SOIL CONTAMINATION CARSWELL AFB, FORT WORTH, TEXAS. REVISED 1985

E-5+00 GROUND–WATER SAMPLE GRID LOCATION (APPROXIMATE)

SD13-06 GROUND–WATER MONITORING WELL

LEGEND

N

FARMERS BRANCH

UNNAMED STREAM

SD13-07 SD13-06 OT12-15C OT12-15B SD13-04 SD13-03 SD13-01 SD13-02

E-6+00 E-5+00 E-4+00 E-3+00 E-2+10 E-1+10 E-0+10 F-3+00

ROGNER DRIVE

D-2+00 D-1+00 D-0+00 C-8+00 C-7+00 C-6+00 C-5+00 C-4+00 C-3+00 C-2+00 C-1+00 C-0+00 B-10+00 B-9+00 B-8+00 B-7+00 B-6+00 B-5+00 B-4+00 B-3+00 B-2+00 B-1+00 B-0+00 A-9+00 A-8+00 A-7+00 A-6+00 A-5+00 A-4+00 A-3+00 A-2+00 A-1+00 A-0+00

KNIGHTS LAKE ROAD

POL TANK FARM

269 48

3.2.2 Soil Program

This section describes the procedures used to advance soil borings and to sample soil from the borings installed in the Unnamed Stream Area.

3.2.2.1 Soil Borings - The soil borings in the Unnamed Stream Area were advanced following procedures outlined in the AFCEE-approved project work plans (LAW, 1994a, 1994b). Soil boring procedures included advancing soil borings with 6.25-inch inner diameter (ID) augers and continuous sample collection using a 3-inch ID split spoon sampler with California Brass Rings. LAW and AFCEE agreed to pushing the split spoon sampler with the California Brass Rings directly into the soil. Because the split spoon sampler was pushed into the soil, standard penetration tests (SPT) were not conducted.

On March 24 and 25, 1994, three soil borings (SD13-05, SD13-06, and SD13-07) were installed. Each boring was advanced to auger refusal at depths ranging from 11.5 feet below the ground surface (SD13-06) to 20 feet below the ground surface (SD13-07). The soil boring operations were observed by an on-site geologist. The geologist logged the subsurface conditions encountered in the borings and recorded the information on soil boring logs (Appendix B). The soils were classified using the Unified Soil Classification System (ASTM D2488-69).

3.2.2.2 Soil Sampling and Analysis - In each soil boring, a decontaminated split spoon sampler was advanced 2 feet. The split spoon sampler was then removed from the boring, placed on aluminum foil, and opened. The brass rings were spaced approximately 2 inches apart and initial photoionization detector (PID) readings were obtained from between each brass ring. The soils encountered were logged by the on-site geologist, the upper most brass ring was

removed, and the remaining brass rings were wrapped in aluminum foil and allowed to equilibrate at atmospheric conditions for approximately 15 minutes. After allowing the soil samples to equilibrate, a second set of PID readings was obtained. Following the field screening, the brass rings were sealed with a Teflon liner and a plastic cap encased the soil in the brass rings. The sampling activities were repeated at each boring location until saturated soils were encountered or refusal was reached.

Typically two sets of soil samples were retained from each soil boring for chemical analyses. The soil samples retained included the sample interval with the highest PID reading and the deepest soil sample collected.

For each of the soil samples retained for laboratory analyses, the middle 6-inch brass ring was sent to the laboratory for volatile organic analysis. Soil from the remaining two brass rings was removed from the brass rings and placed into a stainless steel mixing bowl, thoroughly mixed with a stainless steel spoon, and placed into the appropriate laboratory sample containers.

The soil samples were transported under chain-of-custody protocol via overnight courier to Law Environmental National Laboratories in Pensacola, Florida. The soil samples were analyzed for metals by EPA Method SW3050/SW6010 and for volatile organic compounds by EPA Method SW8240. Additional information on the laboratory methodology is presented in Section 3.3. The results of the laboratory analyses are presented in Section 4.0 and Appendix F.

3.2.3 Ground-Water Program

This section describes the procedures used for the installation of ground-water monitoring wells and for the collection of ground-water samples from the monitoring wells in the vicinity of the Unnamed Stream Area.

3.2.3.1 Monitoring Well Installation - Three monitoring wells were installed in the vicinity of the Unnamed Stream. The monitoring wells included: SD13-05, the upgradient monitoring well located between the Building 1330 and Rogner Drive (Figure 3-4); SD13-06, a downgradient monitoring well located adjacent to the oil/water separator at the Unnamed Stream; and SD13-07, a downgradient monitoring well located between the Unnamed Stream and Farmers Branch.

The monitoring wells were installed with the screened interval intersecting the surface of the ground water. All monitoring well surface casings and riser pipes consisted of new, 4-inch ID, threaded, flush-joint, Schedule 40 polyvinyl chloride (PVC) conforming to ASTM F480-88A standards. Each section was joined by threaded flush joint couplings to form watertight seals. Neither organic solvents nor glue was used in joining the pipe. All well screens consisted of new, threaded, flush joint, 0.010-inch factory slotted, 4-inch PVC. A threaded PVC plug was provided for the bottom of the well.

The screen and riser pipe were installed through the hollow stem augers. The pipe was centered and suspended prior to placing the filter pack. Sand for the filter pack consisted of clean, inert, 10/20 silica sand. The sand was tremied into the annular space between the well casing and the hollow stem augers using a tremie pipe to a minimum of 2 feet above the top of the screened interval. The sand was continuously tamped to prevent bridging. The depth of the sand pack and the amount of sand used was monitored during well installation. After the filter pack was installed, monitoring wells SD13-05 and SD13-07 were surged for a minimum of 10 minutes with a surge block. The depth to the sand pack was remeasured and additional sand was added to bring the level of the sand back up to 2 feet above the screened interval. The wells were then surged for an additional 5 minutes and sand was again added. The process was repeated until the depth to the sand pack stabilized at 2 feet

269 52

ROGNER DRIVE

SD13–05
562.23

SD13–02
558.17

SD13–01
560.16

SD13–03
559.58

SD13–04
558.97

OT12–15B
559.46

OT12–15C
559.44

SD13–06
546.30

SD13–07
539.06

560
558
556
554
552
550
548
546
544
542
540

ABANDONED GASOLINE STATION

FARMERS BRANCH

UNNAMED STREAM

N

LAYER/LEVEL
P01494

LEGEND

544 — POTENTIOMETRIC LINE

SD13–05 — MONITORING WELLS INSTALLED BY LAW, MARCH 1994

SD13–02
558.17 — MONITORING WELLS INSTALLED BY OTHERS
MEASURED ELEVATION OF GROUND–WATER ON APRIL 18, 1994

GROUND–WATER FLOW DIRECTION

0 100 200
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

LOCATION OF GROUND–WATER MONITORING WELLS AND SURFACE WATER/SEDIMENT SAMPLES – UNNAMED STREAM AND ABANDONED GASOLINE STATION

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 3–4	FILE DATE: 10.OCT.94
CHECKED BY: 30CT95		PLOT DATE: 02.OCT.95
PROJECT NO. 11–3517–0111		FILE NAME: POT41894.DWG

above the screened interval. Monitoring well SD13-06 was not surged with a surge block because the height of the water column within the monitoring well was less than 2 feet.

A bentonite seal was placed in the annular space above the filter pack and was allowed to hydrate for approximately 24 hours prior to grouting to prevent the intrusion of grout into the filter pack. Because of the location of the ground-water surface, the thickness of the bentonite seal varied, as follows: 3 feet in monitoring well SD13-07; 2.22 feet in monitoring well SD13-06; and 1.32 feet in monitoring well SD13-05. A cement grout was placed in the annular space between the well casing and the boring from the top of the bentonite seal to the ground surface. The grout mixture consisted of Portland cement and 5 to 7 gallons of water per 94-pound bag of cement. Additionally, 3 percent by weight of bentonite powder was added to the mixture to reduce shrinkage.

Upon completion of the monitoring well, a vented cap was installed to prevent material from entering the well. Monitoring well SD13-05 was completed with a flush-mounted, traffic-rated well vault. For monitoring well SD13-06 and SD13-07, the PVC riser was protected by a locking steel casing extending 24 to 36 inches above the ground surface. A 3-foot square, 4-inch thick concrete pad, sloped away from the monitoring well, was installed around each monitoring well. The above grade monitoring wells were protected by 3-inch diameter, 5-foot long steel posts installed outside the concrete well pads. All wells were visually checked for plumbness upon completion. The monitoring well installation diagrams are presented in Appendix C.

3.2.3.2 Monitoring Well Development - The monitoring wells were developed no sooner than 48 hours after completion of grouting. The development procedures for monitoring well SD13-05 and SD13-07 were as follows:

a. The depth to ground water and the total depth of the monitoring wells were measured.

b. The monitoring wells were developed using a combination of surging, bailing, and pumping. Initially, the wells were surged with a 4-inch diameter surge block for a period of not less than 15 minutes. The wells were then bailed and pumped to remove water. The well development water was containerized in 55-gallon steel drums for subsequent disposal. Well development activities continued until: 1) the suspended sediment content of the water was less than 0.75 milliliters/liter (ml/L) as measured in an Imhoff Cone according to Method E160.5; 2) the turbidity remained within a ten nephelometric turbidity unit (NTU) range for at least 30 minutes; and 3) the temperature, pH, and conductivity had stabilized. The temperature, pH, and conductivity were considered stabilized when conductance measurements indicated that the temperature was plus or minus 1 degree Celsius; pH, plus or minus 0.1 units; and conductivity, plus or minus 5 percent.

c. Approximately 33 gallons of potable water was used during the drilling of monitoring well SD13-05. Therefore, in accordance with AFCEE protocol, at least 100 gallons of water were removed from the well. No fluids were used in the installation of monitoring wells SD13-06 or SD13-07.

d. The physical characteristics (turbidity, temperature, and pH) of the water were recorded periodically during the development activities.

e. The total volume of water removed from the wells, the static water levels after at least 24 hours, and the total depth of each well were recorded.

f. At the end of development activities, approximately 1 liter of water was collected from each well in a clear glass jar. The jar was labelled, and a photograph of the water was taken.

The rate of ground-water recharge was low in monitoring well SD13-06. On March 27, 1994, the stabilized water level was 9.72 feet below the top of casing (TOC). The monitoring well was bailed dry with the water level at 12.66 feet below the TOC; after 4 hours and 50 minutes, the water level in the monitoring well had increased by only 1.08 feet. Well development activities included bailing monitoring well SD13-06 dry three times between March 27 and March 29, 1994.

The locations and the datum elevations of the monitoring wells were surveyed by a land surveyor licensed in the state of Texas. The wells were located using state plane coordinates, and the elevations above mean sea level of the top of casing and ground surface were determined for each well. The survey data are included in Appendix D.

3.2.3.3 Ground-Water Sampling - Three rounds of ground-water sampling were conducted as part of this investigation. Ground-water samples were collected between March 30 and April 1, 1994; June 20 and June 24, 1994; and September 6 and September 9, 1994. Ground-water samples were collected from the following monitoring wells: SD13-01, SD13-02, SD13-03, SD13-05, SD13-06, SD13-07, OT12-B, and OT12-C. The ground-water samples were obtained from these wells using decontaminated teflon bailers with a teflon leader attached to a length of nylon rope. The teflon leader was used to prevent the nylon rope from entering the water within the well. During each sampling event, approximately 1 inch of free product was detected in monitoring well SD13-04; therefore, ground-water samples were not collected from this well.

Initially, the depth to water was measured in each of the nine monitoring wells, and the volume of water per well was calculated. Then each monitoring well was purged and the pH, specific conductivity, and temperature were periodically recorded. Wells were purged until the pH, specific conductivity, and temperature had stabilized to plus or minus 0.1 pH units, plus or minus 5 percent of the conductivity, and plus or minus 1 degree Celsius, or until a minimum of three fluid casing volumes of ground water were purged. Monitoring well SD13-06 was bailed dry after approximately one well volume and the well purging was discontinued for this well.

After purging the well and allowing sufficient recharge, samples for volatile organics were collected using the first bailer volume, in accordance with the procedures outlined in 2.2.1.1 of the Sampling and Analysis Plan (LAW, 1994a). All samples for dissolved metals were collected last and were filtered through 0.45 μm filters using nitrogen gas, a Millipore pressure filtration system.

The ground-water samples were collected in laboratory-prepared sample containers. The ground-water samples for dissolved metals analyses were preserved with nitric acid to a pH of less than or equal to 2.0. The samples were stored on ice, and transported under chain-of-custody protocol to Law Environmental National Laboratories in Pensacola, Florida.

3.2.3.4 Hydraulic Conductivity Testing - Hydraulic conductivity tests were performed on the newly installed monitoring wells, SD13-05, SD13-06, and SD13-07. The tests were performed on April 20 and 21, 1994, approximately 2.5 weeks after ground-water sampling activities had been completed, to allow recharge of monitoring well SD13-06. Initially, the static water levels of the monitoring wells were measured, and a 2-inch PVC slug and pressure transducer were inserted into the well. After allowing the water level in the well to recover to the static level, the PVC slug was removed, and

the changes in the water elevations were recorded using a pressure transducer and a data logger.

The data recorded during the hydraulic conductivity tests were used to estimate the hydraulic conductivity of the soils immediately adjacent to the screened intervals of the wells.

Only data from the rising head (slug out) tests were considered because the static water levels within the monitoring wells were within the screened interval of the wells. The data recorded from the pressure transducers and the calculations of the hydraulic conductivities are presented in Appendix E.

3.2.4 Surface-Water Sampling

On March 27, 1994, three surface-water samples (SD13-SW01, SD13-SW02, and SD13-SW03) were collected from the Unnamed Stream at locations shown on Figure 3-4. The surface-water samples were collected using decontaminated stainless steel beakers in low-flow areas of the stream to avoid the loss of volatiles from the surface water. The order of sampling was from the downstream to the upstream locations. At each location, immediately after the surface-water sample was collected, sediment samples were also collected.

3.2.5 Sediment Sampling

On March 27, 1994, three sediment samples (SD13-SD01, SD13-SD02, and SD13-SD03) were collected from the Unnamed Stream at the locations shown on Figure 3-4. The sediment samples were collected from the upper 6 inches of the sediment using a decontaminated stainless steel hand auger. At each sampling location, the sediment was placed in a decontaminated stainless steel bowl.

Initially, the sample jar for the volatile analysis was completely filled leaving no headspace. Then the remaining sediment in the stainless steel bowl was mixed thoroughly and used to fill the sample containers for the remaining analyses. The sediment sampling sequence was from the downstream to the upstream locations. At each of the sampling locations, the sediment samples were collected immediately after the surface-water sampling.

3.3 LABORATORY AND DATA ACQUISITION ACTIVITIES

The laboratory activities that were employed during this investigation of the Unnamed Stream and the POL Tank Farm are described below. The following paragraphs describe the data quality objectives (DQOs), analytical methodologies, and analytical quality control requirements. Additionally, an evaluation of the quality of the data with respect to the presence or absence of contamination is presented.

Positive analytical results are included in Section 4.0. Full data sets for each sampling location (along with QC samples, such as trip blanks and equipment rinsates) are presented in the data summary tables in Appendix F.

3.3.1 Data Quality Objectives

The data generated by this project were to be of sufficient quality and quantity to meet the overall project objective of improving site characterizations. The identification of possible additional assessments will be based on recommendations specified by LAW.

3.3.1.1 Unnamed Stream - The objectives for the investigation at the Unnamed Stream Area were determined based on the intended use of the data to assess the lateral and vertical extent of petroleum

contamination adjacent to the Unnamed Stream and in the area of the Abandoned Gasoline Station. Soil, sediment, and surface-water samples were collected in March 1994. Ground-water samples were collected during three sampling events (March, June, and September 1994) and were used to assess contamination trends. Precision, accuracy, representativeness, completeness and comparability (PARCC) parameters were evaluated as determined in the Carswell AFB Sampling and Analysis Plan (SAP) (LAW, 1994a).

3.3.1.2 POL Tank Farm - The scope of work at the POL Tank Farm Area included collection of assessment data for the ground water. The objective for this assessment of the POL Tank Farm was to provide ground-water screening data to be used to plan a ground-water study to delineate the extent of the dissolved lead and petroleum constituents in the ground water. The data generated were used to tentatively define the horizontal extent of lead and petroleum contamination in the upper saturated zone within the area of concern.

3.3.2 Analytical Methodologies

The analytical program was selected based on the Conceptual Site Models (CSM) generated from the previous data collected by Radian (Radian, 1986) and the remedial investigation conducted by Radian in 1990 (Radian, 1991a). It was determined that potential sources of POL contamination in the vicinity of the Unnamed Stream may have affected the soil, ground water, surface water, and sediment. The analytical methods chosen for each matrix were based on the results of previous investigations conducted in 1985 and 1991. These investigations indicated that the primary constituents of concern in the area adjacent to the Unnamed Stream were POL-related volatile compounds and metals. The Abandoned Gasoline Station Area was also investigated during the previous investigations. These

investigations indicated that POL contaminants were the primary constituents of concern. The analytical methods used for the Unnamed Stream are included in the table below.

3.3.2.1 Unnamed Stream/Abandoned Gasoline Station -

Matrix	Parameter	EPA Method
Soil Boring	Petroleum Hydrocarbons	418.1
	Metals	SW 6010
	BTEX	SW 8020
	Volatile Organics	SW 8240
Ground Water	Petroleum Hydrocarbons	418.1
	Metals	SW 6010
	Arsenic	SW 7060
	Lead	SW 7421
	Mercury	SW 7470
	Selenium	SW 7740
	Thallium	SW 7841
	BTEX	SW 8020
	Volatile Organics	SW 8240
	Oil and Grease	SW 9071
Surface Water	Petroleum Hydrocarbons	418.1
	Volatile Organics	SW 8240
	Oil and Grease	SW 9071
Sediment	Metals	SW 6010

3.3.2.2 POL Tank Farm - A ground-water screening technique was performed by TEG to further aid in the delineation of the extent of dissolved lead and petroleum contamination at the POL Tank Farm Area. The screening utilized a direct push technology to place a screened tube into the saturated zone to obtain a ground-water sample. The sample was then analyzed on site for lead, petroleum hydrocarbons and BTEX. The data is intended to aid in the placement of future monitoring wells in this area.

3.3.3 Analytical Quality Control (QC)

The QC requirements and the reporting limits applicable to each matrix and analysis performed for the Unnamed Stream are listed in Appendix A of the SAP (LAW, 1994a).

3.3.4 Unnamed Stream Data Quality Evaluation

Data quality was evaluated through the collection and analysis field QC samples including trip blanks, equipment rinsates, duplicate samples, and ambient condition blanks. In addition, method-specific laboratory QC criteria including method blanks, matrix spike (MS) and matrix spike duplicate (MSD) samples, surrogate recoveries (for volatile organic), internal standard recoveries (for volatile organic), laboratory control samples (LCS), extraction and analytical hold times and calibration data for each sample were evaluated. The results of these data quality procedures were then reviewed with respect to the DQOs established in the SAP Addendum (LAW, 1994a) and the usability of the data was determined. The analytical data summary tables are presented in Appendix F. Table 3-1 summarizes the method-specific laboratory QC and the field QC acceptances and outliers for each analytical parameter applicable to each matrix including soil, March 1994 ground water, June 1994 ground water, September 1994 ground water, surface water, and sediment.

3.3.4.1 Petroleum Hydrocarbons - Overall, the laboratory QC for EPA Method 418.1 was acceptable for soil, ground-water, surface-water, and sediment samples, including initial calibration, continuing calibration, method blanks, MS/MSD, LCS recoveries and sample preparation and analysis. Hold times were met for each sample analyzed. MS/MSD results for June ground-water samples were outside of control limits. Positive analytical results for the

TABLE 3-1

QUALITY CONTROL ACCEPTANCES AND OUTLIERS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

Parameter: / Matrix	Soil	Ground Water (March)	Ground Water (June)	Ground Water (September)	Surface Water	Sediment
418.1 PETROLEUM HYDROCARBONS						
Lab QC Data						
MS/MSD Recoveries	X	X	6	X	X	NS
LCS Recoveries	X	X	X	X	X	NS
Sample Prep.	X	X	X	X	X	NS
Analysis Type	X	X	X	X	X	NS
Method Blanks	X	X	X	X	X	NS
Hold Time – extraction	X	X	X	X	X	NS
Hold Time – analysis	X	X	X	X	X	NS
Initial Calibration	X	X	X	X	X	NS
Continuing Calibration	X	X	X	X	X	NS
FIELD QC DATA						
Equipment Blanks	X	X	NS	X	X	NS
Trip Blanks	NS	NS	NS	NS	NS	NS
Duplicates	X	X	X	X	NS	NS
Ambient Blanks	NS	NS	X	NS	NS	NS
SW6010 METALS						
Lab QC Data						
MS/MSD Recoveries	6	6	X	6	NS	6
LCS Recoveries	X	X	X	X	NS	X
Sample Prep.	X	X	X	X	NS	X
Analysis Type	X	X	X	X	NS	X
Method Blanks	X	X	X	X	NS	X
Hold Time – extraction	X	X	X	X	NS	X
Hold Time – analysis	X	X	X	X	NS	X
Initial Calibration	X	X	X	X	NS	X
Continuing Calibration	X	X	X	X	NS	X
FIELD QC DATA						
Equipment Blanks	6	6	NS	6	NS	6
Trip Blanks	NS	NS	NS	NS	NS	NS
Duplicates	6	X	6	X	NS	6
Ambient Blanks	NS	NS	NS	NS	NS	NS

269 62

TABLE 3-1

QUALITY CONTROL ACCEPTANCES AND OUTLIERS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

Parameter :	Matrix Soil	Ground Water (March)	Ground Water (June)	Ground Water (September)	Surface Water	Sediment
SW7000 METALS						
Lab QC Data						
MS/MSD Recoveries	NS	X	X	X	NS	NS
LCS Recoveries	NS	X	X	X	NS	NS
Sample Prep.	NS	X	X	X	NS	NS
Analysis Type	NS	X	X	X	NS	NS
Method Blanks	NS	ß	X	X	NS	NS
Hold Time – extraction	NS	X	X	X	NS	NS
Hold Time – analysis	NS	X	X	X	NS	NS
Initial Calibration	NS	X	X	X	NS	NS
Continuing Calibration	NS	X	X	X	NS	NS
FIELD QC DATA						
Equipment Blanks	NS	X	NS	X	NS	NS
Trip Blanks	NS	NS	NS	NS	NS	NS
Duplicates	NS	X	X	X	NS	NS
Ambient Blanks	NS	NS	NS	NS	NS	NS
SW8020 VOLATILE ORGANICS						
Lab QC Data						
MS/MSD Recoveries	X	X	NS	X	NS	NS
Surrogate Recoveries	X	ß	NS	X	NS	NS
LCS Recoveries	X	X	NS	X	NS	NS
Sample Prep.	X	X	NS	X	NS	NS
Analysis Type	X	X	NS	X	NS	NS
Method Blanks	X	X	NS	X	NS	NS
Hold Time – analysis	X	X	NS	X	NS	NS
Initial Calibration	X	X	NS	X	NS	NS
Continuing Calibration	X	X	NS	X	NS	NS
FIELD QC DATA						
Equipment Blanks	X	X	NS	X	NS	NS
Trip Blanks	X	X	NS	X	NS	NS
Duplicates	X	X	NS	X	NS	NS
Ambient Blanks	X	X	NS	NS	NS	NS

269 63

TABLE 3-1

QUALITY CONTROL ACCEPTANCES AND OUTLIERS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

Parameter :	Matrix Soil	Ground Water (March)	Ground Water (June)	Ground Water (September)	Surface Water	Sediment
SW8240 VOLATILE ORGANICS						
Lab QC Data						
MS/MSD Recoveries	X	X	X	X	X	NS
Surrogate Recoveries	X	X	X	X	X	NS
Internal Standards	X	X	X	X	X	NS
LCS Recoveries	X	X	X	B	B	NS
Sample Prep.	X	X	X	X	X	NS
Analysis Type	X	X	X	X	X	NS
Method Blanks	X	X	X	B	X	NS
Hold Time – extraction	X	X	X	X	X	NS
Hold Time – analysis	X	X	X	X	X	NS
Initial Calibration	X	X	X	X	X	NS
Continuing Calibration	B	B	B	B	X	NS
FIELD QC DATA						
Equipment Blanks	X	X	NS	NS	X	NS
Trip Blanks	B	X	B	X	B	NS
Duplicates	X	X	X	X	X	NS
Ambient Blanks	X	X	X	NS	X	NS
SW9071 Oil and Grease						
Lab QC Data						
MS/MSD Recoveries	NS	X	X	X	X	NS
LCS Recoveries	NS	X	X	X	X	NS
Sample Prep.	NS	X	X	X	X	NS
Analysis Type	NS	X	X	X	X	NS
Method Blanks	NS	X	X	X	X	NS
Hold Time – extraction	NS	X	X	X	X	NS
Hold Time – analysis	NS	X	X	X	X	NS
Initial Calibration	NS	X	X	X	X	NS
Continuing Calibration	NS	X	X	X	X	NS
					X	
FIELD QC DATA					X	
Equipment Blanks	NS	X	NS	X	X	NS
Trip Blanks	NS	NS	NS	NS	NS	NS
Duplicates	NS	B	X	X	X	NS
Ambient Blanks	NS	NS	NS	NS	NS	NS

X – Acceptance
NS – Not sampled
B – Outlier

PREPARED/DATE: DRJ 10/29/94
CHECKED/DATE: JFO

associated samples were flagged "JH" (estimated quantitation - biased high based on QC data).

To evaluate the field sampling, quality control parameters such as equipment blanks and field duplicate samples were collected. Field decontamination procedures were evaluated using equipment blanks, which were free of target organic compounds for all matrices sampled. Field duplicate samples which helped evaluate precision, were in good agreement for all matrices analyzed.

3.3.4.2 Metals - Overall, the laboratory QC for EPA Method SW 6010 was acceptable, including initial calibration, continuing calibration, LCS recoveries, analytical and extraction hold times, and sample preparation and analysis. However, metals data for soil samples, March ground-water samples, September ground-water samples, and sediment samples were qualified based on MS/MSD recoveries. Antimony recoveries for MS and MSD samples were below laboratory established advisory limits (78 percent to 117 percent) for soil sample, March ground-water samples and sediment samples. The associated LCSs and post-digestion spikes for antimony were within laboratory established limits and the data support matrix interference. Furthermore, the laboratory suggested that the high iron concentration in the samples may act as a catalyst to produce antimony pentachloride ($SbCl_5$), which has a boiling point of 79 degrees Celsius. The digestion temperature for EPA Method 3050 is approximately 98 degrees Celsius, resulting in a considerable loss of antimony via conversion to antimony pentachloride. Antimony was flagged "JL" (estimated quantitation - possibly biased low based on QC data) for the assigned MS and MSD sample only. Other metals were outside of control limits and flagged accordingly. In the event that the sample concentration exceeded the spike amount by four times, the metal result was not qualified.

To evaluate the field sampling, quality control parameters, such as equipment blank and field duplicate samples were collected for each matrix, including soil, ground water, and sediments. March ground-water metals data were not qualified based on equipment blanks, because sample results were greater than three times the metal detected in the equipment blank. Equipment blanks EB1090794, collected during the September ground-water sampling event, contained positive results for barium, calcium, copper, magnesium, manganese, potassium, sodium, and zinc. Positive results for associated samples were flagged JB (estimated quantitation possibly biased high based on blank data) if the positive result was three times or less the amount detected in the equipment blank. Metal results for soil and sediment samples were flagged "JH" (estimated quantitation - possibly biased high based on QC data), if the metal was detected in the equipment blank at concentrations greater than three times the detection limit. Decontamination procedures were followed as listed in Section 2.1.8 of the FSP (LAW, 1994a). Field samples and duplicate samples which were not in good agreement, were flagged "J" (estimated quantitation - based on QC data).

In addition to 6010, March ground-water samples, and June ground-water samples, and September ground-water samples were analyzed graphite furnace methods for metals including: EPA Methods 7060 (arsenic), 7421 (lead), 7470 (mercury), 7740 (selenium), and 7841 (thallium). The laboratory QC was acceptable including initial calibration, continuing calibration, MS/MSD, LCS recoveries and sample preparation and analysis. Hold times were met for each sample analyzed. Lead was detected in a method blank associated with the samples collected during the March ground-water sampling event. Associated positive results for lead which were less than five times the value detected in the trip blank were flagged "JB" (estimated quantitation - possibly biased high or false positive based on blank data).

To evaluate the field sampling, equipment. blanks and field duplicate samples were collected. Equipment blanks were free of metal contamination and field duplicate samples were in good agreement.

3.3.4.3 Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) - Overall, the laboratory QC for EPA Method SW 8020 was acceptable, including initial calibration, continuing calibration, method blanks, MS/MSD recoveries, internal standards, LCS recoveries and sample preparation and analysis. Hold times were met for each sample analyzed. Surrogate recoveries were acceptable for all ground-water samples analyzed, except for March ground-water sample SD13-03. Fluorobenzene results (85 percent) were below established QC limits (90 percent to 111 percent) and the associated sample results were flagged "JL" (estimated quantitation - possibly biased low based upon QC data). During the September ground-water sampling episode, total xylene (78 µg/L) and toluene (40 µg/L) were detected in field sample SD13-01. Second column confirmation results were considerably less for total xylene and toluene, 4.2 µg/L and 3.4 µg/L, respectively. The duplicate sample (DUP1) was in poor agreement for total xylene (less than 10.0 µg/L) and toluene (24 µg/L) and the second column results were nondetected (less than 1.0) for total xylene and 2.4 µg/L for toluene. Furthermore, volatile analysis by GC/MS Method SW 8240 was nondetected for both total xylene (less than 5.0) and toluene (less than 5.0). Surrogates failed for the reported values. Otherwise, all other QC associated with BTEX analysis were acceptable. Upon request, additional data were gathered from the laboratory and second column results were compared with the first column results and all associated QC. Also, second column results were in agreement for expected values for total xylene and toluene for sample SD13-01 when compared to SW 8240 results and second column duplicate results. Primary results were reported from second column analysis. The total xylene primary result was changed from

the first column result (6.7 µg/L) to the second column result (1.8 µg/L) in field sample SD13-03 for the same reasons as described for field sample SD13-01.

Equipment blanks, trip blanks, ambient blanks (when applicable) and field duplicate samples were collected to evaluate the field sampling. Equipment blanks, trip blanks and ambient condition blanks were free of target volatile organic compounds and field duplicate samples were in good agreement.

3.3.4.4 Volatile Organic Compounds - Overall, the laboratory QC for EPA Method SW 8240 was acceptable including initial calibration, surrogate recoveries, method blanks, MS/MSD recoveries, internal standards, sample preparation and analysis. Hold times were met for each sample analyzed. The continuing calibration percent difference (less than or equal to 50 percent) for a few volatile compounds were outside of acceptance criteria range for soil samples, March ground-water samples, June ground-water samples, and September ground-water samples. The analytical results for impacted compounds were flagged "J" (estimated based on QC data). LCS recoveries were acceptable for all matrices with the exception of surface-water samples and September ground-water samples. The LCS recovery for 2-chloroethyl vinyl ether (5 percent) was below laboratory limits (9 percent to 244 percent) and associated surface-water samples were flagged "JL" (estimated - biased low based on QC data). September ground-water LCS recoveries for vinyl acetate (40 percent) was below laboratory established limits (82 percent to 114 percent) and associated samples were flagged "J" (estimated - biased low based on QC data). Methylene chloride and chloroform were detected in the method blank associated with ground-water samples collected during the September sampling episode. All positive results for methylene chlorides and chloroform which are five times or less the amount detected in the blank are flagged "JB" (estimated-based on blank contamination).

To evaluate the field sampling, equipment blanks, trip blanks, ambient blanks and field duplicate samples were collected. Equipment blanks and ambient condition blanks were free of target volatile organic compounds and field duplicate samples were in good agreement. Methylene chloride was detected in the trip blanks associated with soil samples and sediment samples. Chloroform and methylene chloride were detected in trip blanks associated with the samples collected during the June sampling event. Associated positive results for methylene chloride which were less than five times the value detected in the trip blank were flagged "JH" (estimated quantitation - possibly biased high based on QC data). Similarly, chloroform positive results which were less than three times the value detected in the trip blank were flagged "JH" (estimated quantitation - possibly biased high based on QC data).

3.3.4.5 Oil and Grease - The total recovery of oil and grease was analyzed by EPA Method SW 9071. Overall, the laboratory QC was acceptable including initial calibration, continuing calibration, method blanks, MS/MSD recoveries, LCS recoveries and sample preparation and analysis. Hold times were met for each sample analyzed.

To evaluate the field sampling, equipment blanks and field duplicate samples were collected. Equipment blanks were free of oil and grease contamination for all matrices sampled and field duplicate samples were in good agreement for all matrices except ground-water samples collected during the March sampling event. Oil and grease (detection limit = 1.0 mg/L) was not detected in ground-water sample SD13-05; however, 5.8 mg/L of oil and grease were detected in the field duplicate sample.

3.3.5 POL Tank Farm Data Quality Evaluation

Data qualify was evaluated through the collection and analysis of field QC samples including duplicate samples. Method-specific laboratory QC criteria, including method blanks and surrogate recoveries (for petroleum hydrocarbons and BTEX), were for each sample collected. A total of 22 ground-water samples were collected and analyzed on site in order to complete the ground-water screen.

3.3.5.1 Lead - Overall, the laboratory and field QC were acceptable for the ground-water field screening for lead (Method SW 7421). The associated methods were all nondetect for lead. The method detection limit (5.0 µg/L) was achieved for all samples and method blanks analyzed. Two duplicates were collected, B200 Dup and B800 Dup and were in good agreement. The ground-water screening results for lead were not qualified. Results are acceptable as a ground-water screening method.

3.3.5.2 Petroleum Hydrocarbons - Overall, the laboratory and field QC were acceptable for the ground-water field screening for petroleum hydrocarbons (Method SW 8015). The gasoline range and diesel range of petroleum hydrocarbons were evaluated. The method blanks were nondetect for the gasoline range-hydrocarbons and diesel range hydrocarbons. Surrogate recoveries were acceptable for all samples analyzed with the exception of the gasoline range for three (3) samples (C800, E400, D700). The high positive results for gasoline range hydrocarbons interfered with the surrogate recovery. The method detection limit (100 µg/L) was achieved for each range analyzed. One duplicate was collected, B800 Dup, and was in good agreement with its associated field sample B800. The ground-water screening results for petroleum hydrocarbons were not qualified.

3.3.5.3 BTEX - Overall, the laboratory and field QC were acceptable for ground-water field screening for BTEX (SW 8020). The method blanks were nondetect for BTEX constituents. Surrogate recoveries were acceptable as well. The method detection limits (1 µg/L) for each BTEX constituent was achieved for each ground-water sample collected. One duplicate sample, B800 Dup, was collected and was in good agreement with its field sample (B800). The ground-water screening results for BTEX were not qualified. Results are acceptable as a ground-water screening method.

4.0 INVESTIGATIVE RESULTS

This section presents the investigative results of assessment activities for the POL Tank Farm Area and the Unnamed Stream site. Field activities include the geophysical survey and ground-water screening for the POL Tank Farm Area, and the geophysical survey and soil, sediment, surface-water, and ground-water sampling at the Unnamed Stream Area.

4.1 POL TANK FARM

Previous environmental assessment activities performed by Radian Corporation (1984-1991) in this area include:

- Drilling of eight soil borings (17A through 17H) to depths ranging from 16.5 to 20 feet below the ground surface within or immediately adjacent to the spill containment berms for the aboveground storage tanks

- Installation of nine shallow ground-water monitoring wells (ST14-17I through ST14-17M and ST14-01 through ST14-04) in the vicinity of the POL Tank Farm and the Pipeline/Truck Loading Area

- Soil gas survey (December 1987) in the vicinity of the POL Tank Farm and the Pipeline/Truck Loading Area

As described by Radian (1991), the POL Tank Farm is underlain by approximately 10 feet of gray to tan clay, overlying 5 to 10 feet of sand and gravel. The gravel content increases with depth to the top of the underlying limestone bedrock of the Goodland Formation.

The depth to the top of the Goodland formation in the area of the POL Tank Farm is approximately 16 to 20 feet below the ground surface.

Ground-water measurements from June 1990 indicated the depth to ground water ranged from 8 to 16 feet below the ground surface. Based on these measurements, the ground-water surface sloped to the southeast toward Farmers Branch.

The soil gas survey (December 1987) indicated elevated concentrations of total organic compounds in two areas: one area within the POL Tank Farm centered around the 1156 and 1157 Tanks and the second area on the eastern boundary of the Pipeline/Truck Fueling Area (Figure 4-1).

Nine monitoring wells (ST14-17I through ST14-17M and ST14-01) were sampled in Spring 1990. Benzene was detected in three monitoring wells, ST14-17J (3.8 μg/L), ST14-17L (0.65 μg/L) and ST14-03 (1.3 μg/L), at levels below the drinking water maximum contaminant levels (MCLs) established by USEPA. However, in monitoring well ST14-17M, benzene was detected above the MCL at a concentration of 16 μg/L. As shown on Figure 4-2 by Radian (1991), the estimated extent of benzene contamination closely correlates to the total organic compound plume determined from the December 1987 soil gas survey.

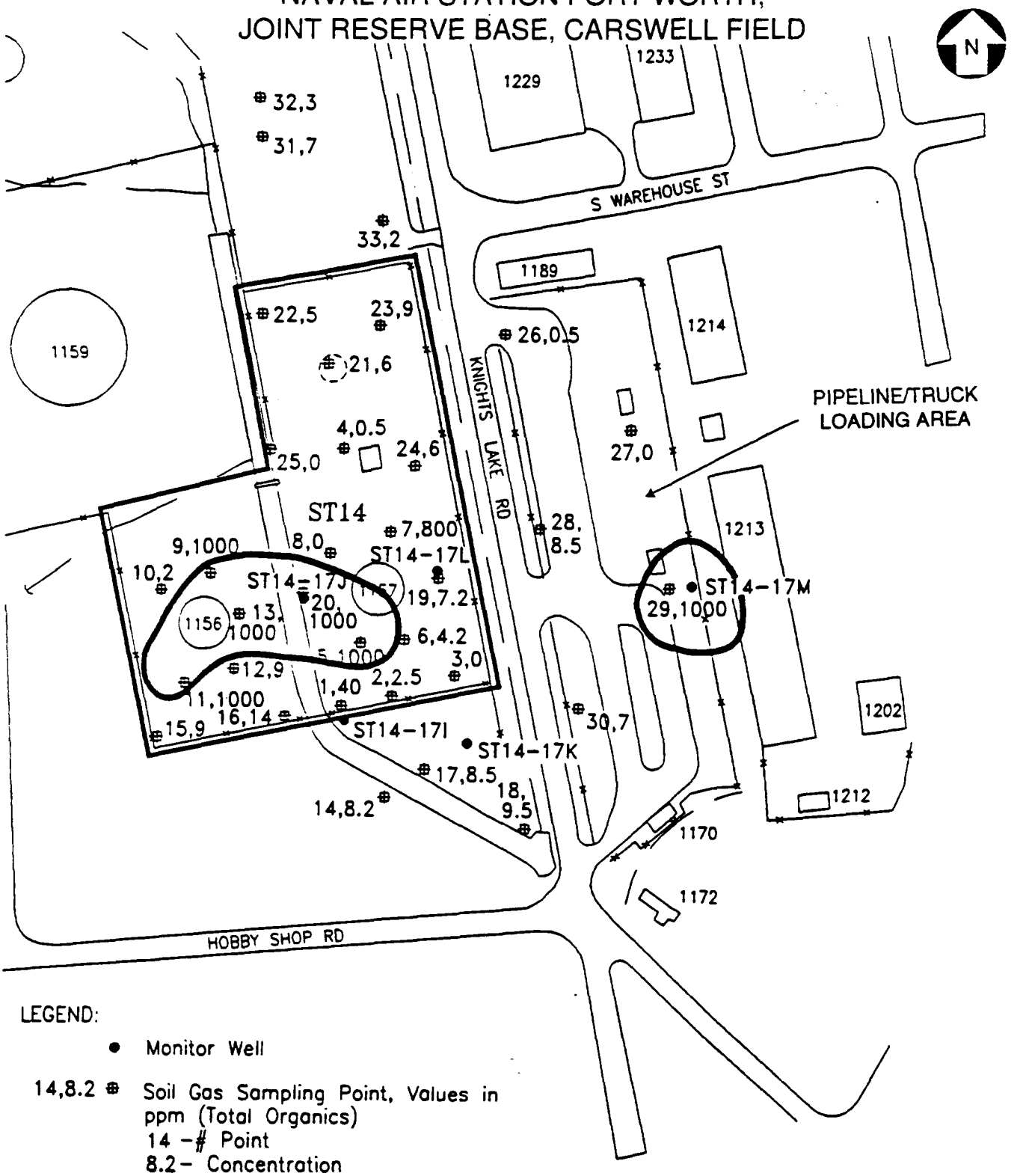
4.1.1 Geophysical Survey

In March 1994, LAW performed an EM61 survey around the POL Tank Farm Area to locate potential buried utilities along proposed ground-water screening survey locations. The locations of these survey lines are shown on Figure 4-3. The geophysical survey was performed along the grid lines for the 33 potential ground-water probe locations. The proposed locations near the POL Tank Farm had been cleared for utilities, and digging permits had been issued for

FIGURE 4-1

PROBABLE AREAS OF SOIL GAS PLUMES (ppm > 1000) AT SITE ST14 / POL TANK FARM (DECEMBER 1987)

NAVAL AIR STATION FORT WORTH,
JOINT RESERVE BASE, CARSWELL FIELD



LEGEND:

- ● Monitor Well
- 14,8.2 ⊕ Soil Gas Sampling Point, Values in ppm (Total Organics)
  14 – # Point
  8.2 – Concentration
- ⬭ Probable Areas of Soil Gas Plume (ppm>1000)

0 100 200
FEET

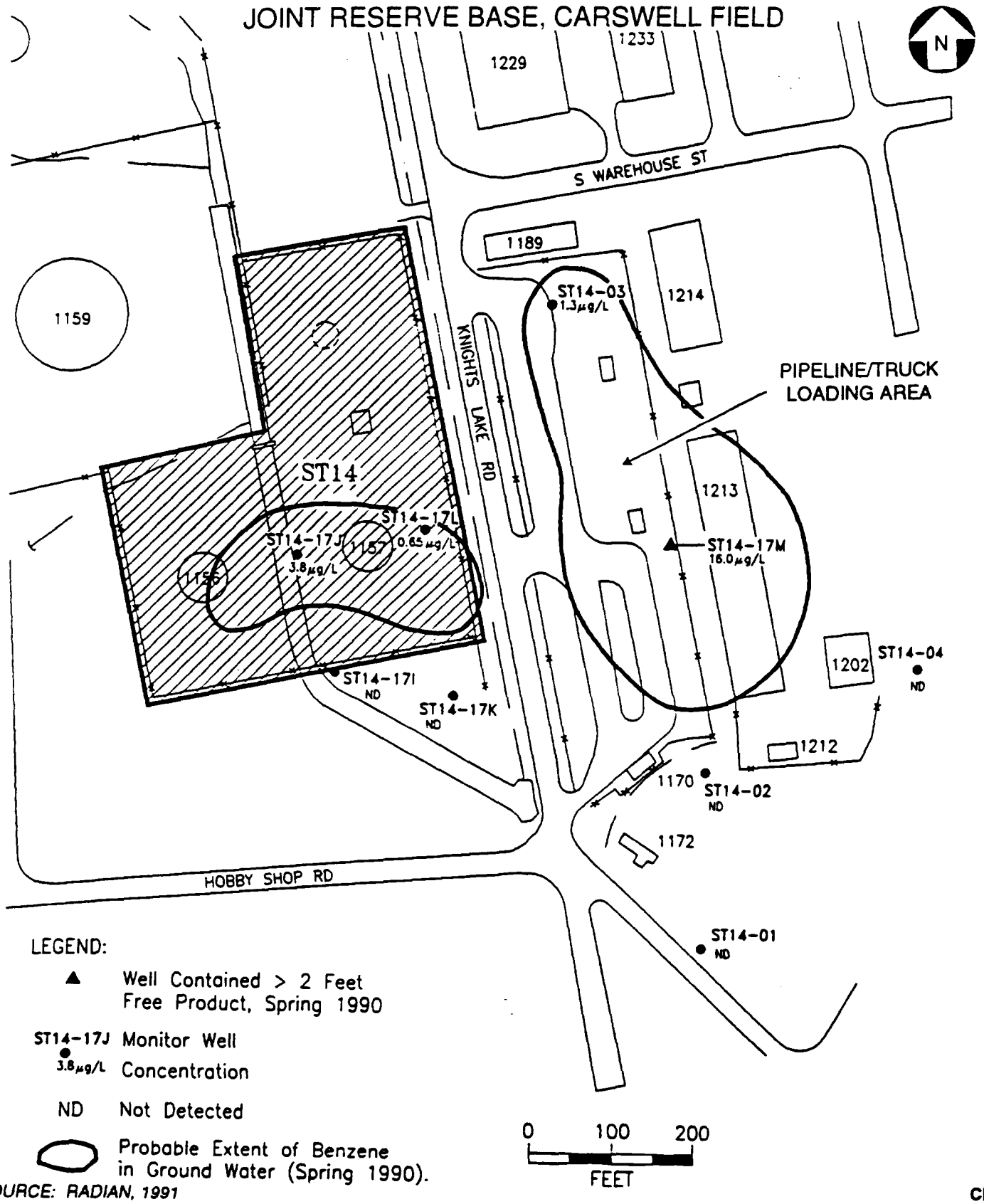
SOURCE: RADIAN, 1991

CP

FIGURE 4-2

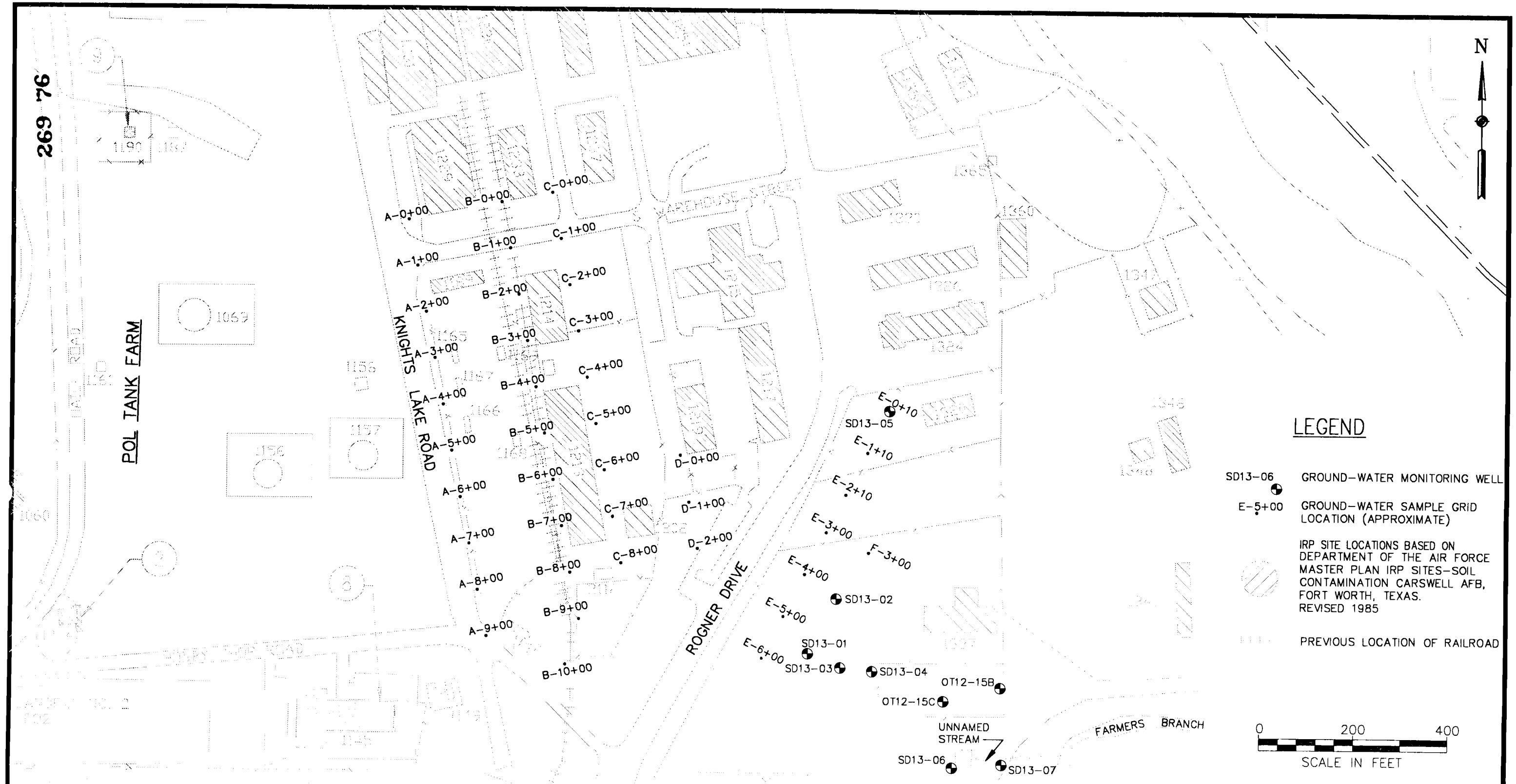
PROBABLE EXTENT OF BENZENE CONTAMINATION AT SITE ST14 (POL TANK FARM) (SPRING 1990)

NAVAL AIR STATION FORT WORTH,
JOINT RESERVE BASE, CARSWELL FIELD



SOURCE: RADIAN, 1991

CP



LEGEND

SD13-06 — GROUND-WATER MONITORING WELL

E-5+00 — GROUND-WATER SAMPLE GRID LOCATION (APPROXIMATE)

IRP SITE LOCATIONS BASED ON DEPARTMENT OF THE AIR FORCE MASTER PLAN IRP SITES-SOIL CONTAMINATION CARSWELL AFB, FORT WORTH, TEXAS. REVISED 1985

PREVIOUS LOCATION OF RAILROAD

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

GROUND-WATER SCREENING SAMPLING GRID

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER:	FILE DATE:	10.OCT.94
CHECKED BY: 30 OCT 95	4-3	PLOT DATE:	02.OCT.95
PROJECT NO. 11-3517-0111		FILE NAME:	PETGRID2.DWG

the ground-water screening survey; however, in areas where the EM61 detected anomalies indicating the potential location of underground utilities or other objects, the proposed probe locations were deleted from the sampling grid. During the ground-water screening, 22 ground-water screening locations were sampled.

Cultural interferences in the survey area included reinforced concrete, railroad tracks, steel drums, power lines, fences, and fire hydrants.

4.1.2 Ground-Water Screening

The results of the chemical analyses of the 22 ground-water samples collected are presented on Table 4-1 and Figures 4-4 through 4-7. The extent and range of concentrations of constituents detected are discussed below by constituent.

Total Petroleum Hydrocarbons

Gasoline range Total Petroleum Hydrocarbons (TPH) were detected in 13 of the 22 ground-water samples analyzed. The concentrations ranged from less than the detection level of 0.1 milligrams per liter (mg/L) to 184 mg/L at sample location (E-4+00) (Table 4-1). As shown on Figure 4-4, the extent of the gasoline range TPH was limited to the southeastern portion of the sample grid, in the area located between the POL Tank Farm Area, Pipeline/Truck Loading Area, and the Abandoned Gasoline Station.

Diesel range TPH was not detected in any of the 22 ground-water samples analyzed.

Benzene, Toluene, Ethylbenzene, and Total Xylenes (BTEX)

BTEX constituents were detected in 12 of the 22 ground-water samples analyzed. The concentration of BTEX ranged from less than

TABLE 4-1

GROUND-WATER SCREENING RESULTS
POL Tank Farm Area
March 1994
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

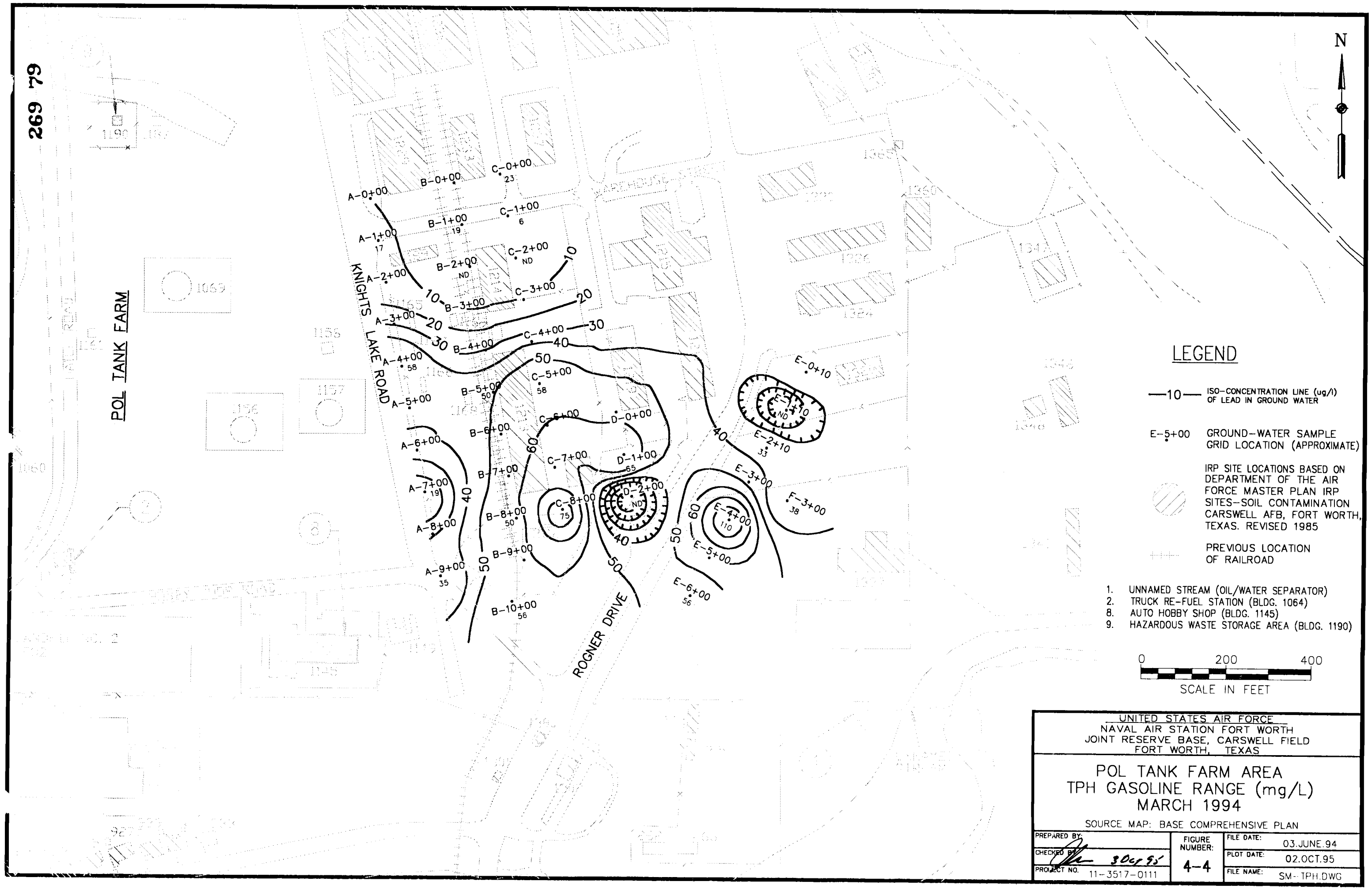
Sample Location	Screen Depth (FT)	Gasoline Range TPH (mg/L)	Diesel Range TPH (mg/L)	BTEX (µg/L)	Benzene (µg/L)	Lead 3500** (µg/L)	Lead 7421** (µg/L)
A 1+00	15	ND	ND	73	ND	17	12
A 4+00		5.5	ND	10	ND	58	60
A 7+00		1.9	ND	ND	ND	19	10
A 9+00	15	0.1	ND	ND	ND	35	30
B 1+00	12	ND	ND	ND	ND	19	ND
B 2+00		3.6	ND	1503	ND	ND	ND
B 5+00	13.5	5.0	ND	164	47	50	35
B 8+00*	15	2.3	ND	37	2	50	58
B 10+00	14	ND	ND	61	42	56	66
C 0+00		ND	ND	ND	ND	23	ND
C 1+00		2.4	ND	4	2	6	ND
C 2+00	15	ND	ND	ND	ND	ND	ND
C 5+00	15	4.6	ND	39	15	58	65
C 8+00		111.0	ND	58	ND	75	88
D 1+00		12.6	ND	31	ND	65	75
D 2+00	15	3.6	ND	32	ND	ND	ND
E 0+10	14	ND	ND	ND	ND	35	50
E 1+10	12	ND	ND	ND	ND	ND	ND
E 2+10	15	ND	ND	ND	ND	33	40
E 3+00	14	No Ground-water Recovery					
E 4+00	12	184.0	ND	264	59	110	90
E 6+00	15	1.3	ND	ND	ND	56	45
F 3+00	15	ND	ND	ND	ND	38	30
Detection Limit		0.1	0.1	1	1	5	5

Notes:

1. Laboratory Analyses performed by Transglobal Environmental Geochemistry, Inc.
2. Total Petroleum Hydrocarbons analyzed using Modified EPA Method 8015
3. BTEX analyzed using EPA Method 8020
4. Lead analyzed in the field using EPA Method 3500-Pb-d, lead was also analyzed at an offsite laboratory using EPA Method 7410
5. ND - Not Detected
6. * Analysis of duplicate sample reported
7. ** EPA Method

PREPARED/DATE: TM 10/29/94
CHECKED/DATE: JFO

3517-0111.20

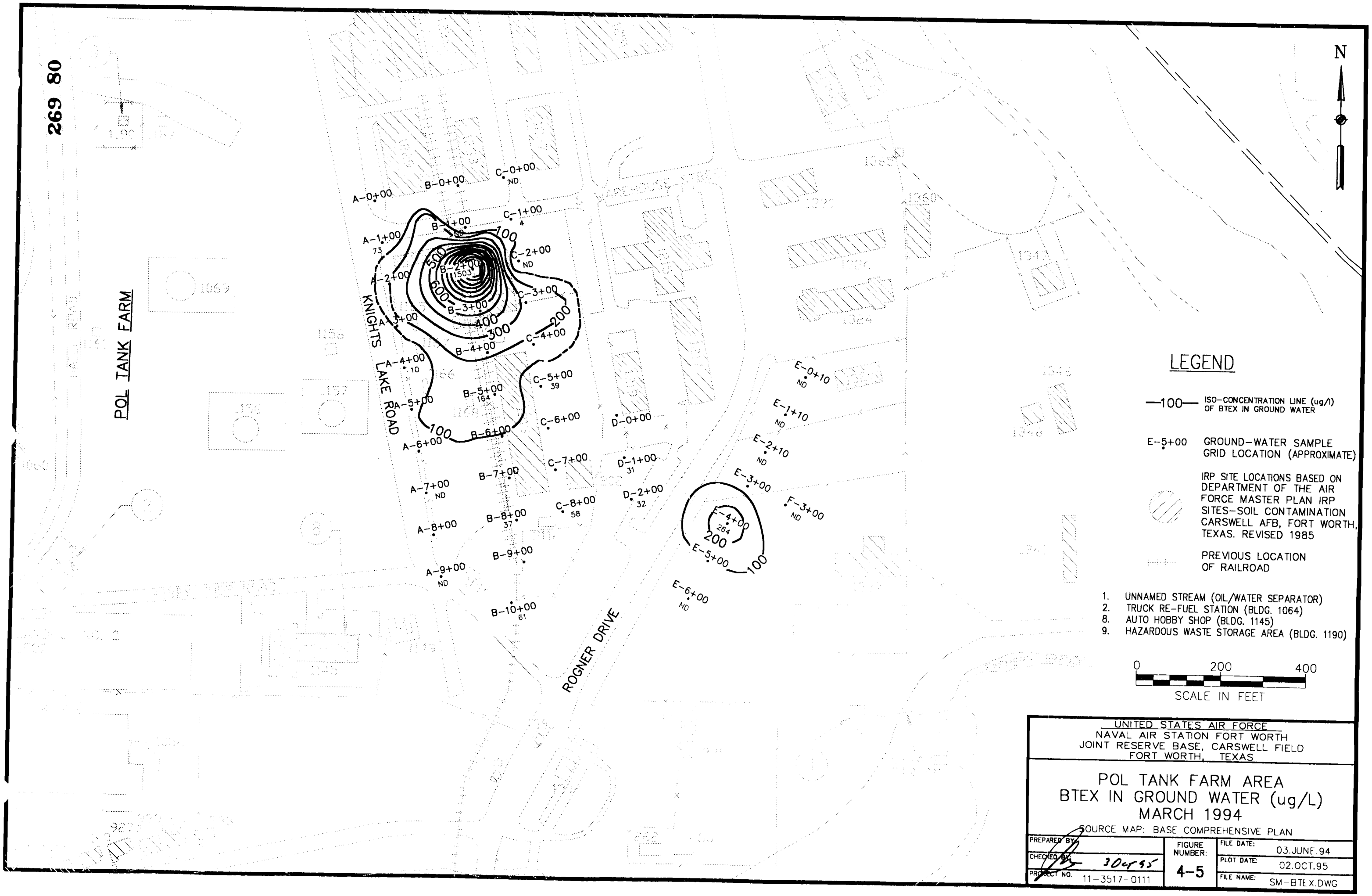


UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

POL TANK FARM AREA TPH GASOLINE RANGE (mg/L) MARCH 1994

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 4-4	FILE DATE:	03.JUNE.94
CHECKED BY: 30 Oct 95		PLOT DATE:	02.OCT.95
PROJECT NO. 11-3517-0111		FILE NAME:	SM-TPH.DWG



UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

POL TANK FARM AREA
BTEX IN GROUND WATER (ug/L)
MARCH 1994

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 4-5	FILE DATE: 03.JUNE.94
CHECKED BY: 30 of 95		PLOT DATE: 02.OCT.95
PROJECT NO. 11-3517-0111		FILE NAME: SM-BTEX.DWG

269 81

POL TANK FARM

KNIGHTS LAKE ROAD

ROGNER DRIVE

BENZENE

N

A-0+00 B-0+00 C-0+00 ND
A-1+00 ND B-1+00 ND C-1+00 2
A-2+00 B-2+00 ND C-2+00 ND
A-3+00 B-3+00 C-3+00 5
A-4+00 ND B-4+00 C-4+00 10
A-5+00 B-5+00 41 C-5+00 15 20
A-6+00 B-6+00 C-6+00 D-0+00
A-7+00 ND B-7+00 C-7+00 5 D-1+00 ND
A-8+00 B-8+00 2 C-8+00 ND D-2+00 ND
A-9+00 ND B-9+00 5 10 20
B-10+00 42
E-0+10 ND
E-1+10 ND
E-2+10 ND
E-3+00 5 10 15 20
E-4+00 59
E-5+00 25
E-6+00 ND
F-3+00 ND

LEGEND

—5— ISO-CONCENTRATION LINE (ug/l) OF BENZENE IN GROUND WATER

E-5+00 • GROUND-WATER SAMPLE GRID LOCATION (APPROXIMATE)

IRP SITE LOCATIONS BASED ON DEPARTMENT OF THE AIR FORCE MASTER PLAN IRP SITES-SOIL CONTAMINATION CARSWELL AFB, FORT WORTH, TEXAS. REVISED 1985

PREVIOUS LOCATION OF RAILROAD

1. UNNAMED STREAM (OIL/WATER SEPARATOR)
2. TRUCK RE-FUEL STATION (BLDG. 1064)
8. AUTO HOBBY SHOP (BLDG. 1145)
9. HAZARDOUS WASTE STORAGE AREA (BLDG. 1190)

0 200 400
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

POL TANK FARM AREA
BENZENE IN GROUND WATER (ug/L)
MARCH 1994

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 4-6	FILE DATE:	03.JUNE.94
CHECKED BY: 30ct95		PLOT DATE:	02.OCT.95
PROJECT NO. 11-3517-0111		FILE NAME:	SM-BENZ.DWG

269 82

POL TANK FARM

KNIGHTS LAKE ROAD

ROGNER DRIVE

WAREHOUSE STREET

A-0+00 B-0+00 C-0+00 23
A-1+00 17 B-1+00 19 C-1+00 6
A-2+00 B-2+00 ND C-2+00 ND
A-3+00 B-3+00 C-3+00
A-4+00 58 B-4+00 C-4+00
A-5+00 B-5+00 50 C-5+00 58
A-6+00 B-6+00 C-6+00 D-0+00
A-7+00 19 B-7+00 C-7+00 D-1+00 65
A-8+00 B-8+00 50 C-8+00 75 D-2+00 ND
A-9+00 35 B-9+00
B-10+00 56
E-0+10 E-1+10 ND E-2+10 33 E-3+00 E-4+00 110 E-5+00 E-6+00 56 F-3+00 38

10 20 30 40 50 60

N

LEGEND

—10— ISO-CONCENTRATION LINE (ug/l) OF LEAD IN GROUND WATER

E-5+00 GROUND-WATER SAMPLE GRID LOCATION (APPROXIMATE)

IRP SITE LOCATIONS BASED ON DEPARTMENT OF THE AIR FORCE MASTER PLAN IRP SITES-SOIL CONTAMINATION CARSWELL AFB, FORT WORTH, TEXAS. REVISED 1985

PREVIOUS LOCATION OF RAILROAD

1. UNNAMED STREAM (OIL/WATER SEPARATOR)
2. TRUCK RE-FUEL STATION (BLDG. 1064)
8. AUTO HOBBY SHOP (BLDG. 1145)
9. HAZARDOUS WASTE STORAGE AREA (BLDG. 1190)

0 200 400
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

POL TANK FARM AREA
LEAD BY EPA METHOD 3500 (ug/L)
MARCH 1994

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:		FILE DATE:	03.JUNE.94
CHECKED BY:	30 OCT 95	PLOT DATE:	02.OCT.95
PROJECT NO.	11-3517-0111	FILE NAME:	SM-EPA.DWG
	FIGURE NUMBER: 4-7		

the detection limit of 1 microgram per liter (µg/L) to 1,503 µg/L at sample location (B-2+00) (Table 4-1). As shown on Figure 4-5, BTEX constituents were detected at locations across the sample grids, with highest concentrations detected in the northern portion near the Pipeline/Truck Loading Area and in the southeastern portion near the Abandoned Gasoline Station.

Benzene was detected in 6 of the 22 ground-water samples analyzed, with the highest concentration of 59 µg/L detected in the ground-water sample from location E-4+00. Because of the greater toxicity of benzene, a separate isoconcentration map of benzene is included (Figure 4-6). The highest concentrations of benzene were detected in ground water from locations west of Building 1213 near the Pipeline/Truck Loading Area, south of Building 1213, and near the Abandoned Gasoline Station.

Lead

Lead was detected in 18 of the 22 ground-water samples analyzed by EPA Method 3500, with the highest concentration detected at 110 µg/L at location E-4+00. Lead was detected in 15 of 22 of the ground-water samples analyzed by Method SW 7421 with the highest concentration detected at 90 µg/L at location E-4+00. As shown on Table 4-1, the concentrations of lead detected in the ground water using Method SW 3500 and SW Method 7421 are similar. Lead was detected in ground-water samples collected from sampling locations across the grid area, with higher concentrations indicated in the area of the Abandoned Gasoline Station (Figure 4-7).

CONCLUSIONS OF GROUND-WATER SCREENING

The POL Tank Farm appears to be a minor source area for petroleum constituents detected in the ground water east of the POL Tank Farm. Grid Line A was located along Knights Lake Road (Desert Storm Drive) in the direction that appears to be immediately

downgradient of the POL Tank Farm (Figure 4-3). Ground-water samples were screened from locations A 1+00, A 4+00, A 7+00, and A 9+00. Relatively low concentrations of BTEX (73 µg/L), benzene (below detection levels), and gasoline range TPH (5.5 mg/L) were detected.

The major probable source areas for petroleum constituents in the ground water include the Pipeline/Truck Loading Area and the Abandoned Gasoline Station. Grid line B was positioned in the direction thought to be located immediately downgradient of the Pipeline/Truck Loading Area. Relatively high concentrations of BTEX (1503 µg/L from B 2+00) and benzene (47 µg/L from sample location B 5+00, and 42 µg/L from sample location B 10+00) were detected in the ground-water samples from screening locations in Grid Line B. Additionally, relatively high concentrations of BTEX (264 µg/L), benzene (59 µg/L), and gasoline range TPH (184 mg/L) were detected from sample location E 4+00 located in the vicinity of the Abandoned Gasoline Station east of Rogner Drive. E 4+00 was located in the area identified by the geophysical survey conducted by LAW in March 1994, as possibly containing an underground storage tank.

As shown on Figures 4-4 through 4-6, the northern, eastern, and western extent of the petroleum constituents have been tentatively defined by the ground-water screening. Elevated concentrations of petroleum constituents were detected along the southern limit of the ground-water screening area, with no definition of extent.

As shown on Figure 4-7, lead was detected in ground-water samples collected across the screening area. Lead may be a naturally occurring metal in the ground water at the site. However, elevated lead concentrations were detected in areas where elevated concentrations of petroleum constituents were also detected (sample locations C 8+00 and E 4+00).

Based on the results of the ground-water screening in the POL Tank Farm Area, the probable major sources of petroleum constituents in the ground water have been tentatively identified as the Pipeline/Truck Loading Area and the Abandoned Gasoline Station. The aboveground storage tanks of the POL Tank Farm appear to be minor sources of petroleum constituents in the ground water. The southern extent of petroleum constituents was not defined. However, subsequent studies by Parsons Engineering-Science (PES) indicated that the petroleum contaminant plume was not connected to the Unnamed Stream site.

4.2 UNNAMED STREAM

Site Hydrogeology

Monitoring wells SD13-06 and SD13-07 were installed in the vicinity of the oil/water separator which is the source for the Unnamed Stream. During the installation of monitoring well SD13-06, 4 feet of clayey fill was encountered, underlain by 2 feet of clay and approximately 0.9 feet of silty sand. Strong petroleum odors were detected within the sand layer. Weathered light gray shaley limestone was encountered from the 6.9-foot depth to the boring termination depth of 11.5 feet.

During installation of monitoring well SD13-07, 12 feet of silts and clays were encountered, underlain by 1 foot of slightly silty coarse to medium sand. Weathered light gray shaley limestone extended from the 13-foot depth to the boring termination depth of 20 feet. The unconsolidated sediments encountered within the soil borings appear to be alluvial deposits from Farmers Branch.

As shown on Figures 4-8, 4-9, and 4-10, borings installed upgradient of the Unnamed Stream in the vicinity of the Abandoned Gasoline Station encountered silt and clay overlying 5 to 10 feet

269 86

SD13–05
A

SD13–02

APPROXIMATE LOCATION OF FRENCH DRAIN

ROGNER DRIVE

SD13–01
B

SD13–03

SD13–04

OT12–SB01

OT12–15B
B'

OT12–15C

OT12–SB02

OT12–SB03

ABANDONED GASOLINE STATION

SD13–06
A'

SD13–07

UNNAMED STREAM

N

LEGEND

OT12–SB01 ○	SOIL BORING LOCATION
SD13–05 ◔	MONITORING WELLS INSTALLED BY LAW, MARCH 1994
SD13–02 ●	MONITORING WELLS INSTALLED BY OTHERS
A ——— A'	CROSS-SECTION LOCATION

0 100 200

SCALE IN FEET

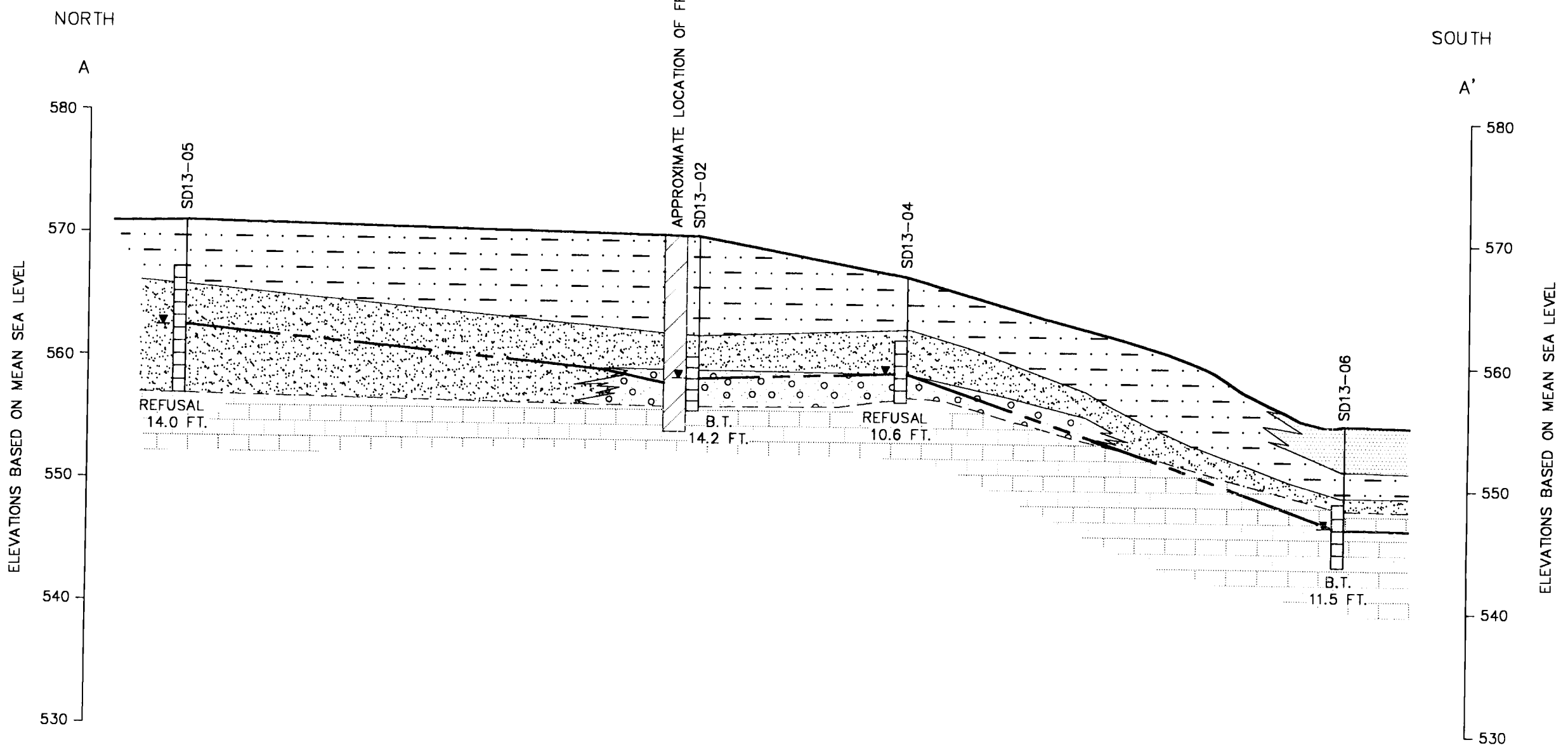
UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

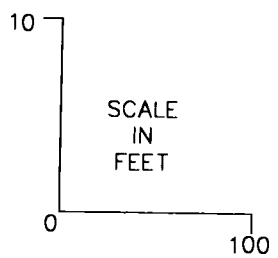
CROSS SECTION LOCATION MAP UNNAMED STREAM AND ABANDONED GASOLINE STATION

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 4-8	FILE DATE: 07.OCT.94
CHECKED BY:		PLOT DATE: 25.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME: XSECT.DWG

269 87





LEGEND

CONTACT	FILL
ESTIMATED CONTACT	FINE TO MEDIUM SAND
WATER LEVEL APRIL 1994	SILT, CLAY AND SAND MIXTURE
SCREENED INTERVAL OF MONITORING WELL	SANDY GRAVEL
B.T. BORING TERMINATED	LIMESTONE AND SHALE

NOTES:
1. MONITORING WELLS SD13-05 AND SD13-06 INSTALLED BY LAW, MARCH 1994.
2. MONITORING WELLS SD13-02 AND SD13-04 INSTALLED BY RADIAN, MARCH 1990.
3. DEPTH TO GROUND-WATER MEASURED ON 18 APRIL 1994.
4. LOCATION OF FRENCH DRAIN BASED ON RADIAN, 1986.

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

CROSS SECTION A-A' ABANDONED GASOLINE STATION AND UNNAMED STREAM

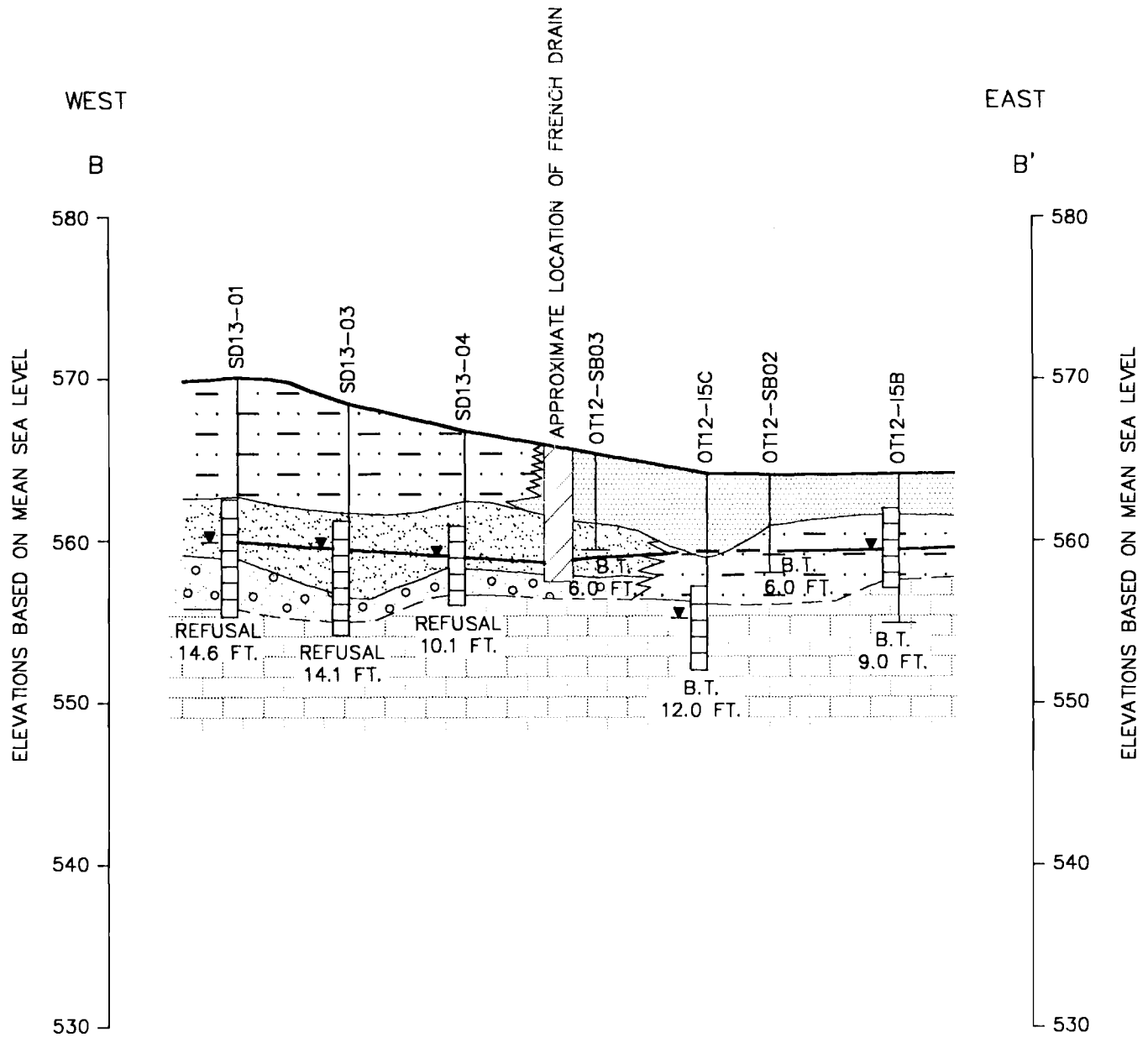
BUILDING 1337

PREPARED BY:	FIGURE NUMBER: 4-9	FILE DATE: 22.AUG.94
CHECKED BY:		PLOT DATE: 22.SEPT.95
PROJECT NO. 11-3517--0111		FILE NAME: XSECTA.DWG

269 88

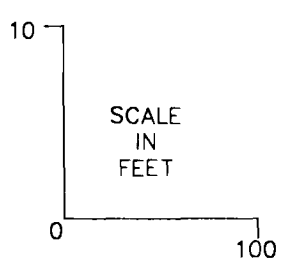
NOTES:

1. SOIL BORINGS OT12-SB02 AND OT12-SB03 ADVANCED BY LAW, IN MARCH 1994.
2. MONITORING WELLS SD13-01, SD13-03, AND SD13-04 INSTALLED BY RADIAN IN 1990.
3. MONITORING WELLS OT12-15B AND OT12-15C INSTALLED BY RADIAN IN 1985
4. DEPTH TO GROUNDWATER MEASURED ON APRIL 18, 1994.
5. LOCATION OF FRENCH DRAIN BASED ON RADIAN 1986.



LEGEND

- CONTACT
- ESTIMATED CONTACT
- WATER LEVEL APRIL 1994
- SCREENED INTERVAL OF MONITORING WELL
- B.T. BORING TERMINATED
- FILL
- FINE TO MEDIUM SAND
- SILT, CLAY AND SAND MIXTURE
- SANDY GRAVEL
- LIMESTONE AND SHALE



UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

CROSS SECTION B-B' ABANDONED GASOLINE STATION AND UNNAMED STREAM

BUILDING 1337

PREPARED BY:	FIGURE NUMBER: 4-10	FILE DATE: 22.AUG.94
CHECKED BY:		PLOT DATE: 22.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME: XSECTB.DWG

of fine to medium sand and sandy gravels. The top of rock dips toward Farmers Branch. In monitoring well SD13-05, the top of rock was encountered at approximately 558 feet above msl, and in monitoring well SD13-07 the top of rock was encountered at approximately 541 feet above msl.

On April 18, 1994, the depth to ground water was measured in the newly installed ground-water monitoring wells in the area of the Unnamed Stream along with the existing monitoring wells near Building 1337 and the Abandoned Gasoline Station. Based on these ground-water measurements, a potentiometric surface map was produced (Figure 4-11). As shown on the potentiometric surface map, in the area of the Unnamed Stream, the ground-water flow is to the southeast toward Farmers Branch. Although the exact location of the french drain near the Abandoned Gasoline Station is unknown; the influence of the french drain on the ground-water flow direction was observed in the area of SD13-02, where there was a depression in the ground-water surface.

On April 1 and April 21, 1994, hydraulic conductivity tests were performed on ground-water monitoring wells SD13-05, SD13-06, and SD13-07. The hydraulic conductivities ranged from 5.61×10^{-3} feet per minute (ft/min) in SD13-07, to 1.98×10^{-3} ft/min in SD13-05, to 1.72×10^{-5} ft/min in SD13-06. As shown on the well construction diagrams (Appendix C), SD13-06 and SD13-07 are screened predominantly within weathered shaley limestone indicating a wide range of hydraulic conductivities within the weathered rock zone. Monitoring well SD13-05 is screened predominantly within sands and gravels.

Based on the hydraulic conductivity measured in monitoring well SD13-05 and the hydraulic gradient in the area of the Abandoned Gasoline Station of 0.005 ft/ft, the ground-water velocity in the area of the Abandoned Gasoline Station and Unnamed Stream is calculated using the following equation:

269 90

SD13–05
562.23

SD13–02
558.17

SD13–01
560.16

SD13–03
559.58

SD13–04
558.97

OT12–15B
559.46

OT12–15C
559.44

SD13–06
546.30

SD13–07
539.06

560
558
556
554
552
550
548
546
544
542
540

ABANDONED GASOLINE STATION

UNNAMED STREAM

RIGNER DRIVE

1222

1320

1337

N

LAYER/LEVEL
P01494

LEGEND

544 — POTENTIOMETRIC LINE

SD13–05 ⊕ MONITORING WELLS INSTALLED BY LAW, MARCH 1994

SD13–02 ● MONITORING WELLS INSTALLED BY OTHERS

558.17 — MEASURED ELEVATION OF GROUND–WATER ON APRIL 18, 1994

→ ESTIMATED GROUND–WATER FLOW DIRECTION

0 100 200
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POTENTIOMETRIC SURFACE MAP, UNNAMED STREAM AND ABANDONED GASOLINE STATION APRIL 18, 1994

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 4–11	FILE DATE:	21.NOV.94
CHECKED BY:		PLOT DATE:	22.SEPT.95
PROJECT NO. 11–3517–0111		FILE NAME:	POTSURF.DWG

$$V = ki/n_e$$

where

V = velocity in feet per minute
k = hydraulic conductivity (ft/min) = 1.98 by 10^{-3} ft/min
i = hydraulic gradient (ft/ft) = 0.005 ft/ft
n_e = effective porosity = 0.25 (Linsley, et al., 1975)

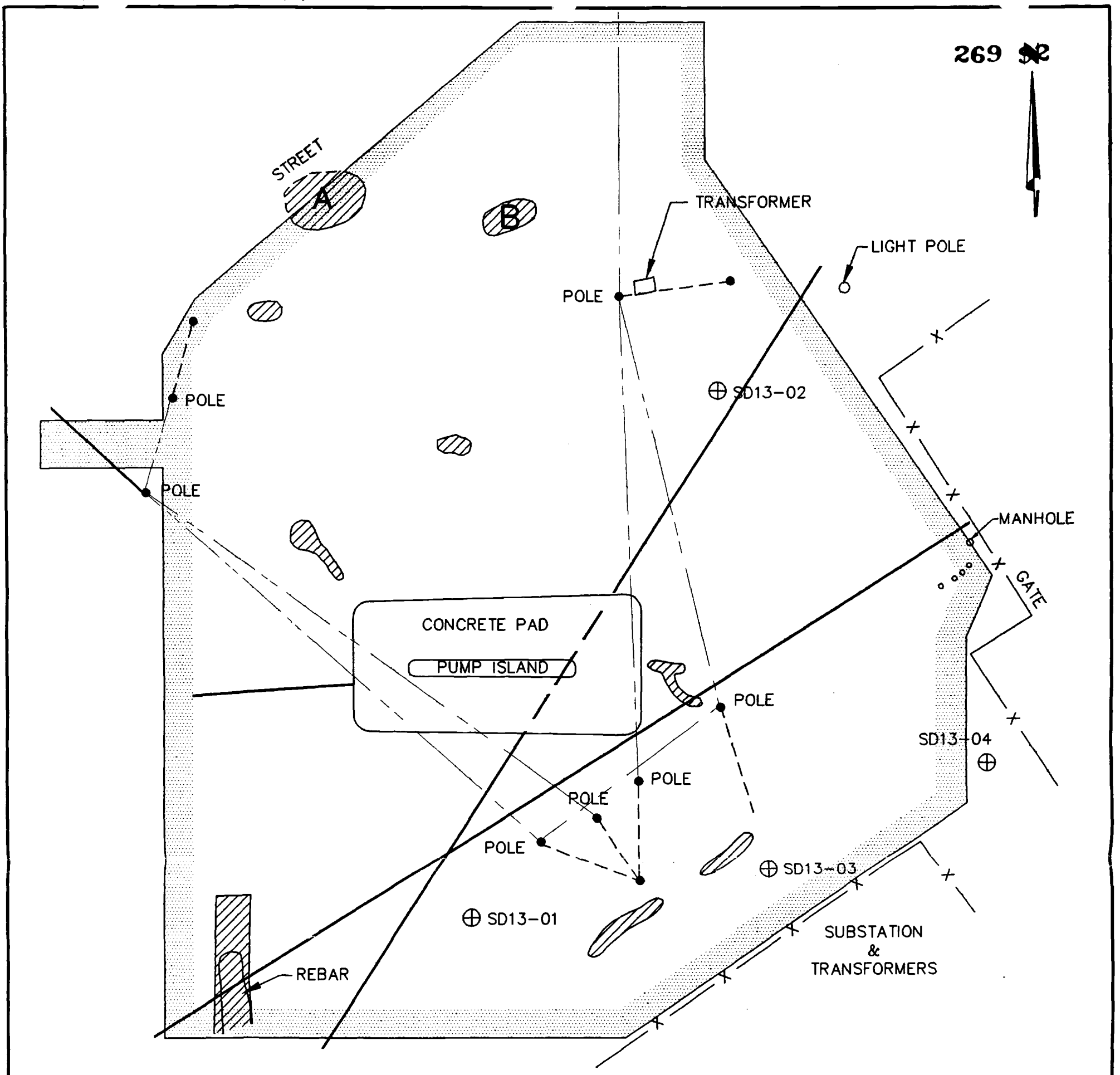
Velocity = 3.96 by 10^{-5} ft/min = 21 feet per year

4.2.1 Geophysical Survey

Geophysical surveys were performed at the Abandoned Gas Station site to help evaluate the potential for USTs in the area. Geophysical anomalies indicative of buried piping, reinforced concrete and other buried metal were identified in the survey area. The lateral extents of the interpreted anomalies are shown on Figure 4-12 as shaded zones. Some of these zones were further interpreted to contain buried metallic pipes. Nine zones of buried metal were identified at the site.

Five of the interpreted zones of buried metal were located north of the concrete pad and away from cultural interference. The three smallest zones are likely caused by small amounts of metal. The northernmost anomaly, marked A on Figure 4-12, is located at the south edge of the street. Anomaly B, east of Anomaly A, is large enough to be caused by a small UST. Both anomalies A and B may be caused by any one of a variety of subsurface targets, such as reinforced concrete, scrap metal, USTs, etc.

Three zones of buried metal were identified between the pump island and the substation. These likely were caused by discontinuous pipes or scrap metal.



LEGEND

- INTERPRETED ZONES OF BURIED METAL
- INTERPRETED BURIED PIPE OR CABLE
- ⊕ SD13-01 MONITORING WELL
- UTILITY POLE AND GUY WIRE
- OVERHEAD LINE
- CYCLONE FENCE
- LIMITS OF GEOPHYSICAL SURVEY

0 30 60
APPROXIMATE SCALE IN FEET

NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

LAW
ENGINEERING AND ENVIRONMENTAL SERVICES

INTERPRETATION OF GEOPHYSICAL ANOMALIES ABANDONED SERVICE STATION SITE

JOB NO. 11-3517-0111 FIGURE 4-12

One anomalous zone was located in the southwest corner of the site. It was interpreted to be associated with reinforced concrete observed in the area.

Cultural interferences were observed within the site, including a reinforced concrete pad surrounding the pump island, a chain link fence, transformer, and power lines. Areas near these objects contain geophysical anomalies; it is possible that a metallic object, possibly a UST, may have been present and was masked within these areas.

4.2.2 Soil Sampling Results

One surface soil and three subsurface soil samples were collected from the monitoring well soil boring SD13-05 for chemical analysis at an off-site laboratory. One surface and three subsurface soil samples were collected from monitoring well soil borings SD13-06 and SD13-07. Positive analytical results are presented in Table 4-2. Sample concentrations of metals, volatile organic compounds (VOC), and total petroleum hydrocarbons (TPHs) detected at each soil boring are presented on Figures 4-13, 4-14, and 4-15, respectively. A majority of the metals analyzed were detected in the surface and subsurface soil samples collected for soil boring SD13-05. The laboratory analyses of soil samples collected from SD13-06 and SD13-07 (located in the area adjacent to the oil/water separator unit) detected a majority of the metals analyzed. Significant metals concentrations detected included arsenic, cadmium, chromium, calcium, cobalt, copper, nickel, vanadium, magnesium, lead, and manganese.

The sample results from surface sample SD13-MW05A for VOC analysis was nondetect for all constituents except methylene chloride. In the area of the oil/water separator, methylene chloride was detected in surface sample (SD13-MW06A) at an estimated

TABLE 4-2

POSITIVE RESULTS SUMMARY TABLE
DO #11 SOIL BORINGS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER		SD13MW05A		SD13MW05B		Sample SD13MW05C		Duplicate SD13MWDP1		SD13MW05D	
	Date Sampled:	03/25/94		03/25/94		03/25/94		03/25/94		03/25/94	
	Depth:	1-3'		3-5'		5-7'		5-7'		7-9'	
E418.1/SW9071,MG/KG											
PETROLEUM HYDROCARBONS		90		2500		110		210		40	
Metals (SW6010/SW3050), MG/KG											
ALUMINUM		6600		4100		4100		4900		350	
ARSENIC		3.7		12		6.0		7.5		<3.5	
BARIUM		106		110		130		120		4.9	
BERYLLIUM		0.52		<1.7		<1.7		<1.7		<0.17	
CADMIUM		1.2		1.5		0.85		0.76		<0.34	
CALCIUM		27000	JH	210000	JH	160000	JH	150000	JH	350	JH
CHROMIUM, TOTAL		6.6		4.4		3.8		4.9		<0.67	
COBALT		3.4		4.4		2.0		2.5		<1.1	
COPPER		21	J	66	JH	44	JH	37	JH	20	JH
IRON		8000		8000		4200		4800		543	
LEAD		11	JH	6.5		6.1		6.8		<3.1	
MAGNESIUM		1200		1500		1100		1100		65	
MANGANESE		108	JH	340		100		94		1.8	
NICKEL		7.6		6.2		3.0		4.2		<2.1	
POTASSIUM		990		420		410		540		90	
SODIUM		47		110		80	J	15	J	<22	
VANADIUM		13		16		<8.5		<8.4		1.0	
ZINC		19	JH	30	JH	24	JH	21	JH	10	JH
Volatile Organics (SW8020/SW5030), MG/KG											
ETHYLBENZENE		<0.0005		<0.0005		<0.0005		<0.0005		<0.0005	
TOTAL XYLENE		<0.001		<0.001		<0.001		<0.001		<0.001	
TOLUENE		0.0008		<0.0005		<0.0005		<0.0005		0.0012	
Volatile Organics (SW8240/SW5030), MG/KG											
ACETONE		<0.012		<0.012		0.023		0.022		<0.012	
METHYLENE CHLORIDE		0.014		0.0098		0.014		0.0092		0.016	

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.

TABLE 4-2

POSITIVE RESULTS SUMMARY TABLE
DO #11 SOIL BORINGS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

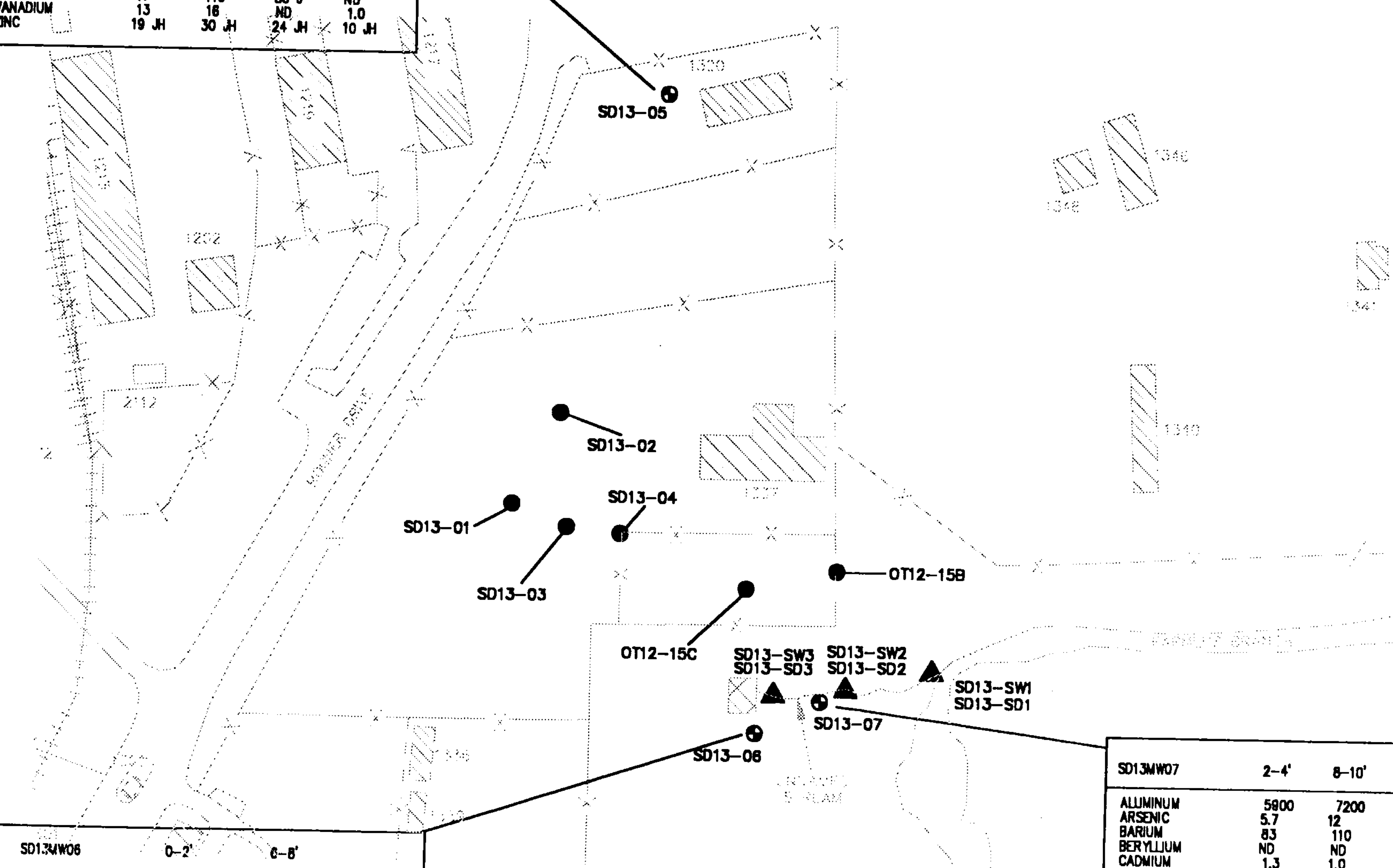
PARAMETER		SD13MW06A		SD13MW06D		SD13MW07B		SD13MW07E	
	Date Sampled:	03/24/94		03/24/94		03/24/94		03/24/94	
	Depth:	0-2'		6-8'		2-4'		8-10'	
E418.1/SW9071,MG/KG									
PETROLEUM HYDROCARBONS		440		670		54		8800	
Metals (SW6010/SW3050), MG/KG									
ALUMINUM		4800		5800		5900		7200	
ARSENIC		4.6		12		5.7		12	
BARIUM		53		100		83		110	
BERYLLIUM		<1.6		<1.6		<1.6		<1.9	
CADMIUM		1.2		1.2		1.3		1.0	
CALCIUM		87000	JH	10000	JH	86000	JH	120000	JH
CHROMIUM, TOTAL		9.7		7.9		7.1		8.8	
COBALT		3.9		5.0		4.9		5.4	
COPPER		19		19		17		42	
IRON		7800	JH	6900	JH	7700	JH	7500	JH
LEAD		36		14		9.3		13	
MAGNESIUM		1400		1800		1700		2400	
MANGANESE		260		280		320		360	
NICKEL		7.8		9.5		8.9		10	
POTASSIUM		720		820		860		1100	
SODIUM		72		110		54		290	
VANADIUM		14		20		23		20	
ZINC		21		33		16		32	
Volatile Organics (SW8020/SW5030), MG/KG									
ETHYLBENZENE		<0.0005		0.036		<0.0005		30	
TOTAL XYLENE		<0.001		0.052		<0.001		29	
TOLUENE		<0.0017		0.013		0.0032		<2.5	
Volatile Organics (SW8240/SW5030), MG/KG									
ACETONE		<0.011		0.034		<0.012		<3.1	
METHYLENE CHLORIDE		0.0069	JH	0.013	JH	0.0073	JH	<1.6	

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.

PREPARED/DATE: DRJ 05/24/94
CHECKED/DATE: JFO

3517-0111.20

SD13MW05 (BACKGROUND)	1-3'	3-5'	5-7'	7-9'
ALUMINUM	6600	4100	4100	350
ARSENIC	3.7	12	6.0	ND
BARIUM	106	110	130	4.9
BERYLLIUM	0.52	ND	ND	ND
CADMIUM	1.2	1.5	0.85	ND
CALCIUM	27000 JH	210000 JH	160000 JH	350 JH
CHROMIUM	6.6	4.4	3.8	ND
COBALT	3.4	4.4	2.0	ND
COPPER	21 J	66 JH	44 JH	20 JH
IRON	8000	8000	4200	543
LEAD	11 JH	6.5	6.1	ND
MAGNESIUM	1200	1500	1100	65
MANGANESE	108 JH	340	100	1.6
NICKEL	7.6	6.2	3.0	ND
POTASSIUM	990	420	410	90
SODIUM	47	110	80 J	ND
VANADIUM	13	16	ND	1.0
ZINC	19 JH	30 JH	24 JH	10 JH



SD13MW06	0-2'	6-8'
ALUMINUM	4800	5800
ARSENIC	4.6	12
BARIUM	53	100
BERYLLIUM	ND	ND
CADMIUM	1.2	1.2
CALCIUM	87000 JH	10000 JH
CHROMIUM	9.7	7.9
COBALT	3.9	5.0
COPPER	19	19
IRON	7800 JH	6900 JH
LEAD	36	14
MAGNESIUM	1400	1800
MANGANESE	260	280
NICKEL	7.8	9.5
POTASSIUM	720	820
SODIUM	72	110
VANADIUM	14	20
ZINC	21	33

SD13MW07	2-4'	8-10'
ALUMINUM	5900	7200
ARSENIC	5.7	12
BARIUM	83	110
BERYLLIUM	ND	ND
CADMIUM	1.3	1.0
CALCIUM	86000 JH	120000 JH
CHROMIUM	7.1	8.8
COBALT	4.9	5.4
COPPER	17	42
IRON	7700 JH	7500 JH
LEAD	9.3	13
MAGNESIUM	1700	2400
MANGANESE	320	360
NICKEL	8.9	10
POTASSIUM	860	1100
SODIUM	54	290
VANADIUM	23	20
ZINC	16	32

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

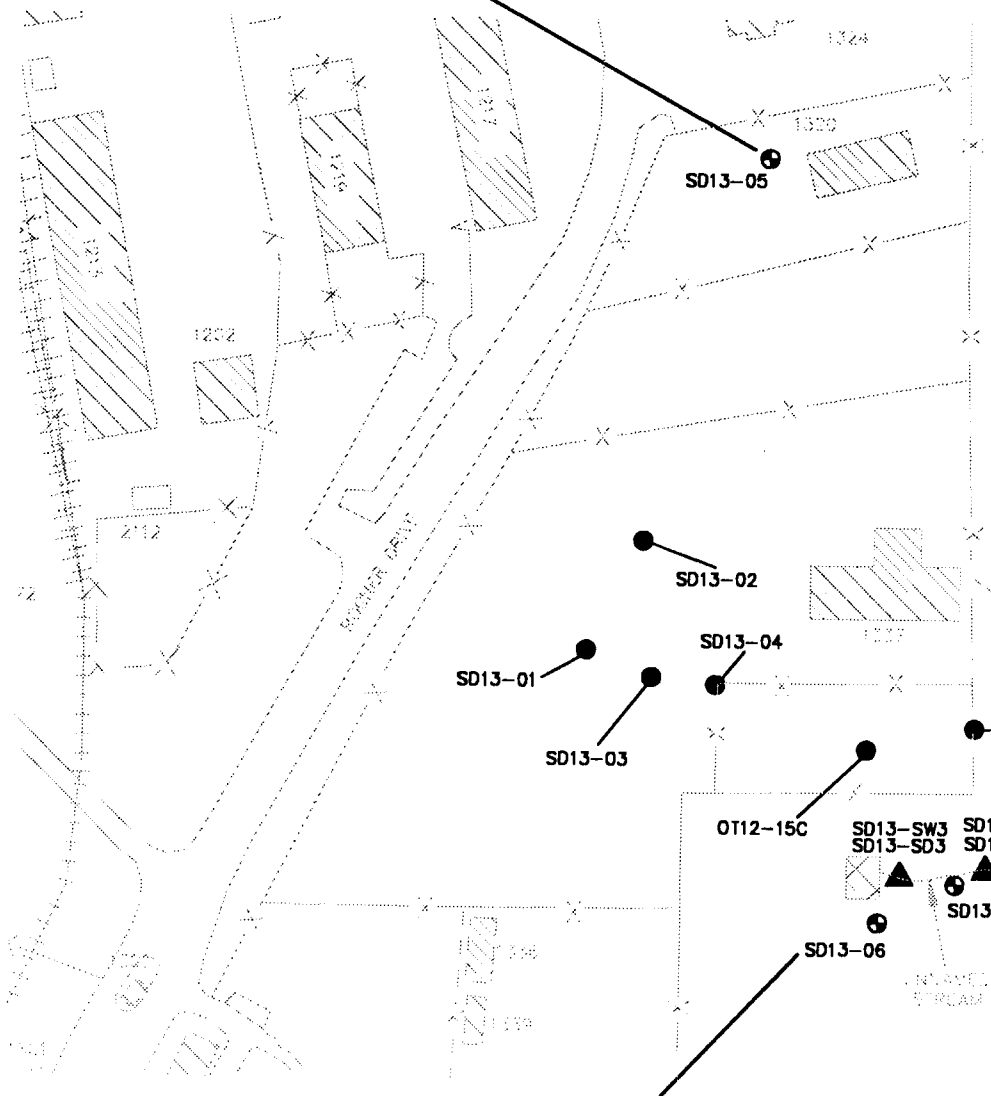
POSITIVE ANALYTICAL RESULTS SOIL BORINGS MARCH EPISODE – METALS (mg/Kg)

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER:	FILE DATE: 11.OCT.94
CHECKED BY: EDL	4-13	PLOT DATE: 22.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME: SOILMET.DWG

269 97

SD13MW05 (BACKGROUND)	1–3'	3–5'	5–7'	7–9'
BTEX (8020)				
ETHYLBENZENE	ND	ND	ND	ND
TOTAL XYLENE	ND	ND	ND	ND
TOLUENE	0.0008	ND	ND	0.0012
VOLATILE ORGANICS (8240)				
ACETONE	ND	ND	0.023	ND
METHYLENE CHLORIDE	0.014	0.0098	0.014	0.016



SD13MW07	2–4'	8–10'
BTEX (8020)		
ETHYLBENZENE	ND	30
TOTAL XYLENE	ND	29
TOLUENE	0.0032	ND
VOLATILE ORGANICS (8240)		
ACETONE	ND	ND
METHYLENE CHLORIDE	0.0073 JH	ND

SD13MW06	0–2'	6–8'
BTEX (8020)		
ETHYLBENZENE	ND	0.036
TOTAL XYLENE	ND	0.052
TOLUENE	ND	0.013
VOLATILE ORGANICS (8240)		
ACETONE	ND	0.034
METHYLENE CHLORIDE	0.0069 JH	0.013 JH

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X—X FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS SOIL BORINGS MARCH EPISODE– VOLATILE ORGANICS (mg/Kg)

POSITIVE RESULTS MAP

PREPARED BY:		FILE DATE:	11.OCT.94
CHECKED BY: CCK	FIGURE NUMBER: 4–14	PLOT DATE:	22.SEPT.95
PROJECT NO. 11–3517–0111		FILE NAME:	SOILVOL.DWG

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X—X FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

SD13MW05 (BACKGROUND)	1-3'	3-5'	5-7'	7-9'
PETROLEUM HYDROCARBONS	90	2500	110	40

SD13MW07	2-4'	8-10'
PETROLEUM HYDROCARBONS	54	8800

SD13MW06	0-2'	6-8'
PETROLEUM HYDROCARBONS	440	670

SD13-05
SD13-02
SD13-04
SD13-01
SD13-03
OT12-15C
OT12-15B
SD13-SW3
SD13-SD3
SD13-SW2
SD13-SD2
SD13-SW1
SD13-SD1
SD13-07
SD13-06

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS SOIL BORINGS MARCH EPISODE- PETROLEUM HYDROCARBONS (mg/Kg)

POSITIVE RESULTS MAP

PREPARED BY:		FIGURE NUMBER:	FILE DATE:	11.OCT.94
CHECKED BY:	SBD	4-15	PLOT DATE:	22.SEPT.95
PROJECT NO.	11-3517-0111		FILE NAME:	SOILPET.DWG

concentration below the detection limit. In subsurface soil samples, methylene chloride and acetone were detected at low concentrations from the samples collected from monitoring well borings SD13-05, SD13-06, and SD13-07.

BTEX analysis of soil samples collected from SD13-05 was nondetect for benzene, ethylbenzene and total xylene. However, toluene was detected at 0.0008 mg/kg in surface soil sample SD13-MW05A (1 to 3 feet) and at 0.0012 mg/kg subsurface soil sample SD13-MW05D (7 to 9 feet). Surface soil sample SD13-MW06A was nondetect for BTEX. Subsurface soil sample SD13-MW07E (8 to 10 feet) had the highest concentrations of ethylbenzene and total xylene, 30 mg/kg and 29 mg/kg, respectively, and SD13-MW06D (6 to 8 feet) had the next highest concentrations at 0.036 mg/kg and 0.052 mg/kg. Toluene was detected at low concentrations in both subsurface soil samples SD13-MW06D (0.013 mg/kg) and SD13-MW07B (0.0032 mg/kg).

Petroleum hydrocarbons were detected in all soil samples collected for chemical analyses. The petroleum hydrocarbon sample results from SD13-MW05 ranged from 40 mg/kg (7 to 9 feet) to 2,500 mg/kg (3 to 5 feet). Petroleum hydrocarbon concentrations detected in SD13-06 and SD13-07 subsurface samples ranged from 54 mg/kg to 8,800 mg/kg and surface soil concentration in SB13-MW06 was 440 mg/kg. A comparison to background concentrations is presented in Section 5.2.1 for surface soils and Section 5.2.2 for subsurface soils.

4.2.3 Ground-Water Sampling Results

Ground-water samples were collected from eight monitoring wells in March, June, and September 1994, and the ground water was analyzed for metals, VOC, BTEX, petroleum hydrocarbons, and oil and grease. Nine wells were to be sampled; however, SD13-04 contained floating product during three sampling events and was not sampled for the above parameters. Monitoring well SD13-05 is the site background

well for the Unnamed Stream site. The positive analytical results for March, June, and September ground-water sampling episodes are located in Tables 4-3, 4-4, and 4-5, respectively. Sample concentrations of metals, VOC, BTEX, TPH, and oil and grease detected at each monitoring well during each sampling episode are shown on Figure 4-16 through Figure 4-24. A comparison to background concentrations is presented in Section 5.2.3.

March Ground-Water Sampling Results

One inch of free product was detected on the ground-water surface in monitoring well SD13-04 and, therefore, was not sampled for the analyses listed above. However, a product sample from SD13-04 was collected and analyzed for ignitability, diesel components and gasoline components. The floating product was sampled and identified as a diesel/gasoline mixture with a higher diesel fraction than gasoline fraction. The analytical results are presented in Table 4-6.

The metals detected in monitoring well SD13-05 included barium, calcium, iron, magnesium, manganese, potassium, sodium, zinc. Selenium was analyzed by graphite furnace (SW 7740) and was detected at 0.0014 mg/L. In addition to the metals detected in SD13-05, copper and iron were detected at low concentrations in OT12-15B and SD13-07. Selenium was detected at the same concentration (0.0014 mg/L) as detected in ground-water samples for SD13-05 in the ground-water sample from monitoring well OT12-15C and at a slightly higher concentration (0.0025 mg/L) in OT12-15B. Aluminum, arsenic, barium, cadmium, chromium, copper, iron and lead were detected in SD13-01, SD13-02, SD13-03, at levels higher than the level detected in SD13-05. Fewer metals were detected at significant concentrations in ground-water samples OT12-15C and SD13-MW06, including aluminum, barium, copper, iron, and lead.

TABLE 4-3

POSITIVE RESULTS SUMMARY TABLE
GROUNDWATER SAMPLES – MARCH
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Sample Date:	OT12-15B 03/30/94		OT12-15C 03/29/94		SD13-MW01 03/29/94		SD13-MW02 03/29/94		SD13-MW03 03/29/94	
E418.1/METHOD, MG/L											
PETROLEUM HYDROCARBONS		<1.0		<1.0		4.4		<1.1		5.2	
METALS (SW6010/SW3005), MG/L											
ALUMINUM		<0.1		1.5		0.241	JB	0.14	JB	0.68	JB
ARSENIC		<0.042		<0.042		0.047		<0.042		0.044	
BARIUM		0.22		0.27		0.298		0.37		0.44	
CADMIUM		<0.004		<0.004		0.004		0.004		0.004	
CALCIUM		330		280		140		140		180	
CHROMIUM, TOTAL		0.008		<0.008		0.008		0.012		0.008	
COBALT		<0.013		<0.013		<0.013		<0.013		<0.013	
COPPER		0.018		0.029		0.01		0.016		0.009	
IRON		0.22		1.2	J	14.727	J	0.740	J	17	J
LEAD		<0.037		<0.037		<0.037		<0.037		7.3	
MAGNESIUM		9.6		5.6		5.9		5.8		7.3	
MANGANESE		0.17		0.5		0.129		0.35		0.2	
MOLYBDENUM		<0.036		<0.036		<0.036		<0.036		<0.036	
NICKEL		<0.025		<0.025		<0.025		<0.025		<0.025	
POTASSIUM		2.4		2.6		0.9 JB		2.1		1.3	
SODIUM		26		27		20		23		21	
VANADIUM		<0.01		<0.01		<0.01		<0.01		<0.01	
ZINC		0.066		0.044		0.032		0.14		0.076	
METALS (SW7060/SW3005), MG/L											
ARSENIC		<0.002		<0.002		0.05950		0.0023		0.042	
METALS (SW7421/SW3005), MG/L											
LEAD		<0.001		0.0023	JB	0.0014	JB	0.0013	JB	0.0049	JB

269101

TABLE 4-3

POSITIVE RESULTS SUMMARY TABLE
GROUNDWATER SAMPLES - MARCH
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Sample Date:	OT12-15B 03/30/94	OT12-15C 03/29/94	SD13-MW01 03/29/94	SD13-MW02 03/29/94	SD13-MW03 03/29/94	
METALS (SW7740/SW3005), MG/L							
SELENIUM		0.0025	0.0014	<0.001	<0.001	<0.001	
Volatile Organics (SW8020/SW5030), µg/L							
ETHYLBENZENE		<0.5	<0.5	4.89	<0.5	3.5	JL
TOTAL XYLENE		<1.0	<1.0	<5.0	<1.0	4.7	JL
TOLUENE		<0.5	<0.5	<2.5	<0.5	<0.5	
Volatile Organics (SW8240/SW5030), µg/L							
TETRACHLOROETHYLENE(PCE)		9.1	<5.0	<5.0	<5.0	<5.0	
OIL AND GREASE, MG/L							
OIL & GREASE, TOTAL REC		2.1	<1.1	1.2	1.3	<1.1	

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.
JL - Estimated quantitation - possibly biased low based upon QC data.
JB - Estimated quantitation - possible biased high or false positive based upon blank data.
NA - Not analyzed
* SD13-MW04 contained free product and was analyzed only for ignitability, gasoline, and diesel components (see Table 4-6).

269102

TABLE 4-3

POSITIVE RESULTS SUMMARY TABLE
GROUNDWATER SAMPLES – MARCH
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER			Sample	Duplicate		
	Sample Date:	SD13-MW04* 03/30/94	SD13-MW05 03/30/94	SD13-MWDUP1 03/30/94	SD13-MW06 03/30/94	SD13-MW07 03/30/94
E418.1/METHOD, MG/L						
PETROLEUM HYDROCARBONS		Free Product – NA	<1.0	<1.0	<1.0	1.9
METALS (SW6010/SW3005), MG/L						
ALUMINUM		NA	<0.1	<0.1	0.14 JB	<0.1
ARSENIC		NA	<0.042	<0.042	<0.042	<0.042
BARIUM		NA	0.2	0.21	0.25	0.31
CADMIUM		NA	<0.004	<0.004	0.004	<0.004
CALCIUM		NA	140	140	190	160
CHROMIUM, TOTAL		NA	<0.008	<0.008	<0.008	<0.008
COBALT		NA	<0.013	<0.013	<0.013	<0.013
COPPER		NA	<0.008	<0.008	0.013	0.008
IRON		NA	0.05 JB	<0.05	1.1 JB	4.1
LEAD		NA	<0.037	<0.037	<0.037	<0.037
MAGNESIUM		NA	4.5	4.4	12	6.3
MANGANESE		NA	0.044	0.041	0.39	0.57
MOLYBDENUM		NA	<0.036	<0.036	<0.036	<0.036
NICKEL		NA	<0.025	<0.025	<0.025	<0.025
POTASSIUM		NA	1.7	1.6	2.9	1.3
SODIUM		NA	26	25	26	27
VANADIUM		NA	<0.01	<0.01	<0.01	<0.01
ZINC		NA	0.011	0.01	0.1	0.068
METALS (SW7060/SW3005), MG/L						
ARSENIC		NA	<0.002	<0.002	0.0024	<0.002
METALS (SW7421/SW3005), MG/L						
LEAD		NA	<0.001	<0.001	0.0017 JL	<0.001 JL

269103

TABLE 4-3

POSITIVE RESULTS SUMMARY TABLE
GROUNDWATER SAMPLES - MARCH
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER			Sample		Duplicate			
	Sample Date:	SD13-MW04* 03/30/94	SD13-MW05 03/30/94		SD13-MWDUP1 03/30/94		SD13-MW06 03/30/94	SD13-MW07 03/30/94
METALS (SW7740/SW3005), MG/L								
SELENIUM		NA	0.0014		0.0014		<0.001	<0.001
Volatile Organics (SW8020/SW5030), µg/L								
ETHYLBENZENE		NA	<0.5		<0.5		2.4	3.7
TOTAL XYLENE		NA	<1.0		<1.0		2.5	3.4
TOLUENE		NA	<0.5		<0.5		<0.5	<0.5
Volatile Organics (SW8240/SW5030), µg/L								
TETRACHLOROETHYLENE(PCE)		NA	<5.0		<5.0		<5.0	<5.0
OIL AND GREASE, MG/L								
OIL & GREASE, TOTAL REC		NA	<1.0	J	5.8	J	7.4	<1.0

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.
JL - Estimated quantitation - possibly biased low based upon QC data.
JB - Estimated quantitation - possible biased high or false positive based upon blank data.
NA - Not analyzed
* SD13-MW04 contained free product and was analyzed only for ignitability, gasoline, and diesel components (see Table 4-6).

PREPARED/DATE: DRJ 05/24/94
CHECKED/DATE: JFO

269104

TABLE 4-4

POSITIVE RESULTS SUMMARY TABLE
DO #11 GROUNDWATERS – JUNE
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Sample Date:	OT1215B 06/22/94		OT1215C 06/22/94	SD13MW01 06/21/94		SD13MW02 06/21/94		SD13MW03 06/21/94	
E418.1/METHOD,MG/L										
PETROLEUM HYDROCARBONS		<1.1		<1.2	3.2	JH	<1.1		3.5	
Metals (SW6010/SW3005), MG/L										
ALUMINUM		0.14		<0.1	<0.1		<0.1		0.32	
ARSENIC		<0.042		<0.042	0.047		<0.042		0.043	
BARIUM		0.26		0.28	0.34		0.26		0.42	
CADMIUM		<0.004		<0.004	0.004		<0.004		0.004	
CALCIUM		140		140	140		140		150	
CHROMIUM, TOTAL		<0.008		<0.008	0.011		<0.008		<0.008	
IRON		<0.05		0.052	12		0.98		16	
MAGNESIUM		7.6		4.4	6.1		6.5		7.3	
MANGANESE		0.095		0.19	0.16		0.47		0.22	
POTASSIUM		2.6		2.3	0.92		2.1		1.1	
SODIUM		26		27	22		24		22	
ZINC		0.066		0.048	0.04		0.038		0.059	
Metals (SW7060/SW3005), MG/L										
ARSENIC		<0.002		<0.002	0.059		<0.002		0.046	
Metals (SW7421/SW3005), MG/L										
LEAD		<0.001		<0.001	<0.001		<0.001		0.0021	
Metals (SW7740/SW3005), MG/L										
SELENIUM		0.0016		0.0027	0.0012		<0.001		<0.001	
Volatile Organics (SW8240/SW5030), UG/L										
BROMODICHLOROMETHANE		<1.0		<1.0	<1.0		<1.0		<1.0	
CHLOROFORM		2.5	JB	<5.0	<5.0		<5.0		<5.0	
DIBROMOCHLOROMETHANE		<5.0		<5.0	<5.0		<5.0		<5.0	
METHYLENE CHLORIDE		<5.0		<5.0	5.9	JB	4.4	JB	4.7	JB
TETRACHLOROETHYLENE(PCE)		8.3		0.96	<5.0		<5.0		<5.0	
TRICHLOROETHYLENE (TCE)		0.85		<5.0	<5.0		<5.0		<5.0	

J – Estimated quantitation based upon QC data.
JH – Estimated quantitation – possibly biased high based upon QC data.
JL – Estimated quantitation – possibly biased low based upon QC data.
JB – Estimated quantitation: possible biased high or false positive based upon blank data
NA - Not analyzed
* SD13MW04 contained free product – not sampled or analyzed.

TABLE 4-4

POSITIVE RESULTS SUMMARY TABLE
DO #11 GROUNDWATERS – JUNE
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Sample Date:	SD13MW04*	SD13MW05 06/23/94		SD13MW06 06/24/94		Sample SD13MW07 06/22/94		Duplicate SD13DUP1 06/22/94	
E418.1/METHOD,MG/L										
PETROLEUM HYDROCARBONS		Free Product – NA	<1.0		<1.0		1.6		1.9	
Metals (SW6010/SW3005), MG/L										
ALUMINUM		NA	<0.1		<0.1		<0.1	J	0.26	J
ARSENIC		NA	<0.042		<0.042		<0.042		<0.042	
BARIUM		NA	0.29		0.42		0.33		0.29	
CADMIUM		NA	<0.004		<0.004		0.004		<0.004	
CALCIUM		NA	120		170		160		170	
CHROMIUM, TOTAL		NA	<0.008		<0.008		<0.008		<0.008	
IRON		NA	<0.05		2.0		6.0		5.7	
MAGNESIUM		NA	3.6		12		6.8		6.7	
MANGANESE		NA	0.09		0.33		0.67		0.66	
POTASSIUM		NA	1.6		1.6		1.2		1.2	
SODIUM		NA	32		26		28		27	
ZINC		NA	0.063		0.098		0.051		0.011	
Metals (SW7060/SW3005), MG/L										
ARSENIC		NA	<0.002		0.0026		0.0033		0.0037	
Metals (SW7421/SW3005), MG/L										
LEAD		NA	<0.001		0.0029		<0.001		<0.001	
Metals (SW7740/SW3005), MG/L										
SELENIUM		NA	0.002		0.0012		<0.001		<0.001	
Volatile Organics (SW8240/SW5030), UG/L										
BROMODICHLOROMETHANE		NA	3.8		<1.0		<1.0		<1.0	
CHLOROFORM		NA	5.2	JB	<5.0		<5.0		<5.0	
DIBROMOCHLOROMETHANE		NA	0.47		<5.0		<5.0		<5.0	
METHYLENE CHLORIDE		NA	1.8	JB	12	JB	7.9	JB	7.1	JB
TETRACHLOROETHYLENE(PCE)		NA	<5.0		<5.0		<5.0		<5.0	
TRICHLOROETHYLENE (TCE)		NA	<5.0		<5.0		<5.0		<5.0	

J – Estimated quantitation based upon QC data.
JH – Estimated quantitation – possibly biased high based upon QC data.
JL – Estimated quantitation – possibly biased low based upon QC data.
JB – Estimated quantitation: possible biased high or false positive based upon blank data
NA - Not analyzed
* SD13MW04 contained free product – not sampled or analyzed.

PREPARED/DATE: DRJ 07-24-94
CHECKED/DATE: JFO

269405

TABLE 4-5

POSITIVE RESULTS SUMMARY TABLE
GROUNDWATER SAMPLES - SEPTEMBER
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER				Sample	Duplicate	
	Date:	OT1215B 08-SEP-94	OT1215C 08-SEP-94	SD13MW01 07-SEP-94	DUP1 07-SEP-94	SD13MW02 08-SEP-94
E418.1/METHOD, (mg/L)						
PETROLEUM HYDROCARBONS		<1.0	<1.0	2.5	3.2	<1.1
METALS (SW6010/SW3005), mg/L						
ARSENIC		<0.037	<0.037	0.073	0.075	<0.037
BARIUM		230	260	0.32 JB	0.31 JB	0.3
CALCIUM		130000	140000	120 JB	120 JB	130
CHROMIUM		<0.01	<0.01	<0.01	<0.01	0.012
COPPER		5.0	5.0	<0.004	0.004	0.006
IRON		<0.05	<0.05	12 JH	11 JH	0.19 JH
MAGNESIUM		6900	4400	5.6 JB	5.5 JB	6.2
MANGANESE		70	220	0.14 JB	0.13 JB	0.35
MOLYBDENUM		<0.01	<0.01	<0.01	<0.01	<0.01
NICKEL		<0.023	<0.023	<0.023	<0.023	<0.023
POTASSIUM		2900	2700	1 JB	1 JB	2.3 JB
SODIUM		29000	28000	22 JB	21 JB	24
ZINC		37	48	0.042 JB	0.037 JB	0.036
METALS (SW7060/SW3005), mg/L						
ARSENIC		<0.005	<0.005	0.065	0.065	<0.005
VOLATILE ORGANICS (SW8020/SW5030), µg/L						
M,P-XYLENE (SUM OF ISOMERS)		<1.0	<1.0	4.2	<1.0	<1.0
TOLUENE		<0.5	<0.5	3.4	2.4	<2.0
VOLATILE ORGANICS (SW8240/SW5030, µg/L						
BROMODICHLOROMETHANE		1.1	<5.0	<5.0	<5.0	<5.0
CHLOROFORM		3.4	0.35	<5.0	<5.0	<5.0
METHYLENE CHLORIDE		4.2	5.8	4.0 JB	2.6 JB	<5.0
TETRACHLOROETHYLENE(PCE)		6.1	<5.0	<5.0	<5.0	<5.0
TRICHLOROETHYLENE (TCE)		1.4	<5.0	<5.0	<5.0	<5.0
SW9070/METHOD,(MG/L)						
OIL & GREASE, TOTAL REC		<1.0	1.1	<1.0	<1.1	<10

JB - Estimated quantitation: possible biased high or false positive based upon blank data
JH - Estimated quantation: possibly biased high based upon QC data
NA - Not analyzed
* SD13MW04 contained free product - not sampled or analyzed

269107

TABLE 4-5

POSITIVE RESULTS SUMMARY TABLE
GROUNDWATER SAMPLES – SEPTEMBER
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Date:	SD13MW03 07-SEP-94	SD13MW04 *	SD13MW05 07-SEP-94	SD13MW06 08-SEP-94	SD13MW07 07-SEP-94
E418.1/METHOD, (mg/L)						
PETROLEUM HYDROCARBONS		3.1	NA	<1.0	<1.1	4.2
METALS (SW6010/SW3005), mg/L						
ARSENIC		0.048	NA	<0.037	<0.037	<0.037
BARIUM		0.37 JB	NA	0.29 JB	0.28	0.35 JB
CALCIUM		120 JB	NA	140 JB	180	160 JB
CHROMIUM		<0.01	NA	<0.01	<0.01	0.034
COPPER		0.005	NA	0.009	0.006	0.006
IRON		12 JH	NA	<0.05	6.3 JH	5.1 JH
MAGNESIUM		6.2 JB	NA	4.1 JB	13	6.8 JB
MANGANESE		0.16 JB	NA	0.078 JB	0.29	0.64 JB
MOLYBDENUM		<0.01	NA	<0.01	0.018	0.017
NICKEL		<0.023	NA	<0.023	<0.023	0.14
POTASSIUM		1.1 JB	NA	2 JB	1.3	1.4 JB
SODIUM		21 JB	NA	33 JB	24	29 JB
ZINC		0.038 JB	NA	0.045 JB	0.049	0.044 JB
METALS (SW7060/SW3005), mg/L						
ARSENIC		0.045	NA	<0.005	0.011	<0.005
VOLATILE ORGANICS (SW8020/SW5030), µg/L						
M,P-XYLENE (SUM OF ISOMERS)		1.8	NA	<1.0	2.6	2.4
TOLUENE		<2.0	NA	<2.0	4.8	<2.0
VOLATILE ORGANICS (SW8240/SW5030, µg/L						
BROMODICHLOROMETHANE		<5.0	NA	<5.0	<5.0	<5.0
CHLOROFORM		<5.0	NA	0.74 JB	<5.0	<5.0
METHYLENE CHLORIDE		<5.0	NA	5.4 JB	0.93	4.7 JB
TETRACHLOROETHYLENE(PCE)		<5.0	NA	<5.0	<5.0	<5.0
TRICHLOROETHYLENE (TCE)		<5.0	NA	<5.0	<5.0	<5.0
SW9070/METHOD,(MG/L)						
OIL & GREASE, TOTAL REC		<1.0	NA	<1.0	<1.0	<1.0

JB – Estimated quantitation: possible biased high or false positive based upon blank data
JH – Estimated quantation: possibly biased high based upon QC data
NA – Not analyzed
* SD13MW04 contained free product – not sampled or analyzed

PREPARED/DATE: DB 10-10-94
CHECKED/DATE: JFO

269108

269109

SD13MW01	
SW6010	
ALUMINUM	0.241 JB
ARSENIC	0.047
BARIUM	0.298
CADMIUM	0.004
CALCIUM	140
CHROMIUM	0.008
COPPER	0.01
IRON	14.727 J
MAGNESIUM	5.9
MANGANESE	0.129
POTASSIUM	0.9 JB
SODIUM	20
ZINC	0.032
SW7060	
ARSENIC	0.05950
SW7421	
LEAD	0.0014 JB

SD13MW02	
SW6010	
ALUMINUM	0.14 JB
BARIUM	0.37
CADMIUM	0.004
CALCIUM	140
CHROMIUM	0.012
COPPER	0.016
IRON	0.740 J
MAGNESIUM	5.8
MANGANESE	0.35
POTASSIUM	2.1
SODIUM	23
ZINC	0.14
SW7060	
ARSENIC	0.0023
SW7421	
LEAD	0.0013 JB

SD13MW05	
SW6010	
BARIUM	0.2
CALCIUM	140
IRON	0.05 JB
MAGNESIUM	4.5
MANGANESE	0.014
POTASSIUM	1.7
SODIUM	26
ZINC	0.011
SW7740	
SELENIUM	0.0014

SD13MW03	
SW6010	
ALUMINUM	0.58 JB
ARSENIC	0.044
BARIUM	0.44
CADMIUM	0.004
CALCIUM	180
CHROMIUM	0.009
COPPER	0.009
IRON	17 J
LEAD	7.3
MAGNESIUM	7.3
MANGANESE	0.2
POTASSIUM	1.3
SODIUM	21
ZINC	0.076
SW7060	
ARSENIC	0.042
SW7421	
LEAD	0.0049 JB

OT12-15B	
SW6010	
BARIUM	0.22
CALCIUM	330
CHROMIUM	0.008
COPPER	0.018
IRON	0.22
MAGNESIUM	9.6
MANGANESE	0.17
POTASSIUM	2.4
SODIUM	26
ZINC	0.066
SW7740	
SELENIUM	0.0025

SD13MW07	
SW6010	
BARIUM	0.31
CALCIUM	160
COPPER	0.008
IRON	4.1
MAGNESIUM	6.3
MANGANESE	0.57
POTASSIUM	1.3
SODIUM	27
ZINC	0.068

SD13MW06	
SW6010	
ALUMINUM	0.14 JB
BARIUM	0.25
CADMIUM	0.004
CALCIUM	190
COPPER	0.013
IRON	1.1 JB
MAGNESIUM	12
MANGANESE	0.39
POTASSIUM	2.9
SODIUM	28
ZINC	0.1
SW7060	
ARSENIC	0.0024
SW7421	
LEAD	0.0017 JL

OT12-15C	
SW6010	
ALUMINUM	1.5
BARIUM	0.27
CALCIUM	280
COPPER	0.029
IRON	1.2 J
MAGNESIUM	5.6
MANGANESE	0.5
POTASSIUM	2.6
SODIUM	27
ZINC	0.044
SW7421	
LEAD	0.0023 JB
SW7740	
SELENIUM	0.0014

SD13-05
SD13-02
SD13-04
SD13-01
SD13-03
OT12-15B
OT12-15C
SD13-SW3
SD13-SD3
SD13-SW2
SD13-SD2
SD13-SW1
SD13-SD1
SD13-07
SD13-06

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X——X FENCE LINE
- STREAM/RIVER

0 200 400
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

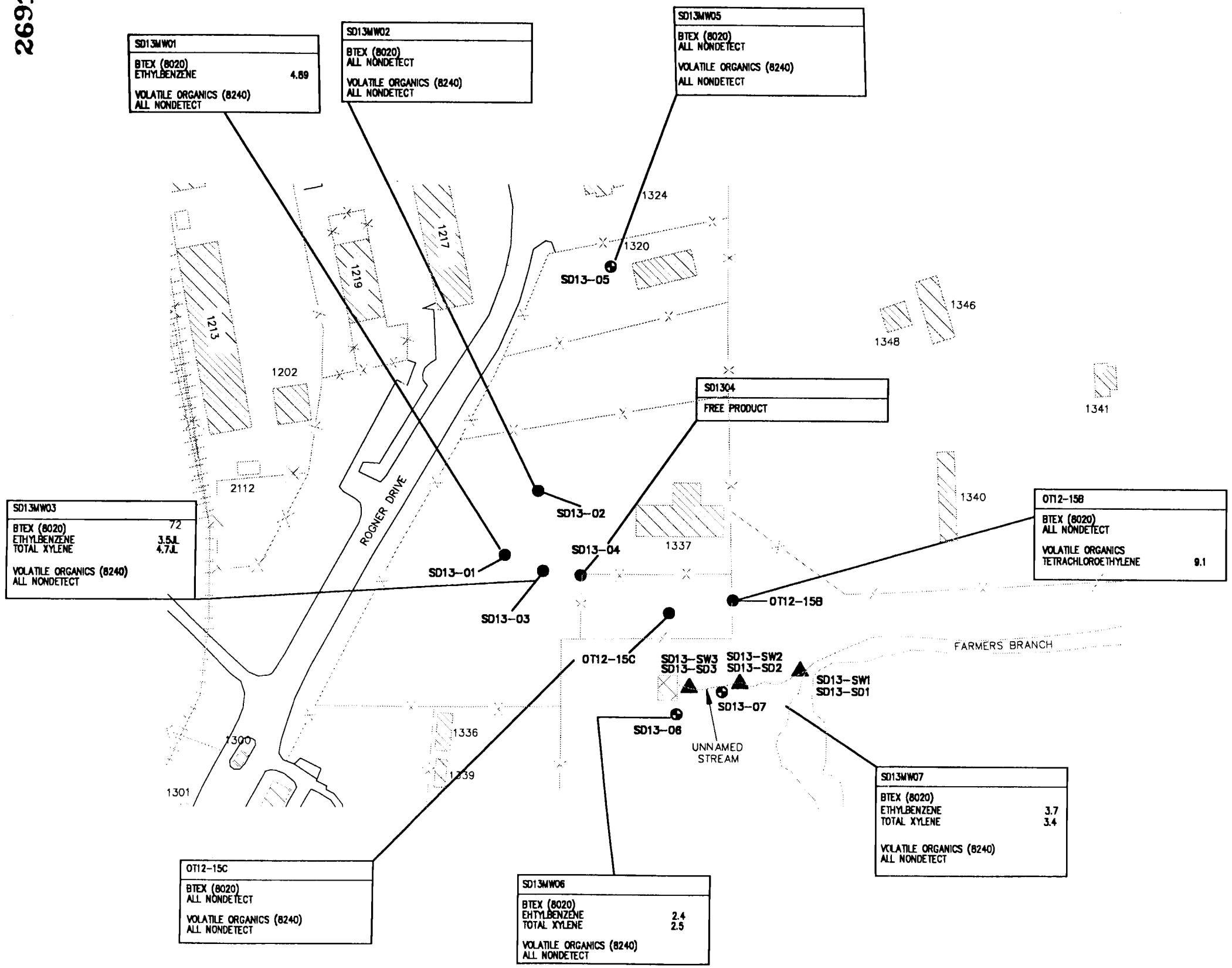
DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER MARCH EPISODE– METALS (mg/L)

POSITIVE RESULTS MAP

PREPARED BY:		FILE DATE:	11.OCT.94
CHECKED BY:		PLOT DATE:	22.SEPT.95
PROJECT NO.	11--3517--0111	FILE NAME:	GWAT3MET.DWG
	FIGURE NUMBER: 4-16		

269110



N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X—X FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

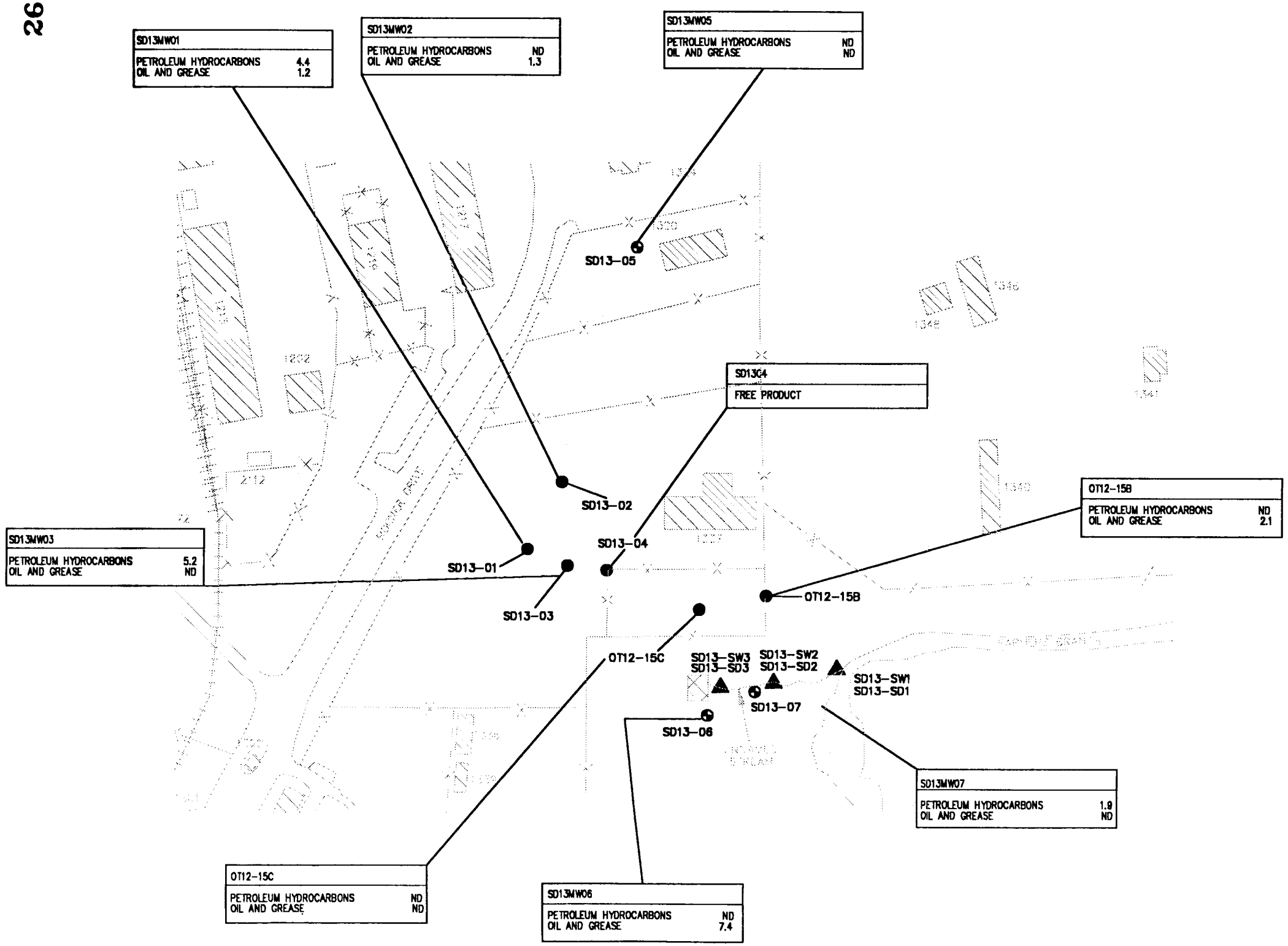
DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER MARCH EPISODE– VOLATILE ORGANICS (ug/L)

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER: 4-17	FILE DATE: 11.OCT.94
CHECKED BY:		PLOT DATE: 22.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME: GWAT3VOL.DWG

269111



N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X—X FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER MARCH EPISODE-PETROLEUM HYDROCARBONS AND OIL AND GREASE (mg/L)

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER:	FILE DATE:	11.OCT.94
CHECKED BY:	4-18	PLOT DATE:	22.SEPT.95
PROJECT NO. 11--3517--0111		FILE NAME:	GWAT3PET.DWG

269112

SD13MW01	
SW6010	
ARSENIC	0.047
BARIUM	0.34
CADMIUM	0.004
CALCIUM	140
CHROMIUM	0.011
IRON	12
MAGNESIUM	6.1
MANGANESE	0.16
POTASSIUM	0.92
SODIUM	22
ZINC	0.04
SW7060	
ARSENIC	0.059
SW7740	
SELENIUM	0.0012

SD13MW02	
SW6010	
BARIUM	0.26
CALCIUM	140
IRON	0.98
MAGNESIUM	6.5
MANGANESE	0.47
POTASSIUM	2.1
SODIUM	24
ZINC	0.038

SD13MW05	
SW6010	
BARIUM	0.29
CALCIUM	120
MAGNESIUM	3.6
MANGANESE	0.09
POTASSIUM	1.6
SODIUM	32
ZINC	0.063
SW7740	
SELENIUM	0.002

OT12-15B	
SW6010	
ALUMINUM	0.14
BARIUM	0.26
CALCIUM	140
MAGNESIUM	7.8
MANGANESE	0.095
POTASSIUM	2.6
SODIUM	26
ZINC	0.066
SW7740	
SELENIUM	0.0016

SD13MW03	
SW6010	
ALUMINUM	0.32
ARSENIC	0.043
BARIUM	0.42
CADMIUM	0.004
CALCIUM	150
IRON	16
MAGNESIUM	7.3
MANGANESE	0.22
POTASSIUM	1.1
SODIUM	22
ZINC	0.059
SW7060	
ARSENIC	0.046
SW7421	
LEAD	0.0021

OT12-15C	
SW6010	
BARIUM	0.28
CALCIUM	140
IRON	0.052
MAGNESIUM	4.4
MANGANESE	0.19
POTASSIUM	2.3
SODIUM	27
ZINC	0.048
SW7740	
SELENIUM	0.0027

SD13MW06	
SW6010	
BARIUM	0.42
CALCIUM	170
IRON	2.0
MAGNESIUM	12
MANGANESE	0.33
POTASSIUM	1.6
SODIUM	26
ZINC	0.098
SW7060	
ARSENIC	0.0026
SW7421	
LEAD	0.0029
SW7740	
SELENIUM	0.0012

SD13MW07	
SW6010	
BARIUM	0.33
CADMIUM	0.004
CALCIUM	160
IRON	6.0
MAGNESIUM	6.8
MANGANESE	0.67
POTASSIUM	1.2
SODIUM	28
ZINC	0.051
SW7060	
ARSENIC	0.0033

SD13-05
SD13-02
SD13-01
SD13-04
SD13-03
OT12-15B
OT12-15C
SD13-SW3
SD13-SD3
SD13-SW2
SD13-SD2
SD13-SW1
SD13-SD1
SD13-07
SD13-06

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X—X FENCE LINE
- STREAM/RIVER

0 200 400
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

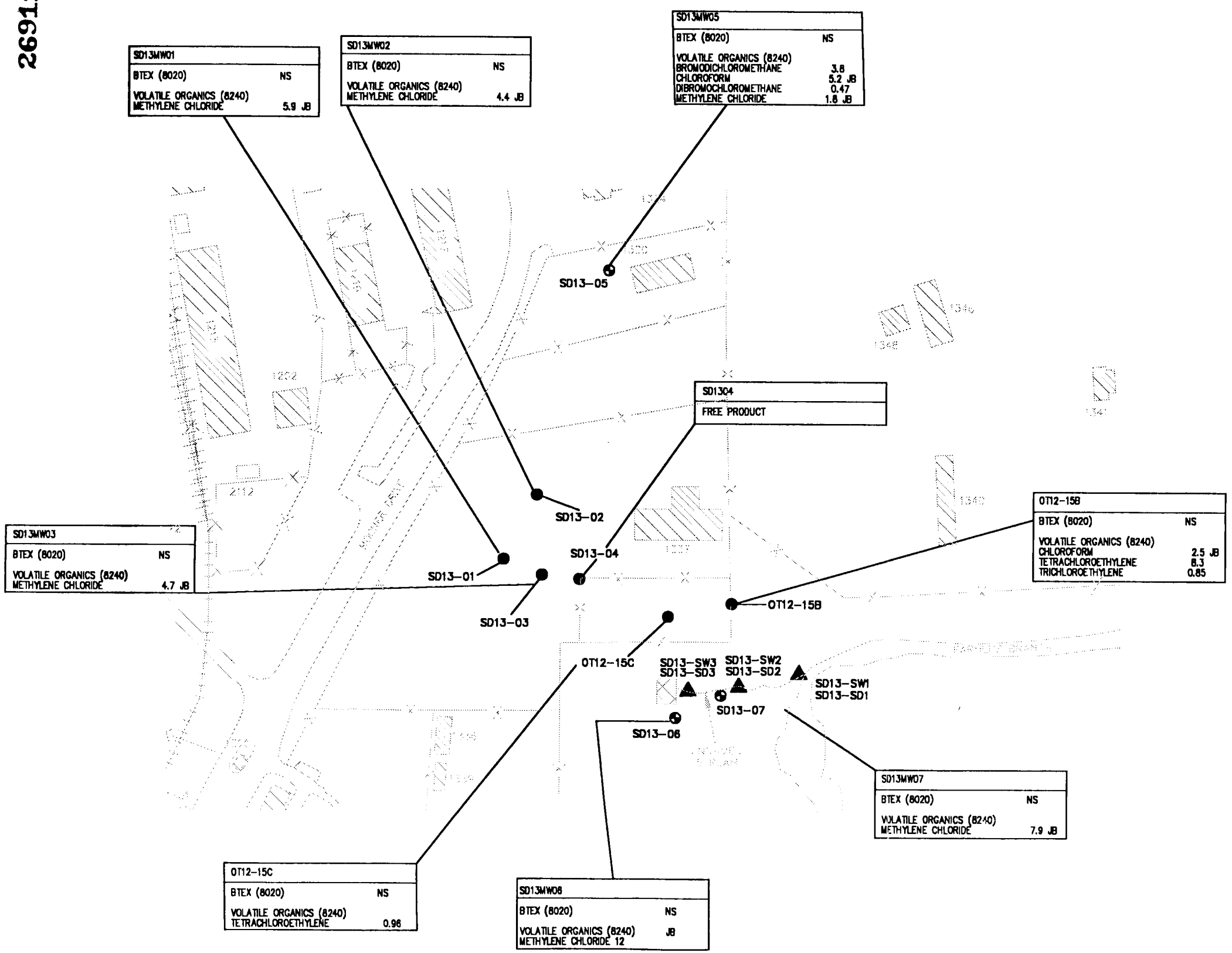
DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER JUNE EPISODE– METALS (mg/L)

POSITIVE RESULTS MAP

PREPARED BY:		FILE DATE:	11.OCT.94
CHECKED BY:		PLOT DATE:	22.SEPT.95
PROJECT NO.	11-3517-0111	FILE NAME:	GWAT6MET.DWG
	FIGURE NUMBER: 4-19		

269113



UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

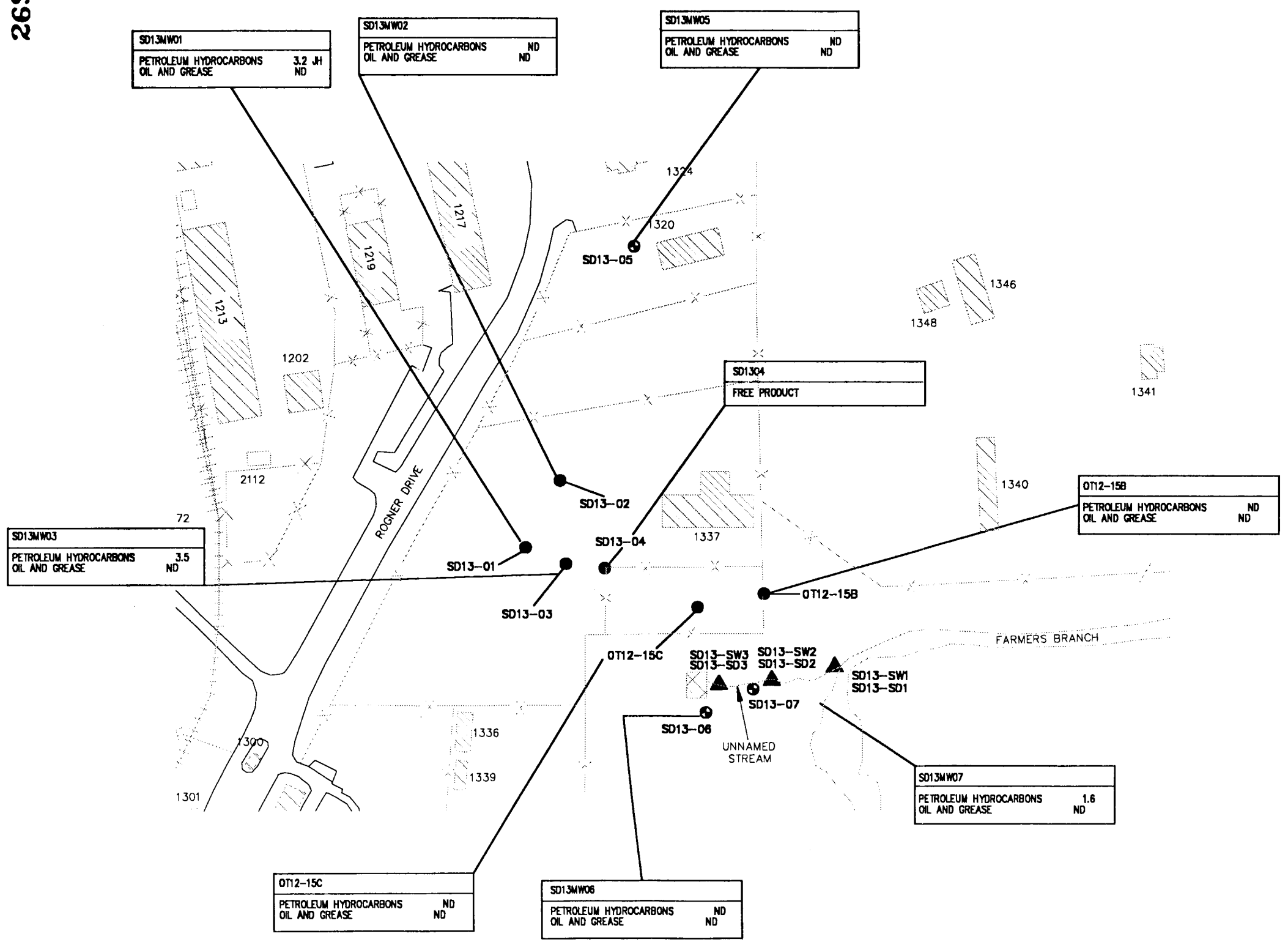
DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER JUNE EPISODE– VOLATILE ORGANICS (ug/L)

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER:	FILE DATE:	11.OCT.94
CHECKED BY:	4-20	PLOT DATE:	22.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME:	GWAT6VOL.DWG

269114



N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X——X FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER JUNE EPISODE–PETROLEUM HYDROCARBONS AND OIL AND GREASE (mg/L)

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER: 4-21	FILE DATE: 11.OCT.94
CHECKED BY: Eds		PLOT DATE: 22.SEPT.95
PROJECT NO.		FILE NAME: GWAT6PET.DWG

269115

SD13MW01

METALS (SW6010/SW3005) mg/L

ARSENIC	0.073
BARIUM	0.32 JB
CALCIUM	120 JB
IRON	12 JH
MAGNESIUM	5.6 JB
MANGANESE	0.14 JB
POTASSIUM	1 JB
SODIUM	22 JB
ZINC	0.042 JB

METALS (SW7060/SW3005) mg/L

ARSENIC	0.065

SD13MW02

METALS (SW6010/SW3005) mg/L

BARIUM	0.3
CALCIUM	130
CHROMIUM	0.012
COPPER	0.006
IRON	0.19 JH
MAGNESIUM	6.2
MANGANESE	0.35
POTASSIUM	2.3 JB
SODIUM	24
ZINC	0.036

SD13MW05

METALS (SW6010/SW3005) mg/L

BARIUM	0.29 JB
CALCIUM	140 JB
COPPER	0.009
MAGNESIUM	4.1 JB
MANGANESE	0.078 JB
POTASSIUM	2 JB
SODIUM	33 JB
ZINC	0.045 JB

SD13MW03

METALS (SW6010/SW3005) mg/L

ARSENIC	0.048
BARIUM	0.37 JB
CALCIUM	120 JB
COPPER	0.005
IRON	12 JH
MAGNESIUM	6.2 JB
MANGANESE	0.16 JB
POTASSIUM	1.1 JB
SODIUM	21 JB
ZINC	0.038 JB

METALS (SW7060/SW3005) mg/L

ARSENIC	0.045

OT12-15C

METALS (SW6010/SW3005) mg/L

BARIUM	260
CALCIUM	140000
COPPER	5.0
MAGNESIUM	4400
MANGANESE	220
POTASSIUM	2700
SODIUM	28000
ZINC	48

SD13MW06

METALS (SW6010/SW3005) mg/L

BARIUM	0.28
CALCIUM	180
COPPER	0.006
IRON	6.3 JH
MAGNESIUM	13
MANGANESE	0.29
MOLYBDENUM	0.018
POTASSIUM	1.3
SODIUM	24
ZINC	0.049

METALS (SW7060/SW3005) mg/L

ARSENIC	0.011

SD13MW07

METALS (SW6010/SW3005) mg/L

BARIUM	0.35 JB
CALCIUM	160 JB
CHROMIUM	0.034
COPPER	0.006
IRON	5.1 JH
MAGNESIUM	6.8 JB
MANGANESE	0.64 JB
MOLYBDENUM	0.017
NICKEL	0.14
POTASSIUM	1.4 JB
SODIUM	29 JB
ZINC	0.044 JB

OT12-15B

METALS (SW6010/SW3005) mg/L

BARIUM	230
CALCIUM	130000
COPPER	5.0
MAGNESIUM	6900
MANGANESE	70
POTASSIUM	2900
SODIUM	29000
ZINC	37

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X——X FENCE LINE
- STREAM/RIVER

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER SEPTEMBER EPISODE– METALS (mg/L)

POSITIVE RESULTS MAP

PREPARED BY:		FILE DATE:	31.OCT.94
CHECKED BY:		PLOT DATE:	22.SEPT.95
PROJECT NO.	11-3517-0111	FILE NAME:	GWAT9MET.DWG
	FIGURE NUMBER: 4-22		

269116

N

SD13MW01	
BTEX (8020)	
TOTAL XYLENE	4.2
TOLUENE	3.4
VOLATILE ORGANICS (8240)	
METHYLENE CHLORIDE	4.0 JB

SD13MW02
BTEX (8020) ALL NONDETECT
VOLATILE ORGANICS (8240) ALL NONDETECT

SD13MW05	
BTEX (8020)	
ALL NONDETECT	
VOLATILE ORGANICS (8240)	
CHLOROFORM	0.74 JB
METHYLENE CHLORIDE	5.4 JB

SD13MW03	
BTEX (8020)	
TOTAL XYLENE	1.8
VOLATILE ORGANICS (8240)	
ALL NONDETECT	

SD13G4
FREE PRODUCT

OT12-15B	
BTEX (8020)	
ALL NONDETECT	
VOLATILE ORGANICS	
BROMODICHLOROMOMETHANE	1.1
CHLOROFORM	3.4
METHYLENE CHLORIDE	4.2
TETRACHLOROETHYLENE	6.1
TRICHLOROETHYLENE	1.4

OT12-15C	
BTEX (8020)	
ALL NONDETECT	
VOLATILE ORGANICS (8240)	
CHLOROFORM	0.35
METHYLENE CHLORIDE	5.8

SD13MW06	
BTEX (8020)	
TOLUENE	2.8
TOTAL XYLENE	4.8
VOLATILE ORGANICS (8240)	
METHYLENE CHLORIDE	0.93

SD13MW07	
BTEX (8020)	
TOTAL XYLENE	2.4
VOLATILE ORGANICS (8240)	
METHYLENE CHLORIDE	4.7 JB

ROGNER DRIVE

UNNAMED STREAM

SD13-01 SD13-02 SD13-03 SD13-04 SD13-05 SD13-06 SD13-07 SD13-SW1 SD13-SD1 SD13-SW2 SD13-SD2 SD13-SW3 SD13-SD3

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X—X FENCE LINE
- STREAM/RIVER

0 200

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

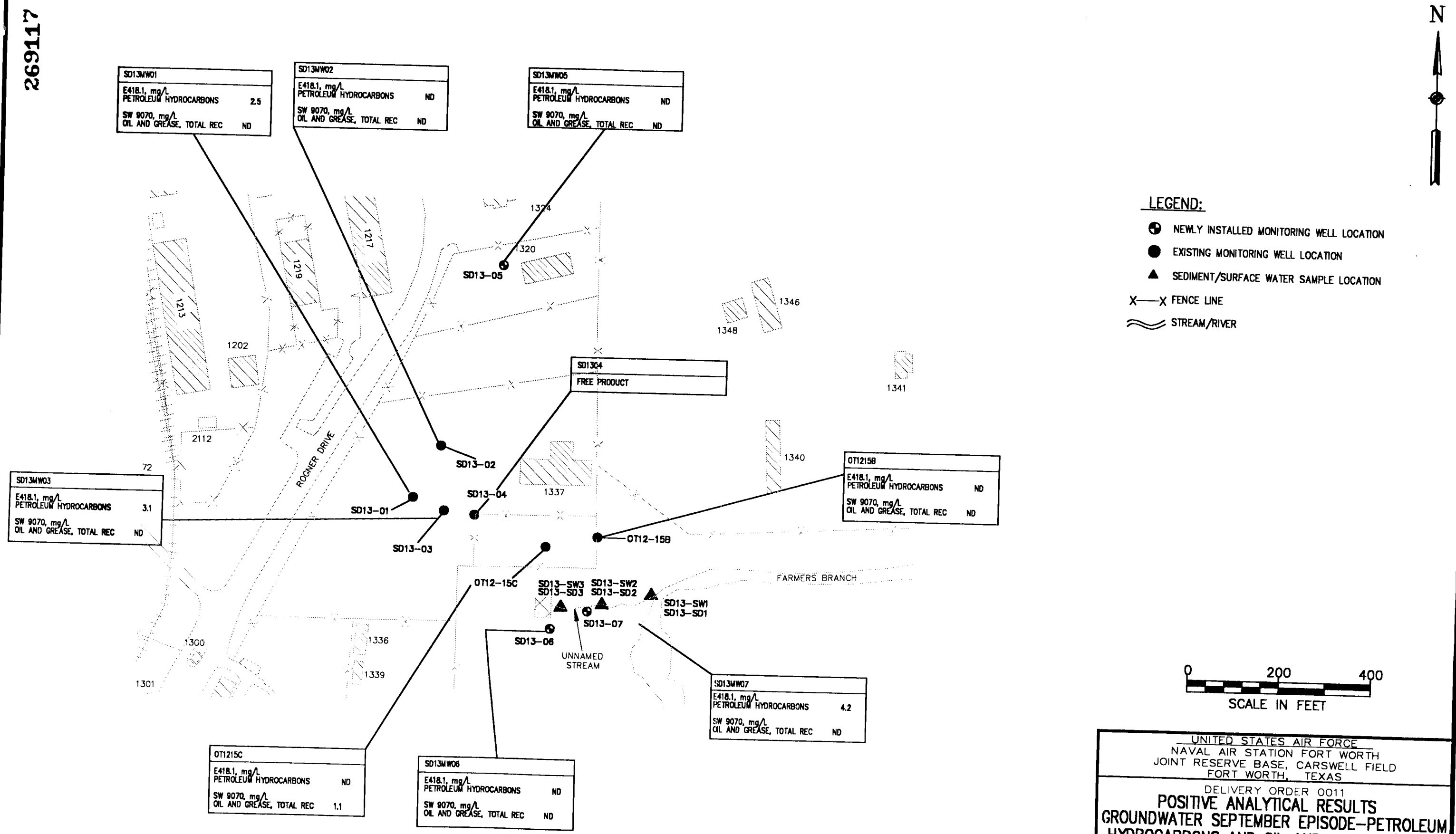
DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER SEPTEMBER EPISODE– VOLATILE ORGANICS (ug/L)

POSITIVE RESULTS MAP

PREPARED BY:		FIGURE NUMBER:	FILE DATE: 11.OCT.94
CHECKED BY:	3 Oct 95	4-23	PLOT DATE: 02.OCT.95
PROJECT NO.	11-3517-0111		FILE NAME: GWSEPT.DWG

269117



UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS GROUNDWATER SEPTEMBER EPISODE–PETROLEUM HYDROCARBONS AND OIL AND GREASE (mg/L)

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER: 4-24	FILE DATE:	31.OCT.94
CHECKED BY:		PLOT DATE:	22.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME:	GWAT9PET.DWG

TABLE 4-6

ANALYTICAL DATA SUMMARY TABLE
PRODUCT ANALYSIS OF FREE PRODUCT FROM SD13-MW04 - MARCH
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	SD13-MW04
M8015/M3510, MG/L	
DIESEL COMPONENTS	96000
GASOLINE COMPONENTS	9000
SW1010/METHOD, DEG (C)	
IGNITABILITY	78

PREPARED/DATE: DRJ 05/24/94
CHECKED/DATE: JFO

Sample results were nondetect for organic analysis (VOC, BTEX and petroleum hydrocarbons) and oil and grease analysis of the ground-water sample collected at SD13-05. Tetrachloroethylene was detected at a concentration of 9.1 µg/L in ground-water sample OT12-15B. Ethylbenzene and total xylene were detected above the Practical Quantitation Limit (PQL) in monitoring wells SD13-07, SD13-06 and SD13-03, while only ethylbenzene was detected above the PQL in ground-water samples collected from SD13-01. Petroleum hydrocarbons (4.4 mg/L) and oil and grease (1.2 mg/L) were both detected in SD13-01. Petroleum hydrocarbons were detected in the ground-water samples collected from SD13-07 (1.9 mg/L) and SD13-03 (5.2 mg/L). Positive oil and grease results were reported in three monitoring wells including SD13-02 (1.3 mg/L), OT12-15B (2.1 mg/L), and SD13-06 (7.4 mg/L).

June Ground-Water Sampling Results

The metals detected in monitoring well SD13-05, included barium, calcium, magnesium, manganese, potassium, sodium, and zinc. Selenium was analyzed by graphite furnace (SW 7740) and was detected at a concentration of 0.002 mg/L. With the exception of samples SD13-02, SD13-03, and SD13-07, selenium was detected in the remaining monitoring wells at concentrations ranging from 0.012 mg/L to 0.0027 mg/L. In addition to the metals found in SD13-05, iron was detected at low concentrations in SD13-02 (0.98 mg/L) and OT15-12C (0.052 mg/L). Aluminum, arsenic, cadmium, chromium, iron, magnesium, manganese, and zinc were detected in SD13-01, SD13-03, SD13-06, and SD13-07 at concentrations higher than those detected in SD13-05.

One-half inch of free petroleum product was detected in monitoring well SD13-04; no sample was obtained for analysis.

Sample results were nondetect for petroleum hydrocarbons and oil and grease analysis of the ground water collected at SD13-05.

However, volatile organics, bromodichloromethane, and dibromochloromethane were detected at concentrations of 3.8 µg/L and 0.47 µg/L, respectively. With the exception of ground-water samples OT12-15B and OT12-15C, methylene chloride was detected in all samples at an estimated concentration ranging from 1.8 µg/L to 12 µg/L. Chloroform was detected in SD13-05 and OT12-15B at estimated concentrations of 5.2 µg/L and 2.5 µg/L, respectively. Tetrachloroethylene was detected in ground-water sample OT12-15B (8.3 µg/L) and OT12-15C (0.96 µg/L). Trichloroethylene was detected in ground-water sample OT12-15B below the PQL. Petroleum hydrocarbons were detected in three monitoring wells including SD13-01 (3.2 mg/L), SD13-03 (3.5 mg/L), and SD13-07 (1.6 mg/L). Oil and grease sample results were nondetect in any of the ground-water samples collected during the June sampling episode.

September Ground-Water Sampling Results

The metals detected in monitoring well SD13-05 included barium, calcium, copper, magnesium, manganese, potassium, sodium and zinc (Table 4-5). In addition to the metals detected in SD13-05, iron and molybdenum were detected at low concentrations in SD13-06 and SD13-07. Chromium was detected at low levels in SD13-07 and SD13-02, and nickel was detected in SD13-07. Arsenic was detected in SD13-01 and SD13-03 by both Method SW 6010 and Method SW 7060. Arsenic was also detected in SD13-06 at low levels (0.011 mg/L) by Graphite Furnace Method SW 7060. Barium, calcium, copper, magnesium, manganese, potassium, sodium and zinc were detected in OT12-15B and OT12-15C at higher concentrations than the levels detected in SD13-05.

One inch of free petroleum product was detected in monitoring well SD13-04; no sample was obtained for analysis.

Sample results were nondetect for petroleum hydrocarbons, oil and grease, and BTEX (SW 8020) analysis of the ground water collected

at SD13-05. Methylene chloride and chloroform were detected at estimated concentrations. TPH was detected at low concentrations in SD13-01 (2.5 mg/L), SD13-03 (3.1 mg/L) and SD13-07 (4.2 mg/L). Oil and grease constituents were detected in one ground-water sample, OT12-15C. BTEX analysis (Method SW 8020) showed the presence of total xylene and toluene at low concentrations in SD13-06 and SD13-01. Also, xylene was detected at low concentrations (1.8 µg/L) in ground-water sample SD13-03. Sample results of volatile organic analysis (SW 8240) of September ground-water samples was nondetect for SD13-02 and SD13-03. Methylene chloride was detected in estimated concentration in SD13-01, SD13-05, and SD13-07. Otherwise, methylene chloride was detected in low levels in SD13-06, OT12-15B, and OT12-15C. Bromodichloromethane was detected in OT12-15B at 1.1 µg/L. Solvents tetrachloroethylene (PCE) and trichloroethylene (TCE) were detected in OT12-15B at 6.1 µg/L and 1.4 µg/L, respectively.

4.2.4 Surface-Water/Sediment Sampling Results

Three surface-water and three sediment samples were collected from the Unnamed Stream. The surface-water samples were analyzed for VOC, petroleum hydrocarbons, and oil and grease, and the sediment samples were analyzed for metals. The analytical positive results for surface-water samples are presented in Table 4-7, and for sediment samples in Table 4-8. The sample concentrations for surface-water and sediment samples are shown on Figure 4-25. A majority of the metals analyzed were detected in the sediment samples. Petroleum hydrocarbons were detected in surface-water samples SD13-SW01 (1.2 mg/L) and SD13-SW03 (1.2 mg/L). Oil and grease constituents were not detected in any surface-water sample. Of the VOCs analyzed, methylene chloride was detected at an estimated concentration of 6.9 µg/L in surface-water sample SD13-SW03.

TABLE 4-7

POSITIVE RESULTS SUMMARY TABLE
DO #11 SURFACE WATERS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Sample SD13-SW01 03/27/94	Duplicate SD13-SWDUP1 03/27/94	SD13-SW02 03/27/94	SD13-SW03 03/27/94
Date Sampled:				
E418.1/METHOD, MG/L				
PETROLEUM HYDROCARBONS	1.2	<1.0	<1.0	1.2
Volatile Organics (SW8240/SW5030), UG/L				
METHYLENE CHLORIDE	<5.0	6.5 JB	<5.0	6.9 JB
OIL AND GREASE, MG/L				
OIL & GREASE, TOTAL REC	<1.0	1.2	<1.0	<1.0

JL -Estimated quantitation - possibly biased low based upon QC data.
JB -Estimated quantitation: possible biased high or false positive based upon blank data.

PREPARED/DATE: DRJ 5/24/94
CHECKED/DATE: JFO

269122

TABLE 4-8

POSITIVE RESULTS SUMMARY TABLE
DO #11 SEDIMENTS
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

PARAMETER	Sample SD13SD01 Date Sampled: 03/27/94		Duplicate SD13SDDUP1 03/27/94		SD13SD02 03/27/94		SD13SD03 03/27/94	
METALS (SW6010/SW3050), MG/KG								
ALUMINUM	380	J	3600	J	5400	JH	5800	JH
ARSENIC	15		13		35		57	
BARIUM	97		88		130		110	
CADMIUM	1.5		1.2		1.7		110	
CALCIUM	120000	JH	120000	JH	110000	JH	90000	JH
CHROMIUM, TOTAL	8.5		6.8		7.6		7.9	
COBALT	4.6		4.5		4.1		3.8	
COPPER	27	J	12	J	10		11	
IRON	5.8	J	8500	J	17000	JH	16000	JH
LEAD	34	JH	32		19		11	
MAGNESIUM	1700		1300		1600		1700	
MANGANESE	188	JH	140	JH	200	JH	100	JH
NICKEL	10		9.6		11		10	
POTASSIUM	660		620		820		1100	
SELENIUM	<8.4		<8.1		8.7		<10	
SODIUM	110		88		130		110	
VANADIUM	21		14		17		17	
ZINC	103	J	34	J	24	JH	22	JH

J – Estimated quantitation based upon QC data.
JH – Estimated quantitation – possibly biased high based upon QC data.
JL – Estimated quantitation – possibly biased low based upon QC data.

PREPARED/DATE: DRJ 5/24/94
CHECKED/DATE: JFO

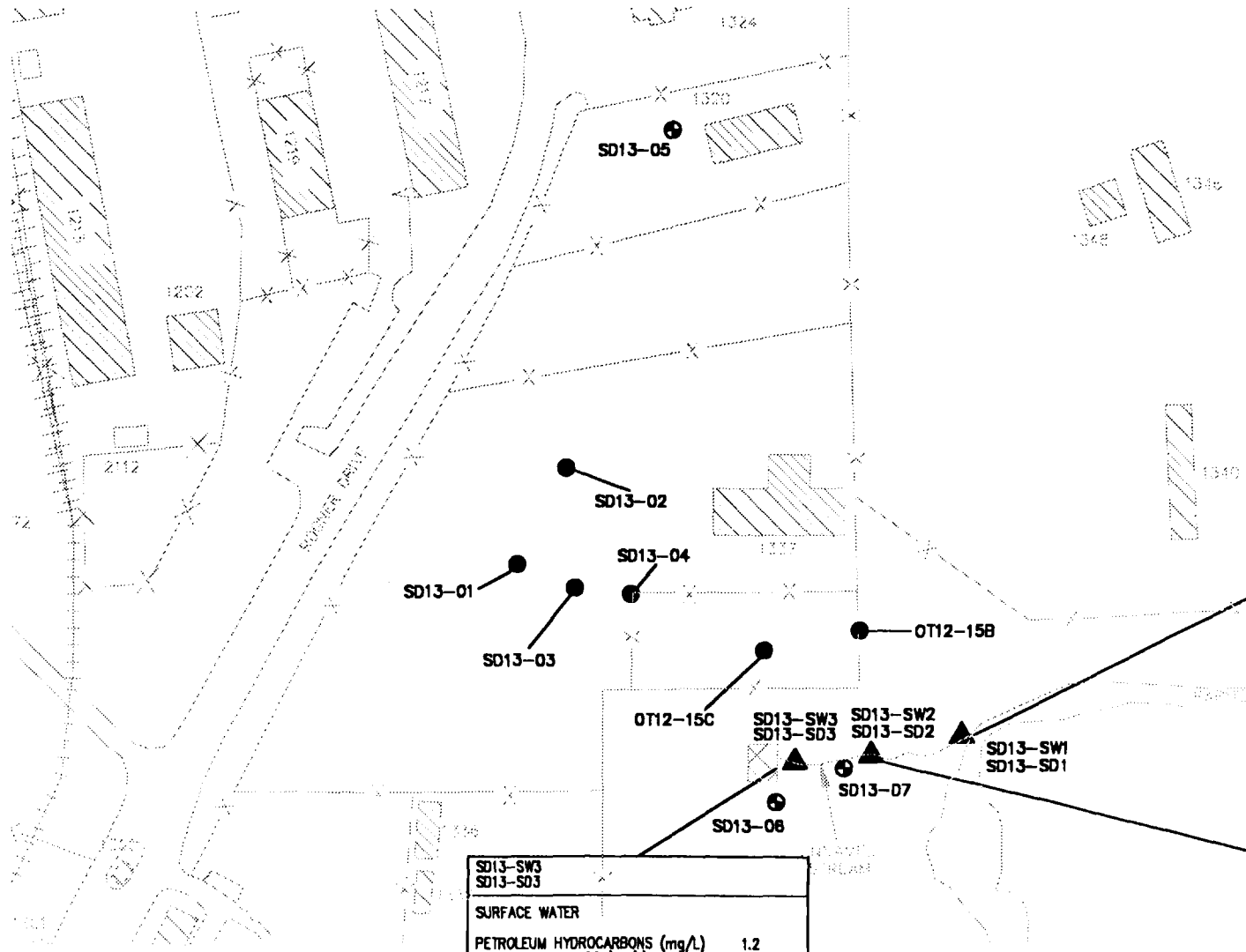
269123

269124

N

LEGEND:

- NEWLY INSTALLED MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION
- SEDIMENT/SURFACE WATER SAMPLE LOCATION
- X——X FENCE LINE
- STREAM/RIVER



SD13-SW1 / SD13-SD1	
SURFACE WATER	
PETROLEUM HYDROCARBONS (mg/L)	1.2
VOLATILE ORGANICS (ug/L)	ND
OIL AND GREASE (mg/L)	ND
SEDIMENT	
METALS (mg/kg)	
ALUMINUM	380 J
ARSENIC	15
BARIUM	97
CADMIUM	1.5
CALCIUM	120000 JH
CHROMIUM	8.5
COBALT	4.8
COPPER	27 J
IRON	5.8 J
LEAD	34 JH
MAGNESIUM	1700
MANGANESE	188 JH
NICKEL	10
POTASSIUM	680
SODIUM	110
VANADIUM	21
ZINC	103 J

SD13-SW2 / SD13-SD2	
SURFACE WATER	
PETROLEUM HYDROCARBONS (mg/L)	ND
VOLATILE ORGANICS (ug/L)	ND
OIL AND GREASE (mg/L)	ND
SEDIMENT	
METALS (mg/kg)	
ALUMINUM	5400 JH
ARSENIC	35
BARIUM	130
CADMIUM	1.7
CALCIUM	110000 JH
CHROMIUM	7.6
COBALT	4.1
COPPER	10
IRON	17000
LEAD	19
MAGNESIUM	1600
MANGANESE	200 JH
NICKEL	11
POTASSIUM	820
SELENIUM	8.7
SODIUM	130
VANADIUM	17
ZINC	24 JH

SD13-SW3 / SD13-SD3	
SURFACE WATER	
PETROLEUM HYDROCARBONS (mg/L)	1.2
VOLATILE ORGANICS (ug/L)	6.9 JB
OIL AND GREASE (mg/L)	ND
SEDIMENT	
ALUMINUM	5800 JH
ARSENIC	57
BARIUM	110
CADMIUM	110
CALCIUM	90000 JH
CHROMIUM	7.9
COBALT	3.8
COPPER	11
IRON	16000 JH
LEAD	11
MAGNESIUM	1700
MANGANESE	100 JH
NICKEL	10
POTASSIUM	1100
SODIUM	110
VANADIUM	17
ZINC	22 JH

0 200 400

SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

DELIVERY ORDER 0011

POSITIVE ANALYTICAL RESULTS SURFACE WATER / SEDIMENT MARCH EPISODE

POSITIVE RESULTS MAP

PREPARED BY:	FIGURE NUMBER: 4-25	FILE DATE:	11.OCT.94
CHECKED BY:		PLOT DATE:	22.SEPT.95
PROJECT NO. 11-3517-0111		FILE NAME:	SURFWAT.DWG

4.3 EXTENT OF CONTAMINATION DETECTED

Petroleum constituents are the major constituents of concern in the area of the POL Tank Farm and the Unnamed Stream. In March and April 1994, ground-water samples were collected and analyzed for BTEX from the ground-water screening in the area of the POL Tank Farm, and ground water was collected from the monitoring wells in the Abandoned Gasoline Station Area during March, June, and September 1994. To estimate the extent of ground water contaminated by petroleum constituents, concentrations of benzene greater than 5 µg/L are shown on Figure 4-26. Based on this criterion, ground-water contamination in the area of the POL Tank Farm is localized in two discrete areas: (1) an area east of Knights Lake Road (renamed Desert Storm Drive) in the vicinity of Building 1168, and (2) an area north of the intersection of Hobby Shop Road and Rogner Drive.

LAW did not determine the ground-water flow direction in the area of the POL Tank Farm. However, Radian Corporation (1991) previously determined that the ground-water flow was to the southeast. In March 1994, petroleum constituents were detected during the ground-water screening extending in a north-south trend from the vicinity of Building 1189 at the intersection of Knights Lake Road (Desert Storm Drive) and South Warehouse Street, south to the vicinity of the intersection of Hobby Shop Road and Rogner Drive. The orientation of the plume could be the result of the source(s) of the release, or the petroleum constituents may not be following the apparent ground-water flow direction to the southeast. Subsurface features such as weathered jointing within the underlying limestone bedrock could form preferential flow pathways influencing the migration of the petroleum constituents within the ground water.

Two isolated areas of petroleum-contaminated ground water were detected in the Unnamed Stream Area. The northern area adjacent to

269126

N

POL TANK FARM

HALL ROAD

KNIGHTS LAKE ROAD

ROGNER DRIVE

S. WAREHOUSE STREET

SHERRY CREEK ROAD

LANDFILL NO. 2

A-0+00 B-0+00 C-0+00
A-1+00 B-1+00 C-1+00
A-2+00 B-2+00 C-2+00
A-3+00 B-3+00 C-3+00
A-4+00 B-4+00 C-4+00
A-5+00 B-5+00 C-5+00
A-6+00 B-6+00 C-6+00 D-0+00
A-7+00 B-7+00 C-7+00 D-1+00
A-8+00 B-8+00 C-8+00 D-2+00
A-9+00 B-9+00
B-10+00

E-0+10 E-1+10 E-2+10 E-3+00 E-3+10 F-3+00 E-4+00 E-5+00 E-6+00

SD13-01 SD13-02 SD13-03 SD13-04 SD13-05 SD13-06 SD13-07
OT12-15B OT12-15C

LEGEND

SD13-06 ● GROUND-WATER MONITORING WELL
CONCENTRATION BTEX (ug/l)

E-5+00 • GROUND-WATER SAMPLE GRID LOCATION (APPROXIMATE)

IRP SITE LOCATIONS BASED ON DEPARTMENT OF THE AIR FORCE MASTER PLAN IRP SITES-SOIL CONTAMINATION CARSWELL AFB, FORT WORTH, TEXAS. REVISED 1985

PREVIOUS LOCATION OF RAILROAD

NOTE: GROUND-WATER SAMPLES COLLECTED IN MARCH/APRIL 1994.

0 200 400
SCALE IN FEET

UNITED STATES AIR FORCE
NAVAL AIR STATION FORT WORTH,
JOINT RESERVE BASE, CARSWELL FIELD
FORT WORTH, TEXAS

ESTIMATED EXTENT OF BENZENE CONCENTRATIONS (>5 ug/L) IN GROUND-WATER

SOURCE MAP: BASE COMPREHENSIVE PLAN

PREPARED BY:	FIGURE NUMBER: 4-26	FILE DATE: 10.OCT.94
CHECKED BY: 3 Oct 95		PLOT DATE: 03.OCT.95
PROJECT NO. 11-3517-0111		FILE NAME: BENZ-GW.DWG

Rogner Drive is located where the geophysical survey detected an anomaly that could be an underground storage tank. The other area was located west of Building 1337 Storage Yard, where 1 inch of free product was detected in monitoring well SD13-04.

Soil samples collected and analyzed during the installation of monitoring wells SD13-05, SD13-06, and SD13-07 contained constituents typical of petroleum contamination. As shown on Figure 4-15, concentration of TPH detected in the soil samples ranged from 40 mg/kg to 2,500 mg/kg in SD13-05, from 440 mg/kg to 670 mg/kg in SD13-06, and from 54 mg/kg to 8,800 mg/kg in SD13-07. The March 1994 analysis of ground-water samples from monitoring wells SD13-05, SD13-06, and SD13-07 detected low concentrations of BTEX ranging from below the detection limits in SD13-05 to 7.1 µg/L in SD13-07. Based on the comparison of soil sampling results with ground-water sampling results, the extent of petroleum contamination in the soil cannot be accurately predicted from the extent of petroleum contamination detected in the ground water. Due to the limited number of soil samples taken, the extent of the soil contamination due to petroleum-type constituents cannot be verified.

Ground-water samples were collected during three 1994 sampling episodes (March, June, September), in order to characterize possible trends of contamination. Lead contaminants decreased over time in SD13-03 from 7.3 mg/L to nondetect (less than 0.005 mg/L). Selenium and arsenic concentrations decreased over time across the entire site. Nickel and molybdenum were detected in SD13-07 during the September 1994 sampling event. OT12-15B and OT12-15C showed, in most cases, an increase in most metal concentrations when comparing June data to September data. For example, barium was detected in OT12-15B in June at a concentration of 0.26 mg/L and in September at a concentration of 230 mg/L. Similarly, calcium, copper, magnesium, manganese, potassium, sodium, and zinc increased in concentration 1,000 fold, in comparison to June and September data.

In general, constituents typical of petroleum contamination including benzene, ethylbenzene, toluene, and xylene appear to be migrating to the southeast. Furthermore, indicator methods such as oil and grease and TPH increase in the wells downgradient (toward the southeast) of the monitoring well with floating product (SD13-04). Monitoring wells SD13-06 and SD13-07 showed a slight increase of BTEX constituents in addition to an increase in TPH concentrations. Samples collected at SD13-01, SD13-02, and SD13-03, upgradient from SD13-04, showed a decrease of typical petroleum constituents.

Based on the increased BTEX, TPH, oil and grease, and metal concentrations detected at OT12-15C, OT12-15B, SD13-06, and SD13-07 (the monitoring wells closest to the Unnamed Stream and Farmers Branch), the suspected petroleum contamination appeared to be migrating southeast toward Farmers Branch.

The solvent PCE was detected in OT12-15B during the March, June, and September ground-water sampling episodes. The values for PCE (9.1 µg/L, 8.3 µg/L, and 6.1 µg/L, respectively) are relatively consistent and are all above the Texas Risk Reduction Rule for the industrial ground-water medium-specific concentration (MSC) of 5 µg/L.

5.0 COMPARISON OF ANALYTICAL DATA WITH REGULATORY STANDARDS

5.1 INTRODUCTION

This section compares the positive analytical results to the applicable regulatory standards appropriate for this investigation. The regulatory standards that apply to this investigation were selected based on available analytical data and LAW's understanding of current land use and probable future land use at the facility.

5.1.1 Regulatory Standards

5.1.1.1 Risk Reduction Standards - The Texas Natural Resource Conservation Commission (TNRCC) published its Final Risk Reduction Standards in the Texas Register which were made effective on June 29, 1993 (TNRCC, 1993) (Appendix G). The requirements of these standards were written to ensure the protection of human health and the environment from exposure to contaminants released from solid waste management facilities or other areas. Furthermore, the standards apply to closure of facilities used for the storage, processing, or disposal of industrial solid waste or municipal hazardous waste, and to remediation of contaminated media resulting from unauthorized releases from such facilities.

Under these standards, a regulated party may initiate site remediation or closure of a facility where contaminated media may exist by applying Risk Reduction Standard Numbers 1, 2, or 3. Attainment of Risk Reduction Standard Number 1 involves closure or remediation to background, or to the practical quantitation limit (PQL), if the PQL is greater than background. If Standard Number 1 is attained, the responsible party is not required to provide deed certifications as may be required under Risk Reduction Standards 2 and 3.

Attainment of Risk Reduction Standard Number 2 involves closure or remediation to health risk-based cleanup levels, namely, the Medium-Specific Concentrations (MSCs). The TNRCC has published MSCs for soil and ground water based on standard exposure parameters for both industrial and residential land use. Using Standard Number 2, the responsible party must register specific information in the registry of county deeds. This information includes a certification that closure or remediation of the area was carried out in accordance with this standard. If the facility meets the residential soil and ground-water requirements, no post-closure care, engineering or institutional control measures are required. However, if the industrial soil and ground-water MSCs are used, the deed certification must contain a statement that current or future owners of the facility are required to undertake actions as necessary to protect human health and the environment, in accordance with TNRCC regulations. The responsible party is released from responsibility for post-closure care once the deed certification is accepted by the executive director of the TNRCC.

If Risk Reduction Standard Number 3 is applied to a site, media cleanup levels are proposed based on an assessment of the potential risk to human health and the environment using site-specific conditions. Standard Number 3 provides flexibility for situations where closure or remediation by removal or decontamination would not be practical. This standard also requires deed certification. For this standard, the county deed records must state that remediation was carried out in accordance with this standard, and whether or not continued post-closure care, control or engineering measures are required.

5.1.1.2 NOAA Sediment Values - The National Oceanic Atmospheric Administration (NOAA) has developed Effects Range concentrations which are nonenforceable guidance criteria protective of aquatic life for estuarine sediments. These concentrations were derived

from data on the potential of these constituents to cause adverse biological effects in coastal marine and estuarine environments. Effects threshold range concentrations are defined as those concentrations at which effects may be perceived in an organism due to exposure to the constituent of concern.

Two effects-based values, the Effects Range-Low (ER-L) and the Effects Range-Median (ER-M), are usually determined for a given constituent, using a method similar to that used in establishing marine quality standards for the state of California (NOAA, 1990). This method involves a three-step approach. First, currently available information (i.e., studies and reports) which contain estimates of constituent sediment concentrations associated with adverse biological effects are assembled and reviewed. Next, a range is established for a particular constituent, based upon a preponderance of evidence, which reflects the concentrations at which biological effects are noted. Lastly, this range is evaluated relative to the sediment constituent data available from the National Status and Trends Program. The ER-L and ER-M values are generated as a result of this process. The ER-L is the 10^{th} percentile of this effects range, while the ER-M is the 50^{th} percentile of the reported range of concentrations associated with biological effects. NOAA ER-L values are used as lower benchmarks (below which effects are not expected to occur) to flag constituent levels of concern. The ER-M value is an upper benchmark above which a negative impact on some organisms is expected.

5.1.1.3 Surface-Water Criteria - There are two relevant surface-water criteria, the federal and the state Ambient Water Quality Criteria.

Federal Ambient Water Quality Criteria - The U.S. Environmental Protection Agency (USEPA) has developed Ambient Water Quality Criteria (AWQC) for constituents in surface waters. The AWQC for

the protection of aquatic organisms are derived based on two criteria: (1) acute criterion representing the maximum concentrations permissible at any time, and (2) chronic criterion representing the maximum permissible concentration averaged over a 24-hour time period.

The AWQC for the protection of human health accounts for ingestion of contaminated water and/or for the ingestion of contaminated organisms in surface waters (USEPA, 1987). The AWQC for the protection of human health from the ingestion of water and organisms assumes a daily intake of 2 liters of water and 6.5 grams of fish, while the AWQC for the protection of human health due to the ingestion of fish assumes an intake of 6.5 grams of fish daily. Ambient concentrations corresponding to several incremental lifetime cancer risk levels have been estimated for constituents exhibiting carcinogenic and/or mutagenic effects in laboratory tests and are, therefore, suspected of being carcinogenic to humans. The ambient concentrations which may result in 1 excess cancer per 1,000,000 persons (i.e., risk = 1×10^{-6}) are presented as AWQC for constituents known or suspected to be carcinogens.

Texas Water Quality Standards - The state of Texas has Water Quality Standards designed to maintain surface waters of satisfactory quality for public health and enjoyment, propagation and protection of terrestrial and aquatic life, and other beneficial uses of the water (TNRCC, 1992a). These standards are enforceable.

5.1.1.4 Risk-Based Corrective Action for Leaking Storage Tank Sites - This program was initiated in January 1994 and replaces the previous leaking petroleum storage tank sites (LPSTs) program, which was put into effect in March 1993. The program is aimed at storage tank sites that have been reported to have had a release, referred to as leaking petroleum storage tank sites (LPSTs). This

corrective action program is risk-based in the approach used to prioritize and remediate LPSTs, which enables a long-term approach necessary for proper management.

Two options (Plans A and B) are provided to establish target cleanup concentrations. Plan A cleanup levels are based on specified methods, conservative assumptions regarding human exposure, and site-specific factors to calculate site cleanup levels. Plan B requires completion of a limited risk assessment to evaluate current and potential future human health risks and short- and long-term fate of constituents. Plan A has target soil and ground-water concentrations for constituents typically found at LPST sites. Although the plan contains individual constituent target concentrations, target concentrations for total petroleum hydrocarbons (middle distillate or gasoline) are no longer in effect (TNRCC, 1994). The previous LPST program (March 1993) gives action levels for TPH (middle distillate and gasoline).

5.1.2 Environmental Setting

The scope of this site investigation was developed to determine the potential for impact to soil and ground water at the facility and to establish an environmental baseline. Background analytical soil data have been obtained for NAS Fort Worth from five soil boring locations (twelve samples) included under AFCEE Delivery Orders 0011 and 0021. Due to the heterogeneity of the soil matrix, a range of background concentrations has been applied (Risk Reduction Standard Number 1) for initial comparison of the data. Background analytical ground-water data have been obtained for the base from one ground-water monitoring well on three sampling occasions. Where site constituent concentrations exceed background concentrations, the next standard in the hierarchy of the regulation, Risk Reduction Standard Number 2, has been applied.

A comprehensive basewide background study is planned for NAS Fort Worth. While limited background information has been obtained and utilized for this study, future investigations should be compared to the subsequent comprehensive background study.

5.2 COMPARISON OF DATA TO RISK REDUCTION STANDARD NUMBERS 1 AND 2

Results of the data evaluation effort were first compared to background data and, where applicable, were then compared to Risk Reduction Standard Number 2 MSCs for soil and ground water. The land use at the site is now, and is expected to continue to be, industrial. Therefore, the MSCs for soil that were utilized for this site are the Soil/Air and Ingestion Standard for Industrial Land Use (SAI-Ind), and the Industrial Soil-to-Ground Water Cross-media Protection Concentration (GWP-Ind). The purpose of the GWP-Ind is to establish concentrations of chemicals in soils that, if leached downward into ground water, would not result in ground-water concentrations above health-based levels. The MSC for ground water that was utilized for this site is the ground-water MSC which is the maximum concentration allowed in ground water for residential exposure conditions (TNRCC, 1993). This area of the site is a recharge zone for the upper zone (Quaternary deposits), and water supply wells have previously been developed in these alluvial deposits in the community of River Oaks (USACE, 1991). Therefore, comparison of site ground-water data to ground-water MSCs is appropriate.

According to the requirements of the Risk Reduction Standard for industrial soil, the concentration of a contaminant within 2 feet of the surface shall not exceed the SAI-Ind nor the GWP-Ind, whichever is lower. At depths below 2 feet, concentrations shall not exceed the GWP-Ind (TNRCC, 1993).

5.2.1 Surface Soils

The analytical results for the surface soil samples were first compared to the surface soil background concentration range for the base. Detected concentrations of lead, manganese, and TPH exceeded their respective maximum surface soil background concentrations (Table 5-1). One sample (SD13-MW06A) had a PQL for beryllium that was higher than the reported maximum background concentration and was not used for comparison. All other detected metal concentrations were below or within their background ranges.

Concentrations of the metals were also compared to U.S. Geological Survey (USGS) data for metals detected in surface soils under ambient conditions in the Western United States (USGS, 1984). The detected metal concentrations fell within their expected ranges for ambient conditions.

Due to the exceedances of maximum surface soil background concentrations, the analytical results for lead and manganese were compared to the GWP-Ind and SAI-Ind MSCs, also in Table 5-1. This comparison shows that the GWP-Ind MSC for lead is exceeded in the surface soil sample, SD13-MW06A, taken to the south of Building 1337. Manganese does not have MSCs for comparison. Therefore, lead was the only metal detected in surface soils at the site which exceeded Standard Number 2 MSCs. Beryllium has a PQL that exceeds the background range and was therefore not included in one surface soil sample.

Five volatile organic compounds (VOCs) (acetone, ethylbenzene, methylene chloride, toluene, and total xylene) were the only VOCs detected above their PQLs. The concentrations of all five VOCs detected were below both their GWP-Ind and SAI-Ind MSCs. Therefore, the surface soils were in compliance with Risk Reduction Standard 2 for VOCs.

TABLE 5-1

SURFACE SOIL CONCENTRATIONS COMPARED TO INDUSTRIAL MSCs, BASE BACKGROUND AND AMBIENT CONCENTRATIONS
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	SD13MW05A 03/25/94 0-2' (mg/kg)	SD13MW06A 03/24/94 0-2' (mg/kg)	MSCs GWP-Ind (mg/kg)	MSCs SAI-Ind (mg/kg)	Surface Soil Background Range (a) (mg/kg)	Ambient Concentrations for the Western U.S. (b) (mg/kg)
Metals :						
Aluminum	6600	4800			6,600 - 16,000	5,000 - 100,000
Arsenic	3.7	4.6			3.7 - 5.3	<0.1 - 97
Barium	106	53			62 - 130	70 - 5,000
Beryllium	0.52	<1.6			0.52 - 0.87	<1 - 15
Cadmium	1.2	1.2			1.2 - 4.4	1 - 10 (c)
Calcium	27000 JH	87000 JH			6,200 - 190,000	600 - 320,000
Chromium (total)	6.6	9.7			6.6 - 18	3 - 2,000
Cobalt	3.4	3.9			2.2 - 6.3	<3 - 50
Copper	21 J	19			6.6 - 21	2 - 300
Iron	8000	7800 JH			6,000 - 17,000	1,000 - >100,000
Lead	11 JH	36	1.5	1,000	6.1 - 16	<10 - 700
Magnesium	1200	1400			1,200 - 1,900	300 - >100,000
Manganese	108 JH	260	--	--	108 - 250	30 - 5,000
Nickel	7.6	7.8			4.7 - 12	<5 - 700
Potassium	990	720			750 - 1,400	1,900 - 63,000
Sodium	47	72			36 - 120	500 - 100,000
Vanadium	13	14			13 - 37	7 - 500
Zinc	19 JH	21			10 - 26	10 - 2,100
Volatile Organics :						
Acetone	<0.012	<0.011	1,020	4,160	<0.011 - <0.012	--
Ethylbenzene	<0.0005	<0.0005	70	17,000	<0.0005 - <0.0057	--
Methylene Chloride	0.014	0.0069 JH	0.5	13.8	0.014-0.019	--
Toluene	0.0008	<0.0017	100	3,630	0.0008 - <0.0057	--
Xylene (total)	<0.001	<0.001	1,000	5,800	<0.001 - <0.0057	--
Total Petroleum Hydrocarbons :	90	440	--	--	90	--

GWP-Ind: Industrial Soil-to-Groundwater Crossmedia Protection Concentration
SAI - Ind: Industrial Soil/Air and Ingestion Standard
MSC: Medium Specific Concentration (where maximum background metal concentration is not exceeded, MSC is not presented)
(a) Background data collected from three locations throughout the base
(b) USGS, 1984
(c) USGS, 1975
J: Estimated quantitation based on QC data
JH: Estimated quantitation - possibly biased high based upon QC data
--: no data available
Boxes: Value exceeds maximum surface soil background concentration
Bold: Value exceeds GWP-Ind MSC
Italics: Value exceeds SAI-Ind MSC

PREPARED/DATE: CDH
CHECKED/DATE: JFO

269136

TPH was also detected at a concentration higher than background; however, they do not have MSCs for comparison. In addition, the background concentration of TPH was higher than could typically be expected. The concentrations of TPH detected in the surface soils were below the action level of 500 parts per million (ppm) for TPH from middle distillate releases (diesel fuel, kerosene, jet fuel, hydraulic oil, and waste oil releases) given in the previous TNRCC LPST sites program (March 1993).

5.2.2 Subsurface Soil Results

The analytical results for the subsurface soil samples were first compared to the subsurface soil background concentration range for the base. The detected sodium concentration exceeded its maximum subsurface soil background concentration (Table 5-2). Five of the six samples had PQLs for beryllium that were higher than the reported maximum background concentration and were not, therefore, used for comparison. All other metal concentrations were below or within their background ranges.

Due to the exceedance of the maximum subsurface soil background sodium concentration, an attempt was made to compare the analytical result for sodium to the GWP-Ind MSC; however, sodium does not have an MSC for comparison. Therefore, subsurface soils are in compliance with Risk Reduction Standard 2 for metals. In five subsurface soil samples, the PQLs for beryllium exceeded the maximum background range and were therefore not included.

Five volatiles (acetone, ethylbenzene, methylene chloride, toluene and total xylene) were the only VOCs detected above their PQLs. The concentrations of methylene chloride detected were below background. The concentrations of ethylbenzene, toluene, and xylene exceeded their maximum background concentrations in two of the six samples. Acetone exceeded its maximum background

TABLE 5-2

SUBSURFACE SOIL CONCENTRATIONS COMPARED TO INDUSTRIAL MSCs AND BASE BACKGROUND CONCENTRATIONS
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	SD13MW05B 03/25/94 2-4' (mg/kg)	SD13MW05C 03/25/94 4-6' (mg/kg)	SD13MW05D 03/25/94 6-8' (mg/kg)	SD13MW06D 03/24/94 6-8' (mg/kg)	SD13MW07B 03/24/94 2-4' (mg/kg)	SD13MW07E 03/24/94 8-10' (mg/kg)	MSC GWP-Ind (mg/kg)	Subsurface Soil Background Range (a) (mg/kg)
Metals :								
Aluminum	4,100	4,900	350	5,800	5,900	7,200		350 - 13,000
Arsenic	12	7.5	<3.5	12	5.7	12		4.1 - 12
Barium	110	130	4.9	100	83	110		4.9 - 130
Beryllium	<1.7	<1.7	<0.17	<1.6	<1.6	<1.9		<0.16 - 0.42
Cadmium	1.5	0.85	<0.34	1.2	1.3	1.0		0.85 - 6.8
Calcium	210,000 JH	160,000 JH	350 JH	10,000 JH	86,000 JH	120,000 JH		350 JH - 210,000 JH
Chromium (total)	4.4	4.9	<0.67	7.9	7.1	8.8		4.4 - 13
Cobalt	4.4	2.5	<1.1	5.0	4.9	5.4		2.3 - 7.6
Copper	66 JH	44 JH	20 JH	19	17	42		5.0 - 66 JH
Iron	8,000	4,800	543	6,900 JH	7,700 JH	7,500 JH		543 - 24,000
Lead	6.5	6.8	<3.1	14	9.3	13		6.3 - 88
Magnesium	1,500	1,100	65	1,800	1,700	2,400		65 - 3,100
Manganese	340	100	1.8	280	320	360		1.8 - 920
Nickel	6.2	4.2	<2.1	9.5	8.9	10		4.2 - 15
Potassium	420	540	90	820	860	1,100		90 - 2,200
Sodium	110	80 J	<22	110	54	290	--	36 - 260
Vanadium	16	<8.5	1.0	20	23	20		1 - 29
Zinc	30 JH	24 JH	10 JH	33	16	32		1.2 - 54
Volatile Organics :								
Acetone	<0.012	0.023	<0.012	0.034	<0.012	<3.1	1,020	<0.011 - 0.023
Ethylbenzene	<0.0005	<0.0005	<0.0005	0.036	<0.0005	30	70	<0.0005 - <0.006
Methylene Chloride	0.0098	0.014	0.016	0.013 JH	0.0073 JH	<1.6	0.5	0.0098 - 0.020
Toluene	<0.0005	<0.0005	0.0012	0.013	0.0032	<2.5	100	<0.0005 - 0.0012
Xylene (total)	<0.001	<0.001	<0.001	0.052	<0.001	29	1,000	<0.0054 - <0.006
Total Petroleum Hydrocarbons :	2,500	210	40	670	54	8,800	--	40 - 2,500

GWP-Ind: Industrial Soil-to-Groundwater Crossmedia Protection Concentration
MSC: Medium Specific Concentration (where maximum background metal concentration is not exceeded, MSC is not presented)
(a) Background data collected from nine locations throughout the base
J: Estimated quantitation based upon QC data
JH: Estimated quantitation - possibly biased high based upon QC data
--: no data available
Boxes: Value exceeds maximum subsurface soil background concentration

PREPARED/DATE: CDH
CHECKED/DATE: JFO

269138

concentration in one of the six samples. None of these VOCs exceeded their GWP-Ind MSCs. Therefore, the subsurface soils were in compliance with Risk Reduction Standard 2 for VOCs.

TPH was also detected at a concentration higher than background; however, they do not have an MSC for comparison. In addition the background concentration of TPH was significantly higher than could typically be expected. The analysis of subsurface soil samples from SD13-05, SD13-06, and SD13-07 detected concentrations of TPH that exceeded the action level of 500 ppm for TPH from middle distillate releases given in the previous TNRCC LPST sites program (March 1993). As defined by the TNRCC, an exceedance of an action level does not indicate a specific risk, but signals the need for further assessment.

5.2.3 Ground Water

Three sets of ground-water sampling data were obtained from samples collected during the sampling events in March, June, and September 1994.

5.2.3.1 March 1994 Ground-Water Data - The analytical results for the March 1994 ground-water samples were first compared to the maximum ground-water background concentrations for the Unnamed Stream Area (monitoring well SD13-05). As can be seen on Table 5-3, 14 of the 18 metals detected, all three of the VOCs, oil and grease, and TPH exceeded their respective maximum ground-water background concentrations. Samples SD13-MW02 and SD13-MW01 had PQLs for TPH and xylene respectively that were higher than the reported background concentration and were, therefore, not used for comparison.

TABLE 5-3

GROUND-WATER CONCENTRATIONS COMPARED TO RESIDENTIAL MSCs AND BASE BACKGROUND CONCENTRATIONS – March 1994 Data
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	OT1215B 03/30/94 (mg/L)	OT1215C 03/29/94 (mg/L)	SD13MW01 03/29/94 (mg/L)	SD13MW02 03/29/94 (mg/L)	SD13MW03 03/29/94 (mg/L)	SD13MW06 03/30/94 (mg/L)	SD13MW07 03/30/94 (mg/L)	MSC GW (mg/L)	Groundwater Background Data (a) (mg/L)
Metals :									
Aluminum	<0.1	1.5	0.241 JB	0.14 JB	0.68 JB	0.14 JB	<0.1	--	<0.1
Arsenic	<0.002	<0.002	0.0595	0.0023	0.042	0.0024	<0.002	0.05	<0.005
Barium	0.22	0.27	0.298	0.37	0.44	0.25	0.31	2	0.29
Cadmium	<0.004	<0.004	0.004	0.004	0.004	0.004	<0.004	0.005	<0.004
Calcium	330	280	140	140	180	190	160	--	140
Chromium (total)	0.008	<0.008	0.008	0.012	0.008	<0.008	<0.008	0.1	<0.01
Cobalt	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013		<0.013
Copper	0.018	0.029	0.01	0.016	0.009	0.013	0.008	--	0.009
Iron	0.22	1.2 J	14.727 J	0.740 J	17 J	1.1 JB	4.1	--	0.05 JB
Lead	<0.001	0.0023 JB	0.0014 JB	0.0013 JB	0.0049 JB	0.0017 JL	<0.001 JL	0.015	<0.001
Magnesium	9.6	5.6	5.9	5.8	7.3	12	6.3	--	4.5
Manganese	0.17	0.5	0.129	0.35	0.2	0.39	0.57	--	0.09
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002
Potassium	2.4	2.6	0.9 JB	2.1	1.3	2.9	1.3	--	2 JB
Selenium	0.0025	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001	0.05	0.002
Sodium	26	27	20	23	21	26	27		33 JB
Thallium	<0.001 JL	<0.001 JL	<0.001 JL	<0.001 JL	<0.001 JL	<0.001 JL	<0.001 JL		<0.001 JL
Zinc	0.066	0.044	0.032	0.14	0.076	0.1	0.068	--	0.063
Volatile Organics :									
Ethylbenzene	<0.0005	<0.0005	0.00489	<0.0005	0.0035 JL	0.0024	0.0037	0.7	<0.0005
Tetrachloroethylene	0.0091	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Xylene (total)	<0.001	<0.001	<0.005	<0.001	0.0047 JL	0.0025	0.0034	10	<0.001
Total Petroleum Hydrocarbons :	<1.0	<1.0	4.4	<1.1	5.2	<1.0	1.9	--	<1.0
Oil and Grease :	2.1	<1.1	1.2	1.3	<1.1	7.4	<1.0	--	5.8 J

MSC: Medium Specific Concentration (where metal background concentration is not exceeded, MSC is not presented)
GW:Maximum concentration in ground water (mg/L) for residential exposure conditions
(a) Background data collected from SD13MW05 on three sampling occasions. Maximum detected concentrations listed
J: Estimated quantitation based upon QC data
JB:Estimated quantitation – possibly biased high or false positive based upon blank data
JL: Estimated quantitation – possibly biased low based upon QC data
--: no data available
Boxes: Value exceeds maximum subsurface soil background concentration
Bold: Value exceeds GW MSC

PREPARED/DATE: CDH
CHECKED/DATE: JFO

Due to the exceedances of maximum ground-water background concentrations the analytical results for these constituents were compared to the ground-water MSC (Table 5-3). This comparison shows that the ground-water MSC for arsenic is exceeded in the ground-water sample, SD13-MW01, taken to the west of Building 1337. All other metals were at concentrations below their ground-water MSCs. Therefore, arsenic was the only metal detected in ground water at the site to exceed its Standard Number 2 MSC. Tetrachloroethylene exceeded its ground-water MSC in one sample, OT12-15B. All other VOCs were detected at concentrations below their ground-water MSCs.

TPH and oil and grease were also detected at concentrations higher than background. However, no MSCs exist for comparison in either the Risk Reduction Standards or the LPST action levels.

In addition, also in March 1994, ground-water samples were collected from 22 ground-water screening locations in the area of the POL Tank Farm. These samples were analyzed on site by a mobile laboratory. The purpose of the ground-water screening was to assist in determining the extent of petroleum constituents within the ground water. The results of the ground-water screening detected concentrations of benzene that exceeded its ground-water MSC of 0.005 mg/L at four locations: B-500 (0.047 mg/L); B-1000 (0.042 mg/L); C-500 (0.015 mg/L); and E-400 (0.059 mg/L). A comparison of the ground-water screening data to the ground-water MSC for lead shows that 17 of the 22 samples had lead concentrations that exceeded the ground-water MSC for lead of 0.015 mg/L. The ground-water screening data are included in Appendix A.

The laboratory results of the ground-water screening have undergone data quality evaluation, and the data indicate the potential for concentrations of benzene and lead in the ground water in the vicinity of the POL Tank Farm that significantly exceed their ground-water MSCs.

5.2.3.2 June 1994 Ground-Water Data - The analytical results for the June 1994 ground-water samples were first compared to the maximum ground-water background concentrations for the Unnamed Stream Area (monitoring well SD13-05). As can be seen on Table 5-4, 13 of the 14 metals detected, two of the four VOCs, and TPH exceeded their respective ground-water background concentrations. Three samples, OT12-15C, OT12-15B, and SD13-MW02, had PQLs for TPH that were higher than the reported background concentration and were, therefore, not used for comparison.

Due to the exceedances of ground-water background concentrations the analytical results for these constituents were compared to the ground-water MSC, also in Table 5-4. This comparison shows that the ground-water MSC for arsenic is exceeded in the same ground-water sample, SD13-MW01, as in the March 1994 data set. All other metals were detected at concentrations below their ground-water MSCs. Therefore, arsenic was the only metal detected in ground water at the site to exceed its Standard Number 2 MSC. The ground-water MSC for tetrachloroethylene is exceeded in one sample, OT12-15B. The ground-water MSC for methylene chloride is exceeded in three of the ground-water samples; however, as methylene chloride was also detected in the blank samples, this can probably be attributed to laboratory contamination. All other VOCs were detected at concentrations below their ground-water MSCs.

TPH was also detected at a concentration higher than background; however, they do not have an MSC for comparison in the Risk Reduction Standards or an action level in the LPST regulations.

5.2.3.3 September 1994 Ground-Water Data - The analytical results for the September 1994 ground-water samples were first compared to the maximum ground-water background concentrations for the Unnamed Stream Area (monitoring well SD13-05). As can be seen on Table 5-5, all of the 13 metals detected, five of the seven VOCs, and TPH

TABLE 5–4

GROUND–WATER CONCENTRATIONS COMPARED TO RESIDENTIAL MSCs AND BASE BACKGROUND CONCENTRATIONS – June 1994 Data
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	OT1215B 06/22/94 (mg/L)	OT1215C 06/22/94 (mg/L)	SD13MW01 06/21/94 (mg/L)	SD13MW02 06/21/94 (mg/L)	SD13MW03 06/21/94 (mg/L)	SD13MW06 06/24/94 (mg/L)	SD13MW07 06/22/94 (mg/L)	MSC GW (mg/L)	Groundwater Background Data (a) (mg/L)
Metals :									
Aluminum	0.14	<0.1	<0.1	<0.1	0.32	<0.1	0.26 J	--	<0.1
Arsenic	<0.002	<0.002	0.059	<0.002	0.046	0.0026	0.0037	0.05	<0.005
Barium	0.26	0.28	0.34	0.26	0.42	0.42	0.33	2	0.29
Cadmium	<0.004	<0.004	0.004	<0.004	0.004	<0.004	0.004	0.005	<0.004
Calcium	140	140	140	140	150	170	170	--	140
Chromium (total)	<0.008	<0.008	0.011	<0.008	<0.008	<0.008	<0.008	0.1	<0.01
Iron	<0.05	0.052	12	0.98	16	2.0	6.0	--	0.05 JB
Lead	<0.001	<0.001	<0.001	<0.001	0.0021	0.0029	<0.001	0.015	<0.001
Magnesium	7.6	4.4	6.1	6.5	7.3	12	6.8	--	4.5
Manganese	0.095	0.19	0.16	0.47	0.22	0.33	0.67	--	0.09
Potassium	2.6	2.3	0.92	2.1	1.1	1.6	1.2	--	2 JB
Selenium	0.0016	0.0027	0.0012	<0.001	<0.001	0.0012	<0.001	0.05	0.002
Sodium	26	27	22	24	22	26	28		33 JB
Zinc	0.066	0.048	0.04	0.038	0.059	0.098	0.051	--	0.063
Volatile Organics :									
Chloroform	0.0025 JB	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1	0.0052 JB
Methylene Chloride	<0.005	<0.005	0.0059 JB	0.0044 JB	0.0047 JB	0.012 JB	0.0079 JB	0.005	0.0054
Tetrachloroethylene	0.0083	0.00096	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Trichloroethylene	0.00085	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Total Petroleum Hydrocarbons :	<1.1	<1.2	3.2 JH	<1.1	3.5	<1.0	1.9	--	<1.0

MSC: Medium Specific Concentration (where metal background concentration is not exceeded, MSC is not presented)
GW:Maximum concentration in ground water (mg/L) for residential exposure conditions
(a) Background data collected from SD13MW05 on three sampling occasions. Maximum detected concentrations listed
J: Estimated quantitation based upon QC data
JB:Estimated quantitation – possibly biased high or false positive based upon blank data
JH: Estimated quantitation – possibly biased high based upon QC data
--: no data available
Boxes: Value exceeds maximum subsurface soil background concentration
Bold: Value exceeds GW MSC

PREPARED/DATE: CDH
CHECKED/DATE: JFO

269143

TABLE 5-5

GROUND-WATER CONCENTRATIONS COMPARED TO RESIDENTIAL MSCs AND BASE BACKGROUND CONCENTRATIONS – September 1994 Data
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	OT1215B 09/08/94 (mg/L)	OT1215C 09/08/94 (mg/L)	SD13MW01 09/07/94 (mg/L)	SD13MW02 09/08/94 (mg/L)	SD13MW03 09/07/94 (mg/L)	SD13MW06 09/08/94 (mg/L)	SD13MW07 09/07/94 (mg/L)	MSC GW (mg/L)	Groundwater Background Data (a) (mg/L)
Metals :									
Arsenic	<0.005	<0.005	0.085	<0.005	0.045	0.011	<0.005	0.05	<0.005
Barium	230	260	0.32 JB	0.3	0.37 JB	0.28	0.35 JB	2	0.29
Calcium	130,000	140,000	120 JB	130	120 JB	180	160 JB	--	140
Chromium (total)	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	0.034	0.1	<0.01
Copper	5.0	5.0	<0.004	0.006	0.005	0.006	0.006	--	0.009
Iron	<0.05	<0.05	12 JH	0.19 JH	12 JH	6.3 JH	5.1 JH	--	0.05 JB
Magnesium	6,900	4,400	5.6 JB	6.2	6.2 JB	13	6.8 JB	--	4.5
Manganese	70	220	0.14 JB	0.35	0.16 JB	0.29	0.64 JB	--	0.09
Molybendum	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	0.017	--	<0.01
Nickel	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	0.14	0.1	<0.023
Potassium	2,900	2,700	1 JB	2.3 JB	1.1 JB	1.3	1.4 JB	--	2 JB
Sodium	29,000	28,000	22 JB	24	21 JB	24	29 JB	--	33 JB
Zinc	37	48	0.042 JB	0.036	0.038 JB	0.049	0.044 JB	--	0.063 JB
Volatile Organics :									
Bromodichloromethane	0.0011	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1	<0.005
Chloroform	0.0034	0.00035	<0.005	<0.005	<0.005	<0.005	<0.005	0.1	0.00074 JB
Methylene Chloride	0.0042	0.0058	0.004 JB	<0.005	<0.005	0.00093	0.0047 JB	0.005	0.0054 JB
Tetrachloroethylene	0.0061	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Toluene	<0.0005	<0.0005	0.024	<0.002	<0.002	0.0048	<0.002	1	<0.002
Trichloroethylene	0.0014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005
Xylene (total)	<0.001	<0.001	0.0042	<0.001	0.0018	0.0026	0.0024	10	<0.001
Total Petroleum Hydrocarbons :	<1.0	<1.0	3.2	<1.1	3.1	<1.1	4.2	--	<1.0
Total Oil and Grease :	<1.0	1.1	<1.1	<10	<1.0	<1.0	<1.0	--	5.8 J

MSC: Medium Specific Concentration (where metal background concentration is not exceeded, MSC is not presented)
GW:Maximum concentration in ground water (mg/L) for residential exposure conditions
(a) Background data collected from SD13MW05 on three sampling occasions. Maximum detected concentrations listed
J: Estimated quantitation based upon QC data
JB:Estimated quantitation – possibly biased high or false positive based upon blank data
JH: Estimated quantitation – possibly biased high based upon QC data
--: no data available
Boxes: Value exceeds maximum subsurface soil background concentration
Bold: Value exceeds GW MSC

PREPARED/DATE: CDH
CHECKED/DATE: JFO

269144

exceeded their respective ground-water background concentrations. A number of samples had PQLs for individual chemicals that were higher than the reported background concentrations and were, therefore, not used for comparison. Two samples, SD13-MW02 and SD13-MW06, had PQLs for TPH that were higher than the background concentration. Sample SD13-MW02 had a PQL for total oil and grease that were higher than the background concentration. Five of the ground-water samples had PQLs for chloroform that were higher than the background concentration.

Due to the exceedances of ground-water background concentrations the analytical results for these constituents were compared to the ground-water MSC, also in Table 5-5. This comparison indicates that the ground-water MSC for barium is exceeded in OT12-15B and OT12-15C ground-water samples. Nickel also exceeds its ground-water MSC in sample SD13-MW07. The ground-water MSC for arsenic is exceeded in the same ground-water sample, SD13-MW01, as in the March and June 1994 data set. All other metals detected at concentrations above background were at concentrations below their ground-water MSCs. Therefore, arsenic, barium, and nickel were detected in ground water at the site to exceed their Standard Number 2 MSCs. The ground-water MSC for tetrachloroethylene is exceeded in one sample, OT12-15B. Methylene chloride exceeded its ground-water MSC in sample OT12-15C, and was not detected in the blank sample. All other VOCs were detected at concentrations below their ground-water MSCs.

TPH was also detected at a concentration higher than background; however, they do not have an MSC for comparison in either the Risk Reduction Standards or an action level in the LPST regulations.

5.2.4 Risk Evaluation Summary

The analytical results for surface and subsurface soil, and ground water were compared with Risk Reduction Standard Number 1 (site

background concentrations) and Standard Number 2 (MSCs) of the TNRCC Risk Reduction Standards (TNRCC, 1993). The regulatory standard applicable for this investigation was selected based upon available analytical data and the understanding that current land use at this site is now, and is expected to continue to be, entirely industrial. Based upon the results of this comparison, the following conclusions were drawn:

- VOCs were detected near the analytical detection limit in surface and subsurface soil samples. However, the detected concentrations did not exceed the MSCs for Risk Reduction Standard Number 2. Therefore, surface and subsurface soils were in compliance with the standard for these analytes.

- The concentrations of two metals in the surface soil samples exceeded their maximum surface soil background concentrations. However, on comparing these metals to the MSCs for Risk Reduction Standard Number 2, only lead exceeded its MSC. Manganese does not have an MSC. Also, the concentrations in surface soil samples were within the range reported for ambient conditions in the western United States. Sodium was the only metal detected in the subsurface soil samples that exceeded its maximum subsurface soil background concentration. Sodium does not have an MSC. Subsurface soils were, therefore, in compliance with Standard Number 2.

- Arsenic exceeded its ground-water MSC in the March, June and September 1994 ground-water samples. Barium and nickel exceeded their ground-water MSCs in the September 1994 ground-water samples. Tetrachloroethylene exceeded its ground-water MSC in March, June and September 1994 ground-water samples. With the exception of methylene chloride detected in the June 1994 ground-water data set

(which can probably be attributed to laboratory contamination), and in the September 1994 ground-water data set (which may not be attributed to laboratory contamination), no other VOCs exceeded their ground-water MSCs.

- TPH were detected in both surface and subsurface soils and ground water at concentrations above maximum background concentrations. The background concentrations of TPH in soils were higher than could typically be expected. The concentrations of TPH in subsurface samples exceed the TPH action level for LPST sites. The concentrations detected at the site indicate the presence of TPH contamination.

- Oil and grease were detected in the March 1994 ground-water results at concentrations above background concentrations.

- No other constituents were detected in soil and ground-water samples.

An analysis of the findings from this study indicated that there were exceedances of an MSC by lead in the surface soil sample SD13-MW06A, arsenic in the ground-water samples from SD13-01, tetrachloroethylene in ground-water samples for OT12-15B, and methylene chloride in a ground-water sample from OT12-15C.

5.3 COMPARISON OF DATA TO NOAA VALUES

Concentrations of detected sediment constituents were compared to NOAA values (Table 5-6). Values were not available for 11 of the 18 metals. The available ER-L value for the metals arsenic and cadmium detected at the site were exceeded. Cadmium also exceeded its ER-M value in one sediment sample, SD13-SD03.

TABLE 5-6

SEDIMENT CONCENTRATIONS COMPARED TO NOAA VALUES
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	SD13SD01 03/27/94 (mg/kg)	SD13SD02 03/27/94 (mg/kg)	SD13SD03 03/27/94 (mg/kg)	NOAA Values (a)	
				ER-L	ER-M
Metals :					
Aluminum	3,600 J	5,400 JH	5,800 JH	--	--
Arsenic	15	35	57	8.2	70
Barium	97	130	110	--	--
Cadmium	1.5	1.7	110	1.2	9.6
Calcium	120,000 JH	110,000 JH	90,000 JH	--	--
Chromium (total)	8.5	7.6	7.9	81	370
Cobalt	4.6	4.1	3.8	--	--
Copper	27 J	10	11	34	270
Iron	8,500 J	17,000 JH	16,000 JH	--	--
Lead	34 JH	19	11	46.7	218
Magnesium	1,700	1,600	1,700	--	--
Manganese	188 JH	200 JH	100 JH	--	--
Nickel	10	11	10	20.9	51.6
Potassium	660	820	1,100	--	--
Selenium	<8.4	8.7	<10	--	--
Sodium	110	130	110	--	--
Vanadium	21	17	17	--	--
Zinc	103 J	24 JH	22 JH	150	410

(a) National Oceanic and Atmospheric Administration (NOAA, 1993)
J: Estimated quantitation based upon QC data
JH: Estimated quantitation – possibly biased high based upon QC data
--: no data available
Boxes: Value exceeds NOAA Effects Range-Low (ER-L) value
Bold: Value exceeds NOAA Effects Range-Median (ER-M) value

PREPARED/DATE: CDH
CHECKED/DATE: JFO

269148

Based on the comparison to NOAA criteria, concentrations of arsenic and cadmium in the sediments appear to exceed an acceptable level.

5.4 COMPARISON OF DATA TO SURFACE-WATER CRITERIA

Potential applicable or relevant and appropriate requirements (ARARs) for protection of aquatic life in surface water include federal AWQC and state of Texas Water Quality Criteria. Federal AWQC for protection of aquatic life were established under the Clean Water Act. These criteria represent guidance on the environmental effects of pollutants which can be used to derive regulatory requirements. Water quality criteria are used for comparison with surface-water data. These criteria are used because the surface water from the Unnamed Stream discharges into Farmers Branch, which in turn discharges to the West Fork of the Trinity River. The designated uses of the West Fork of the Trinity River (below Lake Worth) include contact recreation and a public water supply. This surface water has been designated as a 'high quality' aquatic habitat (TNRCC, 1992a).

The detected constituents in surface-water samples are shown in Table 5-7. Methylene chloride was the only VOC detected above its PQL. However, there are no federal or state water quality criteria designated for methylene chloride. There are also no state (TNRCC, 1992b) drinking water standards, maximum contaminant levels (MCLs), for methylene chloride which would be the default value for comparison where there are no surface-water criteria (TNRCC, 1993). The federal MCL for methylene chloride is 0.005 mg/L (USEPA, 1994), which was exceeded in two of the samples. However, surface water in Farmers Branch or the Unnamed Stream is not used as a drinking water supply. It should also be noted that the samples containing methylene chloride have been flagged with a 'JB' because methylene chloride was detected in the blank samples. Therefore, the presence of methylene chloride in the surface-water samples may probably be attributed to laboratory contamination.

TABLE 5–7

COMPARISON OF SURFACE WATER CONCENTRATIONS TO SURFACE WATER QUALITY CRITERIA
RCRA Facility Investigation
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field

	SD13–SW01 03/27/94 (mg/L)	SD13–SW02 03/27/94 (mg/L)	SD13–SW03 03/27/94 (mg/L)
Volatile Organics:			
Methylene Chloride	0.0065 JB	<0.005	0.0069 JB
Total Petroleum Hydrocarbons:	1.2	<1.0	1.2
Oil and Grease:	1.2	<1.0	<1.0

Note: There are no Texas Water Quality Standards (TNRCC, 1992) or
Federal Ambient Water Quality Criteria (USEPA, 1987) for these constituents.
JB: Estimated quantitation – possibly biased high or false positive based upon blank data
––: no data available

PREPARED/DATE: CDH
CHECKED/DATE: JFO

269150

TPH and oil and grease were also detected in the surface-water samples. However, neither of these constituents have water quality criteria or drinking water standards.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following sections present the conclusions and recommendations based on the analysis of data obtained during this investigation.

6.1 POL TANK FARM AREA

The results of the ground-water screening analyses indicate that the POL Tank Farm is not a primary source of petroleum constituents in the ground water east of the tank farm. Sample locations nearest the aboveground storage tanks indicated only relatively low concentrations of gasoline range total petroleum hydrocarbons (TPHs) at 5.5 mg/L, and low concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX).

The highest levels of petroleum constituents were detected in the vicinity of the Pipeline/Truck Loading Area and the Abandoned Gasoline Station (Figure 1-2). High concentrations of BTEX (1,503 µg/L, including benzene at 47 µg/L) were detected in ground-water samples downgradient of the Pipeline/Truck Loading Area. Additionally, high concentrations of BTEX (264 µg/L, including benzene at 59 µg/L) and gasoline range TPH (184 µg/L) were detected within the area of the Abandoned Gasoline Station.

As indicated on Figures 4-4 through 4-6, the northern, eastern, and western extent of the petroleum constituents in the area east of the POL Tank Farm have been tentatively defined by the ground-water screening results. Elevated concentrations of petroleum constituents were also detected in ground-water samples from the southern boundary of the ground-water screening grid.

Of the 22 ground-water samples analyzed, lead was detected in 15 samples at concentrations ranging from 10 to 90 µg/L. Lead was

detected in samples collected from across the sampling grid and may be a naturally occurring metal in the ground water. However, elevated concentrations of lead were detected in areas (C 8+00 and E 4+00) where high concentrations of petroleum constituents were also detected.

The Pipeline/Truck Loading Area of the POL Tank Farm appears to be a major source area for petroleum contamination. Based on this, as well as subsequent studies by Parsons Engineering Service (PES), we recommend additional assessment and/or remedial activities be conducted in accordance with the Texas LPST regulations.

The Texas LPST regulations require the delineation of the horizontal and vertical extent of petroleum constituents in the soil, and the delineation of petroleum constituents in the ground water regardless of potential beneficial use. We recommend a comprehensive review of existing soil and ground-water data in the vicinity of the POL Tank Farm Area, and the collection and analysis of additional soil and ground-water samples to determine the extent of petroleum constituents. Additional assessment is also recommended to determine the background concentration of lead in the ground water, with additional assessment, if necessary, to determine the extent of elevated lead concentrations in ground water.

6.2 UNNAMED STREAM AREA

The geophysical survey conducted in the vicinity of the Abandoned Gasoline Station detected a magnetic anomaly near the intersection of the Abandoned Gasoline Station paved lot and Rogner Drive. The anomaly did not appear to be associated with underground utilities and could be an abandoned UST. Results obtained during the subsequent ground-water screening in this area identified high concentrations of BTEX and gasoline range TPH in the ground water.

Based on the analyses of soil samples from the Unnamed Stream Area, surface and subsurface soils are in compliance with Texas Risk Reduction Standard Number 2 for volatile organic compounds (VOCs). However, lead was detected above the Texas Risk Reduction Standard Number 2 in one surface soil sample. TPHs were also detected at concentrations exceeding the TPH action level for middle distillate hydrocarbons based on the Texas LPST regulations.

Results of surface-water sampling did not identify contamination above surface-water criteria. While some petroleum constituents were detected (TPH and oil and grease), their presence does not indicate significant contamination of the Unnamed Stream. Detected sediment concentrations indicate that concentrations of arsenic (13 to 57 mg/kg) and cadmium (1.2 to 110 mg/kg) exceed the National Oceanic and Atmospheric Administration (NOAA) guidance values.

The analyses of ground-water samples from three sampling events did not detect BTEX above Texas Risk Reduction Standard Number 2 ground-water medium-specific concentrations (MSCs). However, monitoring well SD13-04 contained free product which was identified as a diesel/gasoline mixture with a higher diesel fraction than gasoline fraction. Arsenic was detected above its MSC of 0.05 mg/L and tetrachloroethylene (PCE) was also detected above its MSC in all three sampling events. In addition, the September ground-water samples detected barium and nickel above their respective MSCs. The origin of the metal and solvent contamination is uncertain and may have resulted from past operations conducted at or near the site, or the migration of contamination onto the site from upgradient sources (possibly through the Abandoned Gasoline Station french drain).

We recommend that additional investigation of site soils be conducted adjacent to the Unnamed Stream to delineate the extent of petroleum constituents. We also recommend further investigation of existing ground-water monitoring wells for metals and volatile

compounds. It is our understanding that additional sampling and analysis conducted by Parsons ES included volatile and semi-volatile compounds. Additional investigation is recommended for the Grounds Maintenance Yard, located south of the Abandoned Gasoline Station, to include analysis of surficial soil samples for volatile compounds, semi-volatile compounds, metals, pesticides/PCBs, and herbicides. The analytes listed in EPA Methods SW-8240, SW-8270, SW-8080, and SW-6010 are considered representative of constituents of concern at these sites, based on previous activities known to have occurred on the base. Subsequent analyses should be compared to the results of the planned, comprehensive basewide background study.

Recovery activities should be implemented to remove the free product detected in monitoring well SD13-04 in the Abandoned Gasoline Station. Also, the area of the magnetic anomaly detected near Rogner Drive, possibly an abandoned UST, should be further investigated. If a UST is present, closure would be required.

Based on the detection of petroleum constituents in the surface waters of the Unnamed Stream, we recommend that the oil/water separator which feeds the Unnamed Stream be permitted under the National Pollutant Discharge Elimination System (NPDES). The NPDES permit would require monitoring of the effluent for petroleum constituents.

We recommend additional sampling and analysis of sediments to determine the extent of metals contamination downstream of the confluence of the Unnamed Stream with Farmers Branch, with the objective of delineating the area(s) for possible excavation. Results of subsequent sediment analyses should be compared to the results of site-specific background samples collected upstream of the confluence of the Unnamed Stream with Farmers Branch.

REFERENCES

AFSC, 1991. Handbook to Support the Installation Restoration Program (IRP) Statements of Work, Volume 1; Human Systems Division (AFSC), May 1991.

Barnes, Virgil E., 1988. Geologic Atlas of Texas, Dallas Sheet, The University of Texas at Austin, Bureau of Economic Geology, 1988.

Bouwer, Herman and R.C. Rice, 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, Volume 12, Number 3, June.

Bouwer and Rice, 1989. The Bouwer and Rice Slug Test - An Update, Ground Water, May-June 1989.

CH2M Hill, 1984. Installation Restoration Program Phase I Records Search for Carswell AFB; CH2M Hill, February 1984.

ES, 1993. Draft Bioventing Test Work Plan and Petroleum, Oil, and Lubricant Tank Farm Site ST-14, Carswell AFB, Texas, April 1993.

Hargis and Montgomery, 1983. Phase I Investigation of Subsurface Conditions at U.S. Air Force Plant No. 4, Fort Worth, Texas; Hargis and Montgomery, Inc., February 1983.

LAW, 1993. Installation Restoration Program (IRP) RCRA Facility Investigation Health and Safety Plan, Carswell Air Force Base, Fort Worth, Texas, Law Environmental, Inc., December 1993.

LAW, 1994a. Installation Restoration Program (IRP) RCRA Facility Investigation Revised Final Sampling and Analysis, Carswell Air Force Base, Fort Worth, Texas, Law Environmental, Inc., February 1994.

LAW, 1994b. Installation Restoration Program (IRP) RCRA Facility Investigation Work Plan, Carswell Air Force Base, Fort Worth, Texas, Law Environmental, Inc., February 1994.

Linsley, et al., 1975. Hydrology For Engineers, Second Edition, McGraw-Hill Book Company, New York.

Maxim, 1991. Subsurface Contamination Assessment Building No. 1337; Maxim Engineers, Inc., April 1990.

NOAA, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA 52.

NOAA, 1993. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments, Edward R. Long et al., October 15, 1993.

Radian, 1986. Installation Restoration Program Phase II - Confirmation/Quantification Stage 1; Final Report for Carswell AFB, Texas, October 1986.

Radian, 1991a. Remedial Investigation Report for the East Area; Final Report for Carswell AFB, Texas, October 1991.

Radian, 1991b. Feasibility Study Report for the East Area; Final Report for Carswell AFB, Texas, October 1991.

TNRCC, 1992a. Texas Water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Surface Water Quality Standards (307.1-307.10), Amended effective November 13, 1992.

TNRCC, 1992b. Texas Drinking Water Standards, Texas Administrative Code, Title 31, Chapter 290, Water Hygiene, Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Supply Systems, Recodified and amended effective March 1, 1992.

TNRCC, 1993. Final Risk Reduction Standards, Texas Administrative Code, Title 30, Chapter 335, Industrial Solid Waste and Municipal Hazardous Waste in General, Subchapter A, Risk Reduction Standards (TWC 335.551-335.568), June 15, 1993.

TNRCC, 1994. Leaking Storage Tank Program, Risk-Based Corrective Action for Leaking Storage Tank Sites, January 1994, RG-36.

USACE, 1991. Carswell Air Force Base, Texas, Work Plan SWMU No. 64 French Underdrain System and SWMU No. 67 Building 340 Oil/Water Separator, U.S. Army Corps of Engineers, Fort Worth District, October 1991.

USDA, 1981. U.S. Department of Agriculture, Soil Conservation Service, 1981.

USEPA, 1986. "Superfund Public Health Evaluation Manual"; Office of Emergency and Remedial Response OSWER EPA 540/1-86/060.

USEPA, 1987. Quality Criteria for Water 1986, U.S. Environmental Protection Agency, Office of Water Regulations and Standards, USEPA Publication No. EPA/44015-86-001.

USEPA, 1988. Guidelines for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final, EPA 540/G-89/004, October 1988.

USEPA, 1994. Drinking Water Regulations and Health Advisories, U.S. Environmental Protection Agency, Office of Water, May 1994.

USGS, 1975. J.J. Connor and H.T. Shacklette, United States Geological Survey Professional Paper 574-F.

USGS, 1984. T. H. Shacklette and J.G. Boerngen, United States Geological Survey Professional Paper 1270.

USGS, 1993. Personal communication between LAW and J. Bartelino (Project Chief, U.S. Geological Survey, Austin, Texas), October 20, 1993.

USGS, 1994. H.T. Shacklette, United States Geological Survey Professional Paper 574-F.

TAB

APPENDIX A

APPENDIX A

GROUND-WATER SCREEN DATA

teg

TRANSGLOBAL ENVIRONMENTAL GEOCHEMISTRY, INC.

269162

April 12, 1994

Mr. John O'Brien
Law Environmental, Inc.
Government Services
114 Town Park Drive, 4th Floor
Kennesaw, GA 30144-5599

SUBJECT: **DATA REPORT - CARSWELL AIRFORCE BASE PROJECT - FORT WORTH TEXAS - LAW ENVIRONMENTAL, INC. PROJECT #11-3517-0111**

TEG Project #NW940321, STRATAPROBE #940321SP2

Mr. O'Brien:

Please find enclosed a data report for water sample analyses from the above referenced site for Law Environmental, Inc. TEG conducted the following analyses:

- Lead in water by EPA Methods 3500-Pb-d (Dithizone) and 7421
- Petroleum Hydrocarbons in Water by Mod. EPA Method 8015 (Gasoline-Range and Diesel-Range Hydrocarbons)
- Volatile Aromatic Hydrocarbons in Water by EPA Method 8020.

The results of the analyses are summarized in the attached tables. Applicable detection limits, method blank, and sample duplicates are included.

TEG appreciates the opportunity to provide analytical services to Law Environmental, Inc. for this project. If you have any questions relating to this data or report, please contact us at 619/793-0401.

Sincerely

Mr. John Sohl
Director of Operations

CARSWELL AIRFORCE BASE PROJECT
Fort Worth, Texas
Law Environmental, Inc.
Project No. 11-3517-0111

Lead in Water by EPA Methods 3500-Pb-d (Dithizone) and 7421

SAMPLE Number	Date Analyzed	3500-Pb (ug/l)	7421 (ug/l)
Meth. Blank	03/21/94	nd	nd
100 ppb Std.	03/21/94	97	96
A 100	03/21/94	17	12
A 900	03/21/94	35	30
B 100	03/21/94	19	nd
C 100	03/21/94	6	nd
C 500	03/21/94	58	65
C 800	03/21/94	75	88
D 200	03/21/94	nd	nd
Meth. Blank	03/22/94	nd	nd
100 ppb Std.	03/22/94	100	102
B 500	03/22/94	50	35
B 1000	03/22/94	56	66
A 700	03/22/94	19	10
C 200	03/22/94	nd	nd
A 400	03/22/94	58	60
B 200	03/22/94	nd	nd
B 200 Dup.	03/22/94	nd	nd
E 0+10	03/22/94	35	50
E 1+10	03/22/94	nd	nd
E 600	03/22/94	56	45
F 300	03/22/94	38	30
Meth. Blank	03/23/94	nd	nd
100 ppb Std.	03/23/94	98	97
E 400	03/23/94	110	90
E 2+10	03/23/94	33	40
B 800	03/23/94	54	--
B 800 Dup.	03/23/94	50	58
C 0	03/23/94	23	nd
D 700	03/23/94	65	75

Method Detection Limit = 5.0 ug/l
"nd" Indicates Not Detected at the listed MDL.

CARSWELL AIRFORCE BASE PROJECT
Fort Worth, Texas
Law Environmental, Inc.
Project No. 11-3517-0111

Petroleum Hydrocarbons in Water by Mod. EPA Method 8015
(Gasoline-Range and Diesel-Range Hydrocarbons)

SAMPLE Number	Date Analyzed	Recovery (%)		Gasoline (ug/l)	Diesel (ug/l)	
Meth. Blank	03/21/94	109		nd	nd	
A 100	03/21/94	105		nd	nd	
A 900	03/21/94	106		100	nd	
C 100	03/21/94	106		2400	nd	
Meth. Blank	03/22/94	98		nd	nd	
B 100	03/22/94	116		nd	nd	
B 500	03/22/94	96		5000	nd	
B 1000	03/22/94	87		nd	nd	
C 500	03/22/94	90		4600	nd	
C 800	03/22/94	int		111000	nd	
D 200	03/22/94	99		3600	nd	
A 700	03/22/94	96		1900	nd	
A 400	03/22/94	120		5500	nd	
B 200	03/22/94	119		3600	nd	
C 200	03/22/94	91		nd	nd	
E 0+10	03/22/94	109		nd	nd	
E 1+10	03/22/94	119		nd	nd	
E 600	03/22/94	118		1300	nd	
Meth. Blank	03/23/94	89		nd	nd	
E 400	03/23/94	int		184000	nd	
E 2+10	03/23/94	118		nd	nd	
B 800	03/23/94	82		1600	nd	
B 800 Dup.	03/23/94	91		2300	nd	
C 0	03/23/94	85		nd	nd	
D 700	03/23/94	int		12600	nd	
F 300	03/23/94	119		nd	nd	
Method Detection Limit				100	100	

"nd" Indicates Not Detected at the listed MDL.
"int" Indicates that interferences prevent determination

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES NORTHWEST, INC.

269165

CARSWELL AIRFORCE BASE PROJECT
Fort Worth, Texas
Law Environmental, Inc.
Project No. 11-3517-0111

Volatile Aromatic Hydrocarbons in Water by EPA Method 8020.

SAMPLE Number	Date Analyzed	Benzene (ug/l)	Toluene (ug/l)	Eth. Benz. (ug/l)	Xylene (ug/l)	Recovery (%)
Meth. Blank	03/21/94	nd	nd	nd	nd	97
A 100	03/21/94	nd	5	31	37	115
A 900	03/21/94	nd	nd	nd	nd	97
C 100	03/21/94	2	2	nd	nd	100
Meth. Blank	03/22/94	nd	nd	nd	nd	99
B 100	03/22/94	nd	nd	nd	nd	102
B 500	03/22/94	47	22	18	77	104
B 1000	03/22/94	42	12	nd	7	114
C 500	03/22/94	15	nd	nd	24	84
C 800	03/22/94	nd	14	nd	44	97
D 200	03/22/94	nd	4	nd	28	119
A 700	03/22/94	nd	nd	nd	nd	98
A 400	03/22/94	nd	5	nd	5	76
B 200	03/22/94	nd	5	409	1089	98
C 200	03/22/94	nd	nd	nd	nd	109
E 0+10	03/22/94	nd	nd	nd	nd	110
E 1+10	03/22/94	nd	nd	nd	nd	94
E 600	03/22/94	nd	nd	nd	nd	102
Meth. Blank	03/23/94	nd	nd	nd	nd	112
E 400	03/23/94	59	69	74	62	110
E 2+10	03/23/94	nd	nd	nd	nd	92
B 800	03/23/94	3	5	9	25	95
B 800 Dup.	03/23/94	2	6	9	20	94
C 0	03/23/94	nd	nd	nd	nd	95
D 700	03/23/94	nd	2	5	24	86
F 300	03/23/94	nd	nd	nd	nd	89
Method Detection Limit		1	1	1	1	

"nd" Indicates Not Detected at the listed MDL.
"int" Indicates that interferences prevent determination

269166

CARSWELL AIRFORCE BASE PROJECT
Fort Worth, Texas
Law Environmental, Inc.
Project No. 11-3517-0111

Lead in Water by EPA Methods 3500-Pb-d (Dithizone) and 7421

SAMPLE Number	Date Analyzed	3500-Pb (ug/l)	7421 (ug/l)
Meth. Blank	03/21/94	nd	nd
100 ppb Std.	03/21/94	97	96
A 100	03/21/94	17	12
A 900	03/21/94	35	30
B 100	03/21/94	19	nd
C 100	03/21/94	6	nd
C 500	03/21/94	58	65
C 800	03/21/94	75	88
D 200	03/21/94	nd	nd
Meth. Blank	03/22/94	nd	nd
100 ppb Std.	03/22/94	100	102
B 500	03/22/94	50	35
B 1000	03/22/94	56	66
A 700	03/22/94	19	10
C 200	03/22/94	nd	nd
A 400	03/22/94	58	60
B 200	03/22/94	nd	nd
B 200 Dup.	03/22/94	nd	nd
E 0+10	03/22/94	35	50
E 1+10	03/22/94	nd	nd
E 600	03/22/94	56	45
F 300	03/22/94	38	30
Meth. Blank	03/23/94	nd	nd
100 ppb Std.	03/23/94	98	97
E 400	03/23/94	110	90
E 2+10	03/23/94	33	40
B 800	03/23/94	54	--
B 800 Dup.	03/23/94	50	58
C 0	03/23/94	23	nd
D 700	03/23/94	65	75

Method Detection Limit = 5.0 ug/l
"nd" Indicates Not Detected at the listed MDL.

269167

CARSWELL AIRFORCE BASE PROJECT
Fort Worth, Texas
Law Environmental, Inc.
Project No. 11-3517-0111

Petroleum Hydrocarbons in Water by Mod. EPA Method 8015
(Gasoline-Range and Diesel-Range Hydrocarbons)

SAMPLE Number	Date Analyzed	Recovery (%)		Gasoline (ug/l)	Diesel (ug/l)	
Meth. Blank	03/21/94	109		nd	nd	
A 100	03/21/94	105		nd	nd	
A 900	03/21/94	106		100	nd	
C 100	03/21/94	106		2400	nd	
Meth. Blank	03/22/94	98		nd	nd	
B 100	03/22/94	116		nd	nd	
B 500	03/22/94	96		5000	nd	
B 1000	03/22/94	87		nd	nd	
C 500	03/22/94	90		4600	nd	
C 800	03/22/94	int		111000	nd	
D 200	03/22/94	99		3600	nd	
A 700	03/22/94	96		1900	nd	
A 400	03/22/94	120		5500	nd	
B 200	03/22/94	119		3600	nd	
C 200	03/22/94	91		nd	nd	
E 0+10	03/22/94	109		nd	nd	
E 1+10	03/22/94	119		nd	nd	
E 600	03/22/94	118		1300	nd	
Meth. Blank	03/23/94	89		nd	nd	
E 400	03/23/94	int		184000	nd	
E 2+10	03/23/94	118		nd	nd	
B 800	03/23/94	82		1600	nd	
B 800 Dup.	03/23/94	91		2300	nd	
C 0	03/23/94	85		nd	nd	
D 700	03/23/94	int		12600	nd	
F 300	03/23/94	119		nd	nd	
Method Detection Limit				100	100	

"nd" Indicates Not Detected at the listed MDL.
"int" Indicates that interferences prevent determination

TRANSGLOBAL ENVIRONMENTAL GEOSCIENCES NORTHWEST, INC.

269168

CARSWELL AIRFORCE BASE PROJECT
Fort Worth, Texas
Law Environmental, Inc.
Project No. 11-3517-0111

Volatile Aromatic Hydrocarbons in Water by EPA Method 8020.

SAMPLE Number	Date Analyzed	Benzene (ug/l)	Toluene (ug/l)	Eth. Benz. (ug/l)	Xylene (ug/l)	Recovery (%)
Meth. Blank	03/21/94	nd	nd	nd	nd	97
A 100	03/21/94	nd	5	31	37	115
A 900	03/21/94	nd	nd	nd	nd	97
C 100	03/21/94	2	2	nd	nd	100
Meth. Blank	03/22/94	nd	nd	nd	nd	99
B 100	03/22/94	nd	nd	nd	nd	102
B 500	03/22/94	47	22	18	77	104
B 1000	03/22/94	42	12	nd	7	114
C 500	03/22/94	15	nd	nd	24	84
C 800	03/22/94	nd	14	nd	44	97
D 200	03/22/94	nd	4	nd	28	119
A 700	03/22/94	nd	nd	nd	nd	98
A 400	03/22/94	nd	5	nd	5	76
B 200	03/22/94	nd	5	409	1089	98
C 200	03/22/94	nd	nd	nd	nd	109
E 0+10	03/22/94	nd	nd	nd	nd	110
E 1+10	03/22/94	nd	nd	nd	nd	94
E 600	03/22/94	nd	nd	nd	nd	102
Meth. Blank	03/23/94	nd	nd	nd	nd	112
E 400	03/23/94	59	69	74	62	110
E 2+10	03/23/94	nd	nd	nd	nd	92
B 800	03/23/94	3	5	9	25	95
B 800 Dup.	03/23/94	2	6	9	20	94
C 0	03/23/94	nd	nd	nd	nd	95
D 700	03/23/94	nd	2	5	24	86
F 300	03/23/94	nd	nd	nd	nd	89
Method Detection Limit		1	1	1	1	

"nd" Indicates Not Detected at the listed MDL.
"int" Indicates that interferences prevent determination

TAB

APPENDIX B

APPENDIX B

SOIL BORING LOGS

269171

APPENDIX B-1

SOIL BORING LOGS (FIELD COPY)

269172

SOIL TEST BORING RECORD

JOB NO. 1E3517011
JOB NAME Caldwell AFB
DATE: March 26, 1991
WEATHER light rain 60's
DRILLER JOHN ATEC

BORING NO. SB-01
G.S. ELEV.
HOURS MOVING
HOURS DRILLING
PAGE 1 OF 1

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATON AND REMARKS	DEPTH (FEET)
	Asphalt									gravel & sand	
	gravel									25% recovery	
	Fill										
1	yellowish orange										
	fine to med sand 60%									fine gravel layers	
	silt 30%									2" concrete w/	
2	clay 10% SM									wire mesh	
	minor coarse gravel										
3	light brown to										
	yellowish orange										
	fine to med sand 60%									gravel layers	
	silt 30										
4	clay 10										
										60% recovery	
5											
	light brown										
	fine sand 95%									30% recovery	
	silt 5% SW										
6											
										WATER in hole ~6'	
7	fine gravel 60% med to fine sand 30% silt 10%									GW-GC/clayey gravel	
										well installed	

BORING TERMINATED: 7.0'
BORING REFUSAL:
WATER TOB DEPTH 20'
WATER 24 HR.: DEPTH NA
WATER LOSSES 0
CASING: SIZE NA LENGTH NA

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 7
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: JDM CHECKED BY: DISCREPANCIES:

269173

SOIL TEST BORING RECORD

JOB NO. ~~EM~~ 11-3517011
JOB NAME Carswell AFB
DATE: March 26, 1991
WEATHER LIGHT RAIN 60's
DRILLER ATEC - Silva

BORING NO. SA-2
G.S. ELEV.
HOURS MOVING
HOURS DRILLING
PAGE 1 OF 1

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATON AND REMARKS	DEPTH (FEET)
	gravel - coarse and silty fine sand FILL										
1	FILL yellowish orange to light gray fine sand 40% coarse sand 20% fine gravel 20% silt 20% 0M									Angular limestone gravel NO ODOR	
2	thick 2.0 - 2.4'									25% recovery PID slightly elevated	
3	FILL light gray mottled dark gray fine sand 40% silt 30% clay 30%									100% recovery	
4	clay										
5										100% recovery	
6	REFUSAL										

BORING TERMINATED:
BORING REFUSAL: 6.0
WATER TOB DEPTH ~6.0
WATER 24 HR.: DEPTH NM
WATER LOSSES 0
CASING: SIZE NA LENGTH NA

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 6
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: JDM CHECKED BY: DISCREPANCIES:

269174

SOIL TEST BORING RECORD

JOB NO. 11-35170111
JOB NAME Caswell AFB
DATE: March 26, 1991
WEATHER light rain, 60's
DRILLER ATR. JOHN

BORING NO. SB-03
G.S. ELEV.
HOURS MOVING
HOURS DRILLING
PAGE 1 OF 1

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATON AND REMARKS	DEPTH (FEET)
	Fill	1								50% recovery	
	yellowish orange and black									black tar-like layer in	
	fine - med sand - 40%									sample	
	gravel - 20%										
1	silt - 20%									rounded quartz gravel	
	clay - 20% SM/SC										
2	Fill										
	dark gray to black										
	fine gravel 40%									50 % recovery	
	fine sand 20% SM/SC									petrol. & odor	
	silt 20%									Asphalt like layer	
3	clay 20%									removed quartz gravel	
4										10% recovery	
	gray to dark gray										
	fine to med. sand 70%										
5	coarse sand 25%										
	silt 5% SW										
6										hard rock in bottom of	
	~~Bor~~ Refusal									auger.	
	TOR.										
	~~WATER~~										

BORING TERMINATED: —
BORING REFUSAL: 6.0
WATER TOB DEPTH ~6.0
WATER 24 HR.: DEPTH NA
WATER LOSSES 0
CASING: SIZE NA LENGTH NA

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 6
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TOM CHECKED BY: _____ DISCREPANCIES: _____

269175

APPENDIX B-2

SOIL BORING LOGS (REPORT COPY)

SOIL TEST BORING RECORD 269176

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 25, 1994
WEATHER: Overcast 70°F
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW05 (BG-1)
GROUND SURFACE ELEVATION: 571.59
HOURS MOVING:
HOURS DRILLING:
PAGE: 1 OF 2

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
	Asphalt with gravel base							–		Soil samples collected using 3-inch ID split spoon w/ California brass rings		
1	Slightly sandy silty CLAY (CL) Slightly plastic fines 90% Fine sand 10% Dark gray (7.5YR 4/1)	1						15		30% 1'-3' sample retained for chemical laboratory analyses		1
2												2
3		2						16		50% 3'-5' sample retained for chemical laboratory analyses		3
4	Clayey very sandy SILT (ML) Slightly plastic fines 60% Fine sand 40% Mottled light gray (5YR 7/1) and reddish brown (5YR 4/4)											4
5		3						9		100% 5'-7' sample retained for chemical laboratory analyses		5
6	Slightly fine SAND (SM) Fine SAND 70% Non-plastic fines 30% Reddish brown (5YR 4/4)											6

BORING TERMINATED: 14.0 FT.
BORING REFUSAL: 14.0 FT.
WATER TOB DEPTH:
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE _____ LENGTH _____

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 14
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM CHECKED BY: JLB DISCREPANCIES:

SOIL TEST BORING RECORD 269177

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 25, 1994
WEATHER: Overcast 70°F
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW05 (BG-1)
GROUND SURFACE ELEVATION: 571.59
HOURS MOVING:
HOURS DRILLING:
PAGE: 2 OF 2

DEPTH (FEET)	STRATA DESCRIPTION	#	'N' 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
	Slightly silty SAND (SP)	4						3	50%			
	Fine SAND 95%								7'-9' sample retained for analyses			
	Non-plastic fines 5%											
	Moist to saturated											
	Quartzose SAND											
8	Light reddish brown (5YR 6/9)											8
9												9
		5						–	100%			
10												10
11												11
		6							100%			
12												12
	95% fine well rounded gravel / 5% SAND (GP)								Gravel - white, gray, and reddish brown			
	Very silty fine SAND (SM)								chert and quartz			
	Fine SAND 60%											
	Non-plastic fines 40%											
	Saturated											
13												13
		7						–	50%			
									Auger refusal at 14.0 ft.			
	Auger refusal @ 14.0 ft.								Boring completed as Type II monitoring well			

BORING TERMINATED: 14.0 FT.
BORING REFUSAL: 14.0 FT.
WATER TOB DEPTH:
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE LENGTH

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 14
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM | CHECKED BY: JLB | DISCREPANCIES:

SOIL TEST BORING RECORD 269178

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 24, 1994
WEATHER: Cloudy 70°F Windy
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW06
GROUND SURFACE ELEVATION: 555.74
HOURS MOVING:
HOURS DRILLING:
PAGE: 1 OF 2

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
	Silty CLAY w/ gravel (CL) - FILL	1						7.5	50%			
	Slightly plastic fines 90%									Petroleum odor		
	Fine gravel 10%											
	Angular limestone gravel									0'-2' sample retained for analyses		
	Dark gray (N4/)											
1												1
2												2
		2						50	50%			
3												3
4												4
	Slightly silty CLAY (CH)	3						58	50%			
	High plastic fines									Gravel encountered during drilling		
	Dark greenish gray (5GY 4/1)											
5												5
6												6
	Silty medium SAND (SM)	1						7.5	40%			
	Medium SAND 70%									Strong petroluem odor		
	Non-plastic fines 30%									Split spoon refusal at 6.9'		
	Black (N2.5/1)									6'-6.9' sample retained for analyses		

BORING TERMINATED: 11.5 FT.
BORING REFUSAL: 11.5 FT.
WATER TOB DEPTH: 10 FT.
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE LENGTH

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 11.5
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM CHECKED BY: JLB DISCREPANCIES:

SOIL TEST BORING RECORD 269179

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 24, 1994
WEATHER: Cloudy 70°F Windy
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW06
GROUND SURFACE ELEVATION: 555.74
HOURS MOVING:
HOURS DRILLING:
PAGE: 2 OF 2

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
	Weathered light gray Shaley limestone									Weathered rock - no split spoon samples collected		
8												8
9												9
10												10
11												11
	Auger refusal at 11.5 FT.									Boring completed as Type II Monitorng Well		
12										Soil samples obtained using 3-inch ID split spoon w/ California brass rings		12
13												13

BORING TERMINATED: 11.5 FT.
BORING REFUSAL: 11.5 FT.
WATER TOB DEPTH: 10 FT.
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE LENGTH

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 11.5
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM CHECKED BY: JLB DISCREPANCIES:

SOIL TEST BORING RECORD 269180

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 24, 1994
WEATHER: Cloudy, light rain 70°F
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW07
GROUND SURFACE ELEVATION: 554.42
HOURS MOVING:
HOURS DRILLING:
PAGE: 1 OF 3

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
	Silty CLAY (CL) Slightly plastic fines Dry Greenish gray (5G 6/1)	1						5	25%			
1												1
2		2						5.8	30%			2
										2'-4' sample retained for analyses		
3												3
4	Slightly silty SAND (SP) Medium SAND 90% Non-plastic fines 10% Dry - Reddish brown (5YR 5/4) and light brown (7.5YR 6/3)	3						4.0	50%			4
5	Slightly silty CLAY (CL) Slightly plastic fines Dark greenish gray (5GY 4/1) to dark gray (N4/1)											5
6	Slightly sandy and clayey SILT (ML) Slightly plastic fines 90% Fine sand 10% Dark gray (N4/)	4						3.0	50%	Strong petroleum odor sample contained roots/wood		6

BORING TERMINATED: 20.0 FT.
BORING REFUSAL: 20.0 FT.
WATER TOB DEPTH:
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE _____ LENGTH _____

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 20
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM CHECKED BY: JLB DISCREPANCIES:

SOIL TEST BORING RECORD 269181

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 24, 1994
WEATHER: Cloudy, light rain 70°F
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW07
GROUND SURFACE ELEVATION: 554.42
HOURS MOVING:
HOURS DRILLING:
PAGE: 2 OF 3

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
8		5						50	75%			8
									Strong Petroleum odor			
									8'-10' sample retained for analyses			
9												9
	Slightly sandy clayey SILT (ML) Slightly plastic fines 90% Fine to medium sand 10% Mottled light gray (N7/1) and black (N2.5/1)											
10		6						425	100%			10
									Strong petroleum odor			
11												11
12												12
	Slightly silty medium to coarse SAND (SW) Medium to coarse SAND 90% Non-plastic fines 10% Calcareous sand; moist; light gray (N7/1)	7						425	50% split spoon refusal at 13 ft.			
									Strong petroleum odor			
13												13
	Weathered shaley limestone								Weathered rock - no split spoon samples			
									available			

BORING TERMINATED: 20.0 FT.
BORING REFUSAL: 20.0 FT.
WATER TOB DEPTH:
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE _____ LENGTH _____

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 20
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM CHECKED BY: JLB DISCREPANCIES:

3517-0111.11

SOIL TEST BORING RECORD

269182

JOB NUMBER: 11-3517-0111
JOB NAME: Carswell AFB
DATE: March 24, 1994
WEATHER: Cloudy, light rain 70°F
DRILLER: B. Christopher - ATEC

BORING NUMBER: SD13-MW07
GROUND SURFACE ELEVATION: 554.42
HOURS MOVING:
HOURS DRILLING:
PAGE: 3 OF 3

DEPTH (FEET)	STRATA DESCRIPTION	#	"N" 1	2	3	4	N	PID	REC	SOIL CLASSIFICATION AND REMARKS	TIME	DEPTH (FEET)
	Weathered shaley limestone									Weathered rock - no split spoon samples available		
15												15
16												16
17												17
18												18
19										Boring completed as Type II monitoring well		19
20	Auger refusal									Soil samples obtained using 3-inch ID split spoon w/ California brass rings		20

BORING TERMINATED: 20.0 FT.
BORING REFUSAL: 20.0 FT.
WATER TOB DEPTH:
WATER 24 HR.: DEPTH:
WATER LOSSES: 0.0 gallons
CASING: SIZE LENGTH

METHOD OF ADVANCING BORING	DEPTH
POWER AUGER	0 TO 20
HAND CHOP: W/MUD: W/WATER	TO
ROTARY DRILL: W/MUD: W/WATER	TO
DIAMOND CORE	TO

QA / QC | INSTALLED BY: TDM CHECKED BY: JLB DISCREPANCIES:

3517-0111.11

TAB

APPENDIX C

APPENDIX C

MONITORING WELL INSTALLATION DIAGRAMS

APPENDIX C-1

MONITORING WELL INSTALLATION DIAGRAMS (FIELD COPY)

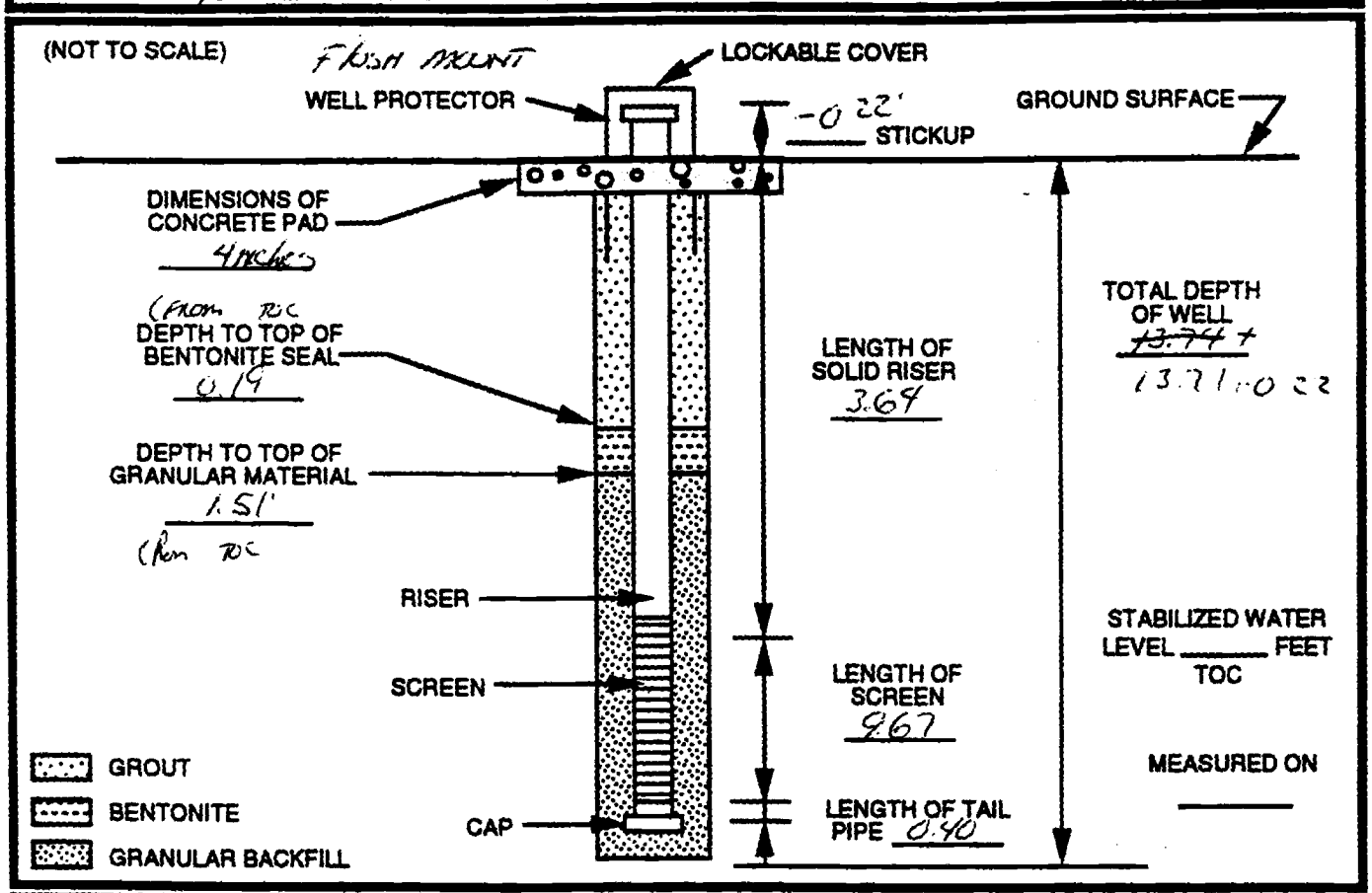
MONITORING WELL INSTALLATION DIAGRAM 269186

JOB NAME Carswell AFB
WELL NO. SD13 MW05 JOB NO. 11357-011
DATE March 25, 1994 TIME 16:30
WELL LOCATION In front of 1320 Building

GROUND SURFACE ELEVATION _____
TOP OF SCREEN ELEVATION _____
REFERENCE POINT ELEVATION _____
TYPE SAND PACK Silica Sand GRADATION 10/20
SAND PACK MANUFACTURER Texas Mining Co.
SCREEN MATERIAL PVC
MANUFACTURER Johnson Well Supply
RISER MATERIAL PVC
MANUFACTURER Johnson Well Supply
RISER DIAMETER 4 inch ID
DRILLING TECHNIQUE Hollow Stem Auger
AUGER SIZE AND TYPE 8¼ inch ID
REMARKS Flush mounted well w/ 4' x 4' x 4" pad cut into asphalt.

BENTONITE TYPE Chips
MANUFACTURER PDS Company
CEMENT TYPE Portland Cement
MANUFACTURER Lonestar
BOREHOLE DIAMETER 13 inches
SCREEN DIAMETER 4 inch SLOT SIZE 0.01
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE Tom McCombs
DRILLING CONTRACTOR ATEC
AMOUNT BENTONITE USED ~ 50 lbs
AMOUNT CEMENT USED NA
AMOUNT SAND USED ~ 1000 lbs
STATIC WATER DEPTH (after dev.) _____

(NOT TO SCALE)



QA / QC

INSTALLED BY: B Christian ATEC INSTALLATION OBSERVED BY: T McCombs
DISCREPANCIES: _____

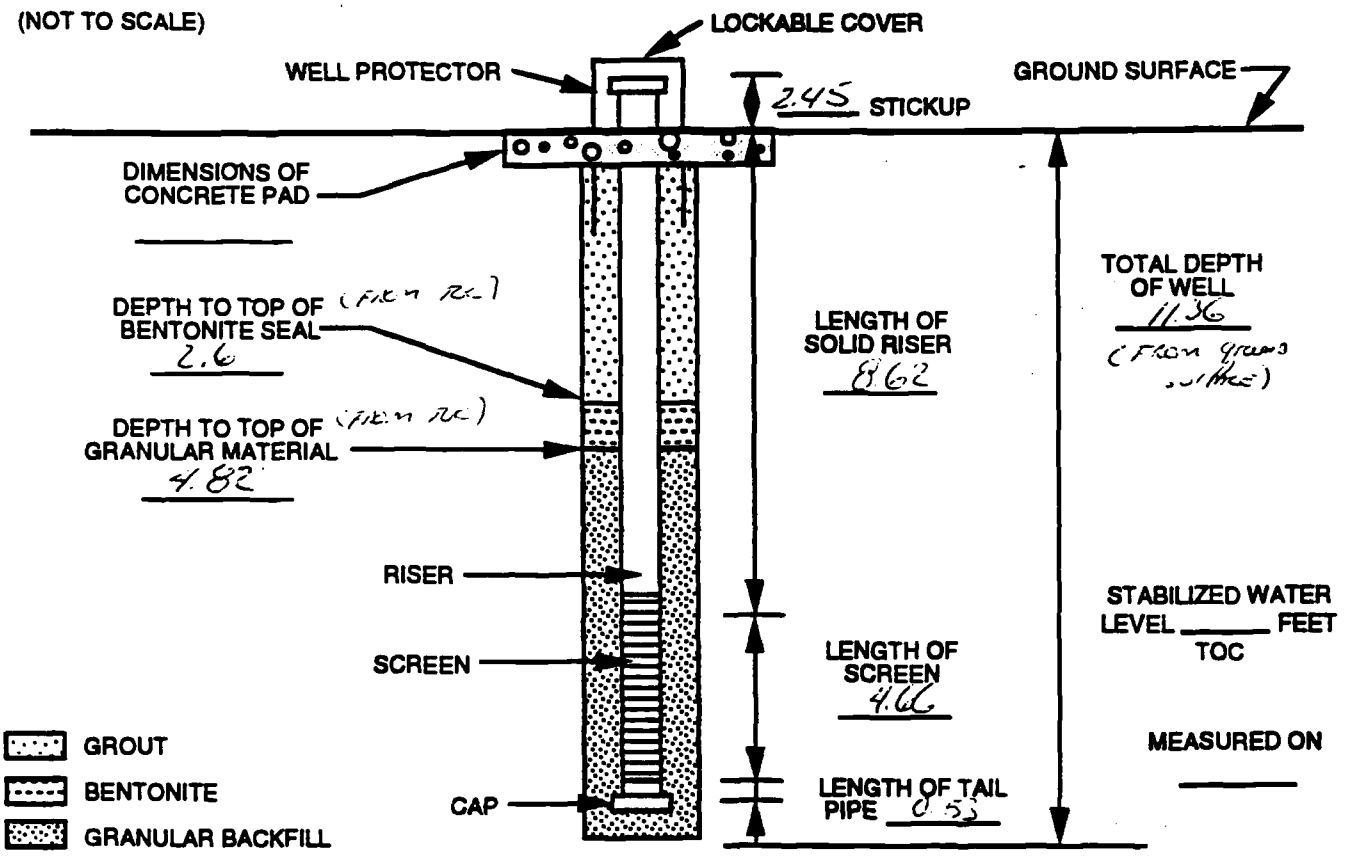
MONITORING WELL INSTALLATION DIAGRAM 269187

JOB NAME Cosine/ AFB
WELL NO. SDB-MW06 JOB NO.
DATE MARCH 25, 1994 TIME 10:40
WELL LOCATION Un-named Stream

GROUND SURFACE ELEVATION
TOP OF SCREEN ELEVATION
REFERENCE POINT ELEVATION
TYPE SAND PACK Silica Sand GRADATION 10/20
SAND PACK MANUFACTURER Texas Mining Co
SCREEN MATERIAL PVC
MANUFACTURER Johnson Well Supply
RISER MATERIAL PVC
MANUFACTURER Johnson Well Supply
RISER DIAMETER 4-inch ID
DRILLING TECHNIQUE Hollow Stem Auger
AUGER SIZE AND TYPE 8 1/4-inch ID
REMARKS Boring Drilled + Sampled Using 4 1/4 inch ID Auger Boring Ramed w/ 8-inch ID Auger

BENTONITE TYPE Chips (Western Gravel)
MANUFACTURER PDS Company
CEMENT TYPE Portland Cement
MANUFACTURER Lone Star
BOREHOLE DIAMETER 13-inch
SCREEN DIAMETER 4-inch SLOT SIZE 0.010
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE Tom McComas
DRILLING CONTRACTOR ATEC
AMOUNT BENTONITE USED 50 lbs
AMOUNT CEMENT USED 5 gal (grout)
AMOUNT SAND USED 700 lbs
STATIC WATER DEPTH (after dev.)

(NOT TO SCALE)



QA / QC

INSTALLED BY: S Christopher ATEC INSTALLATION OBSERVED BY: Tom McComas
DISCREPANCIES:

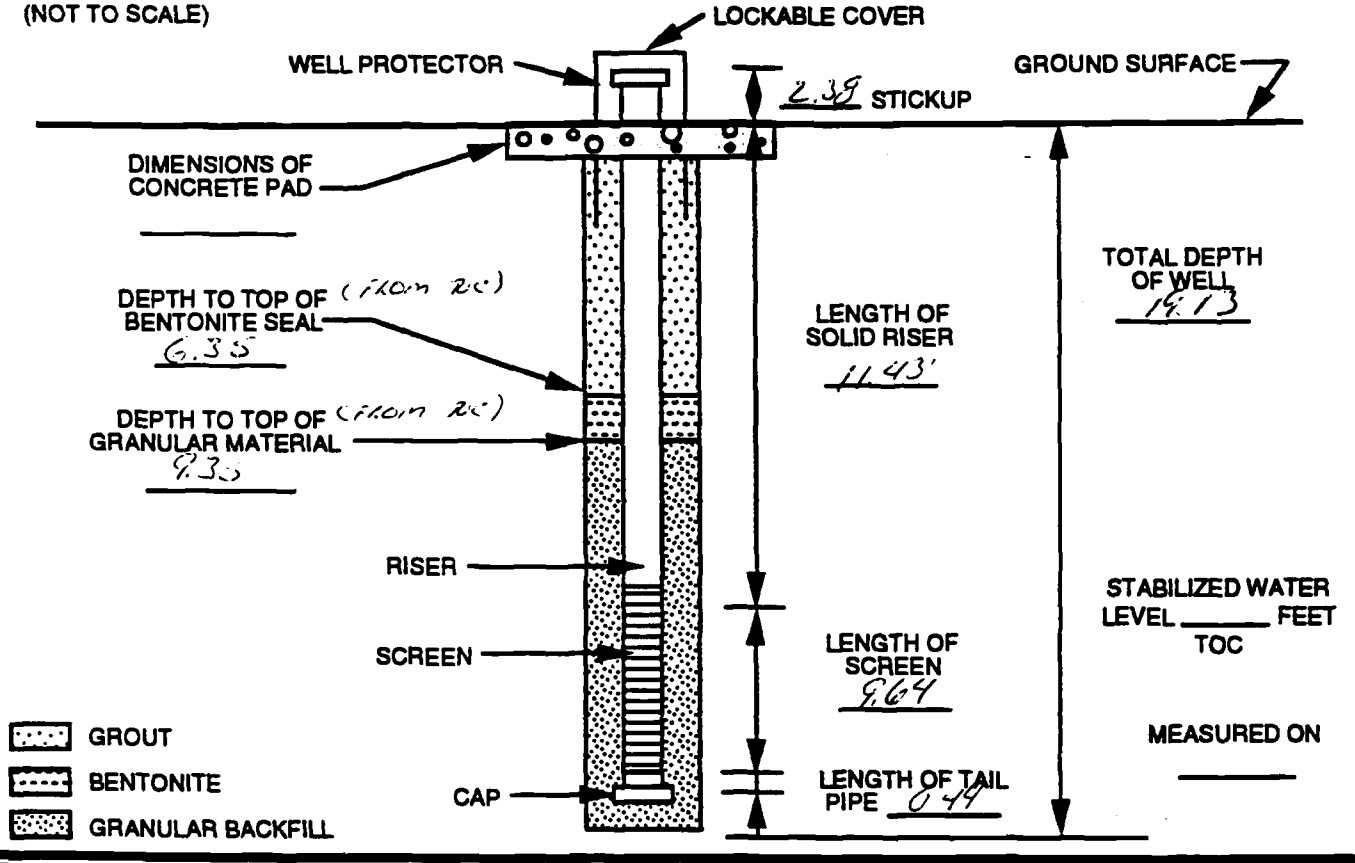
MONITORING WELL INSTALLATION DIAGRAM 269188

JOB NAME Crowell AFB
WELL NO. SDS MW07 JOB NO. 11-3517-011
DATE June 25 1994 TIME 10:30
WELL LOCATION On Northeast Section 7

GROUND SURFACE ELEVATION _____
TOP OF SCREEN ELEVATION _____
REFERENCE POINT ELEVATION _____
TYPE SAND PACK 10/20 GRADATION _____
SAND PACK MANUFACTURER Texas Silica Co.
SCREEN MATERIAL PVC
MANUFACTURER Johnson Well Supply
RISER MATERIAL PVC
MANUFACTURER Johnson Well Supply
RISER DIAMETER 4-inch ID
DRILLING TECHNIQUE Hollow Stem Auger
AUGER SIZE AND TYPE 8¼-inch ID
REMARKS Initially drilled + sampled w/ 4¼-inch Auger Reamed w/ 8¼-inch Augers

BENTONITE TYPE Pellets
MANUFACTURER BDS Company
CEMENT TYPE Portland Cement
MANUFACTURER Lone Star
BOREHOLE DIAMETER 13 inches
SCREEN DIAMETER 4-inch SLOT SIZE 0.010
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE T. McComas
DRILLING CONTRACTOR ATEC
AMOUNT BENTONITE USED 1 3/4 = 50 pounds
AMOUNT GROUT CEMENT USED 3.5 gallons
AMOUNT SAND USED 1000 pounds
STATIC WATER DEPTH (after dev.) _____

(NOT TO SCALE)



QA / QC

INSTALLED BY: A. Christopher ATEC INSTALLATION OBSERVED BY: T. McComas
DISCREPANCIES: _____

APPENDIX C-2

MONITORING WELL DEVELOPMENT FORMS

269190

JOB NAME Aswell AFB JOB No. 11-357-011

BY Tom McCombs CHECKED JAB SHEET 1 OF 2

WELL DEVELOPMENT DATA

1. Well No. SD3 MW06
2. Date of Installation : 3/25/94
3. Date of Development : 3/27/94
4. Static Water Level : Before Development 9.72 ft.: 24 Hours After 10.13 ft
5. Quantity of Water Loss During Drilling, If Used — 0 — Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 4.03 Gal.

	Start	During	End	
7. Specific Conductance (umhos/cm)	703	711		
Temperature (c°)	60.9°F	60.2°F		
pH (s.u.)	6.97	6.78		

8. Depth From Top of Well Casing to Bottom of Well 13.81' ft. (from Well Installation Diagram)
9. Well Diameter 4 inch
10. Screen Length 4.66 ft.
11. Minimum Quantity of Water to be Removed (5 Well Volumes) 55 gal
12. Depth to Top of Sediment : Before Development 0.0 ft.; After Development 0.0 ft
13. Physical Character of Water: silty initially sandy at @ 1020 with h water 1266
14. Type and Size of Well Development Equipment : Bailer, Sanko dev 3 TIMES
15. Description of Surge Technique, If Used : Using pump-n 4-in surge block for 15 min.
16. Height of Well Casing Above Ground Surface : 2.45 ft. (from Well Installation Diagram)
17. Quantity of Water Removed : 16 Gal. Time for Removal : 3X60 Hr./Mi
18. 1-Liter Water Sample Collected : 3/31/94/12:50 (Time)
19. Turbidity in Nephelometric Units >200 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

HF WDDR

WELL DEVELOPMENT DATA

269191

JOB NAME Chevron 11 AFB JOB No. 11-3517-0111

BY Tom McCombs CHECKED SHEET 2 OF 2

Well No. SDB MW06

INITIAL TIME 9:55 3/27/94

Date/ Time	Hrs Dev/ Cum Hrs Dev	Gals Purged/ Cum Gals Purged	pH	Temp	Cond	Remarks
10:15 / 3/27/94	0.20 / 0.20	4 gal	6.97	66.9°F	722	
10:30 / 3/27/94	0.15 / 0.35	4 / 8 gal	6.78	66.2°F	711	Depth to water 8.66 well dry.
15:20 3/27/94	DEPTH to	WATER 11.58				
16:50 3/27/94	DEPTH to	WATER 10.35				
17:00 3/27/94	0.10 / 0.45	4 / 12	6.72	58.6	776	well dry depth to water 12.54
1230 3/29/94	DEPTH TO	WATER				
~~1~~ 12:45 3/29/94	0.15 / 0.60	4 / 16	6.78	69.6	873	well DY @ 12:45 TURBIDITY 7200 NTUs
3/29/94 12:50	SET OUT WATER IN 1m hoff		Conc	13:20		10mL SO/L H2O

269192

JOB NAME Carswell AFB JOB No. 11-3517-0111

BY Tom McCombs CHECKED JB SHEET 1 OF 2

WELL DEVELOPMENT DATA

1. Well No. SD13 MW05
2. Date of Installation : 3/25/94
3. Date of Development : 3/28/94
4. Static Water Level : Before Development ~11 ft.: 24 Hours After 9.11 ft (FROM RIG)
5. Quantity of Water Loss During Drilling, If Used 33 Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 11 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)				
Temperature (c°)				
pH (s.u.)				

8. Depth From Top of Well Casing to Bottom of Well 13.71 ft. (from Well Installation Diagram)
9. Well Diameter 4 IN
10. Screen Length 9.67 ft.
11. Minimum Quantity of Water to be Removed (5 Well Volumes) 55 gal + 99 gal = 154 gal
12. Depth to Top of Sediment : Before Development 0 ft.; After Development -0- ft.
13. Physical Character of Water: clear, very low turbidity, no sediment
14. Type and Size of Well Development Equipment : BAILING AND PUMPING W/ RIG MOUNTED PUMP
15. Description of Surge Technique, If Used : surge block for 15 minutes AND REPEATELY PUMPING DRY W/ RIG PUMP
16. Height of Well Casing Above Ground Surface : -0.22' ft. (from Well Installation Diagram)
17. Quantity of Water Removed : 176 Gal. (3/28/94) Time for Removal : ~~16:30~~ ~~16:45~~ 4:30 Hr./Min
18. 1-Liter Water Sample Collected : 1450 (Time)
19. Turbidity in Nephelometric Units 78 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

WELL DEVELOPMENT DATA

269193

JOB NAME Caswell AF13 JOB No. 11-3517-0111

BY Tom McComb CHECKED JB SHEET 2 OF 2

Well No. SD13 MW05

TIME 0 = 12:15

Date/ Time	Hrs Dev/ Cum Hrs Dev	Gals Purged/ Cum Gals Purged	pH	Temp	Cond	Remarks
3/28/94 1:28 pm	1:13 / 1:13	45 / 45 gal	7.68	69.1	709	pumped w/ RIG
3/28/94 1:47 pm	0:19 / 1:32	10 / 55 gal	7.94	60.8	649	pumped w/ RIG
3/28/94 19:38	0:51 / 2:23	30 / 85 gal	7.23	60.8	678	TURBIDITY > 200 NTUs pumped w/ RIG
3/28/94 15:13	0:35 / 2:58	25 / 110 gal	6.96	58.2	665	pumped w/ RIG
15:15	to 15:30 OSD	4-inch screen black				
1550	0:37 / 3:35	20 / 130	7.22	60.4	697	pumped w/ RIG
1610	0:20 / 3:55	20 / 150	7.36	60.5	666	pumped w/ RIG
1625	0:15 / 4:10	15 / 165	7.84	61.4	637	TURBIDITY >200 NTUs pumped w/ RIG
3/29/94 14:35	Depth to	water 9.11'				
14:45	0:10 / 4:20	4 / 169	7.09	72.2	708	bailing
14:50	0:05 / 4:25	4 / 173	7.09	67.8	728	
14:50	Collection	WATER on Inhalf line		15:20		0.0 mL SOD / L WATER
14:55	0.05 / 4.30	3 / 176	702	66.9	702	
1500	TURBIDMeter	78 NTUs				

JOB NAME Casino II AFB JOB No. 11-3579-044 269194

BY T. McComb CHECKED _____ SHEET 1 OF 2

WELL DEVELOPMENT DATA

1. Well No. SD13-MW07
2. Date of Installation : 3/25/94
3. Date of Development : 3/27/94
4. Static Water Level : Before Development 16.59' ft.: 24 Hours After 16.76 f
5. Quantity of Water Loss During Drilling, If Used — 0.00 — Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 13.5 ' Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)				
Temperature (c°)				
pH (s.u.)				

8. Depth From Top of Well Casing to Bottom of Well 21.51 ft. (from Well Installation Diagram)
9. Well Diameter 4 inch
10. Screen Length 9.64 ft.
11. Minimum Quantity of Water to be Removed (5 Well Volumes) 67.3 gal.
12. Depth to Top of Sediment : Before Development 0 ft.; After Development 0 ft
13. Physical Character of Water: clear, very low turbidity + no sediment observed
14. Type and Size of Well Development Equipment : ~~4 inch surge block and~~ 2" grundfos pump and bailer
15. Description of Surge Technique, If Used : 4-inch surge block and 2" grundfos pump used surge block twice, pumped well dry quickly
16. Height of Well Casing Above Ground Surface : 2.38' ft. (from Well Installation Diagram)
17. Quantity of Water Removed : 228 Gal. Time for Removal : ~~30 min~~ 6.40 Hr./Mi
18. 1-Liter Water Sample Collected : 3/29/94 13:25 (Time)
19. Turbidity in Nephelometric Units 47.8 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

HF WDDR

WELL DEVELOPMENT DATA

269195

JOB NAME Caldwell AFB JOB No. 11-3517-0111

BY Tom McComb CHECKED _____ SHEET 2 OF 2

Well No. SDB-MW07

Date/ Time	Hrs Dev/ Cum Hrs Dev	Gals Purged/ Cum Gals Purged	pH	Temp	Cond	Remarks
~~11:05~~ 3/27/94 11:05	0	0	7.02	58.1	684	
12:30	1:05 / 1:05	15	6.92	60.1	827	Slight sheen, petroleum odor
12:55	0:25 / 1:30	30	6.85	59.5	712	Petrol odor
14:45	1:30 / 3:20	55	6.80	59.9	750	Turbidity 7200 NTUs After 30 min 65 ml/l SCD. petrol odor
15:10		75	6.82	60.9	750	Turbidity 7200 NTUs petrol odor
Used	surge block for ~		10	min.		
1:15	1:20 / 4:50	110	6.67	59.2	696	high turbidity high sediment < 1.075 in ~10 petroleum odor
3/28/94 11:13	0:40 / 5:30	55 / 165	—	—	—	Pumped w/ N2
3/28/94 12:45 ~~12:45~~	0:52 / 6:22	53 / 220	—	—	—	Pumped w/ N2 low turbidity petroleum odor ~~7200 NTUs~~
3/29/94 1320	0:10 / 6:32	4 / 224	7.07	65.5	744	
1325	purged water into Intermediate Cont					
1333	0:08 / 6:40	4 / 228	7.13	63.1	761	
	Pumping stopped @ 13:33					
1335	Turbidimeter reading 47.8		NTUs			

APPENDIX C-3

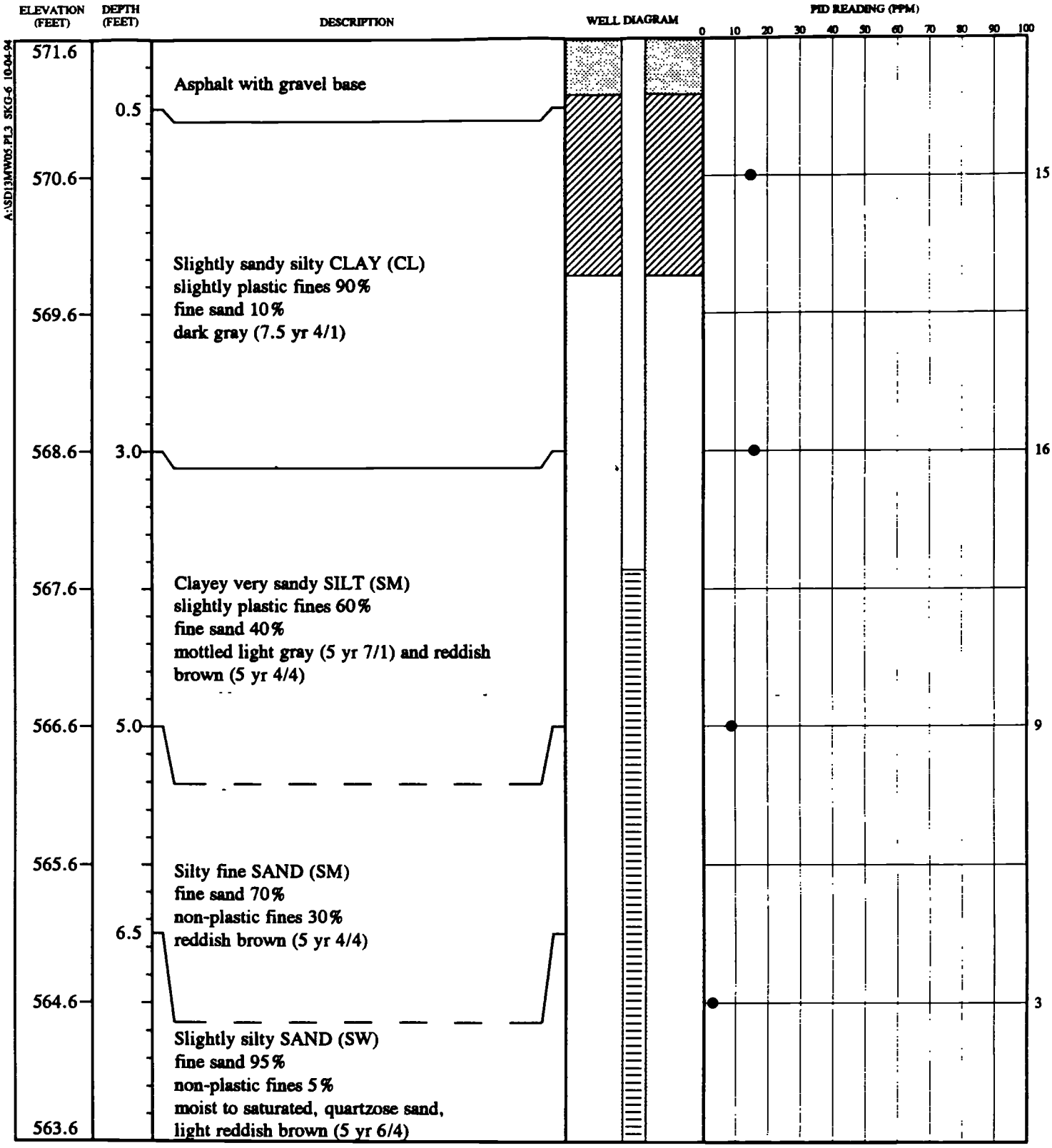
TEST BORING RECORDS

269197

TEST BORING RECORD

DATUM ELEVATION: 571.40 Ft.
HEIGHT OF RISER: -0.22 Ft.

A:\SD13MW05.PL3 SKG-6 10-04-94



REMARKS:

1) Soil boring advanced with 8-inch ID hollow-stem augers.
2) Soil samples collected with California Brass Rings.
3) Following soil samples retained for chemical analyses 1'-3', 3'-5', 5'-7', and 7'-9'.

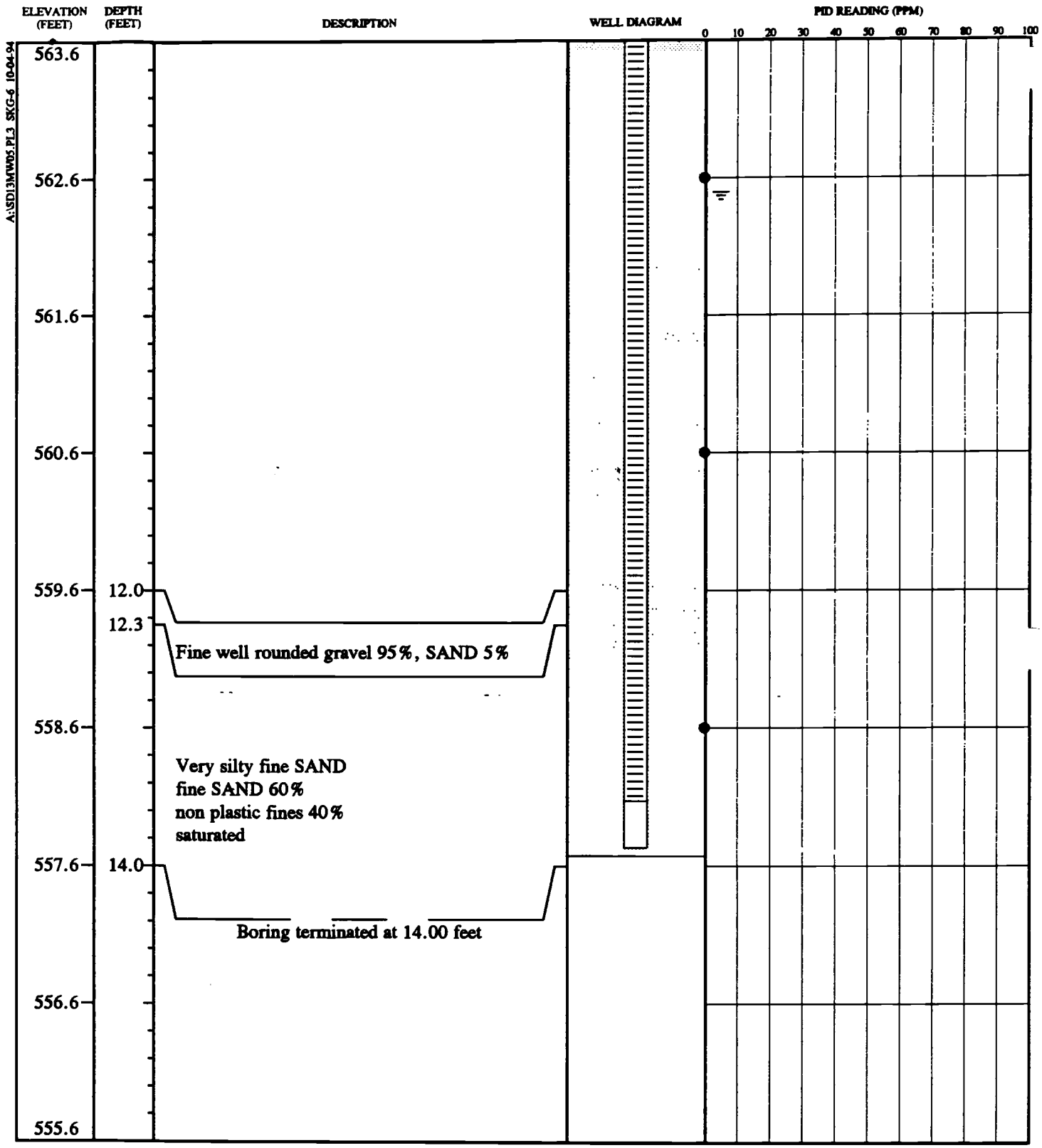
DRILLED BY	BC
LOGGED BY	TDM
CHECKED BY	JLB

BORING NUMBER	SD13-MW05
DATE STARTED	3-25-94
DATE COMPLETED	3-25-94
JOB NUMBER	11-3517-0111

Law Environmental

TEST BORING RECORD

269198



REMARKS:
Boring completed as Type II ground-water monitoring well

DRILLED BY	BC	BORING NUMBER	SD13-MW05
LOGGED BY	TDM	DATE STARTED	3-25-94
CHECKED BY	JLB	DATE COMPLETED	3-25-94
		JOB NUMBER	11-3517

Law Environmental

269199

TEST BORING RECORD

DATUM ELEVATION: 557.66 Ft.
HEIGHT OF RISER: 2.45 Ft.

A:\SD13MW06.PL3 SKG-3 10-03-94

ELEVATION (FEET)	DEPTH (FEET)	DESCRIPTION
555.2		
554.2		
553.2		Silty CLAY with gravel (CL) FILL slightly plastic fines 90% fine gravel 10% angular limestone gravel dark gray (N 4/1)
552.2		
551.2	4.0	
550.2		Slightly silty CLAY (CH) high plastic fines dark greenish gray (5GY 4/1)
549.2	6.0	
		Silty medium SAND (SM) medium sand 70% non-plastic fines 30% black (N 2.5/1) strong petroleum odor
548.2	6.9	split spoon refusal at 6.9 feet
		Weathered light gray shaley limestone
547.2		

WELL DIAGRAM

OVA READINGS (ppm)

0 10 20 30 40 50 60 70 80 90 100

5

5.8

400

REMARKS:

1) Soil boring advanced with 8-inch I.D. hollow-stem augers.
2) Soil samples collected with California Brass Rings.
3) Following soil samples retained for chemical analyses 0-2 ft and 6.0-6.9 ft.
4) Boring completed as Type II ground-water monitoring well.

DRILLED BY	BC	BORING NUMBER	SD13-MW-06
LOGGED BY	TDM	DATE STARTED	3-24-94
CHECKED BY	JLB	DATE COMPLETED	3-25-94
		JOB NUMBER	11-3517-011

Law Environmental

TEST BORING RECORD

269200

A:\SD13MW06.PL3 SKG-3 10-03-94

ELEVATION (FEET)	DEPTH (FEET)	DESCRIPTION	WELL DIAGRAM	OVA READINGS (ppm) 0 10 20 30 40 50 60 70 80 90 100
547.2				
546.2				
545.2				
544.2				
	11.5	Boring terminated at 11.50 feet		
543.2				
542.2				
541.2				
540.2				
539.2				

REMARKS:

DRILLED BY	BC	BORING NUMBER	SD13-MW-06
LOGGED BY	TDM	DATE STARTED	3-24-94
CHECKED BY	JLB	DATE COMPLETED	3-25-9[illegible]
		JOB NUMBER	11-35 11

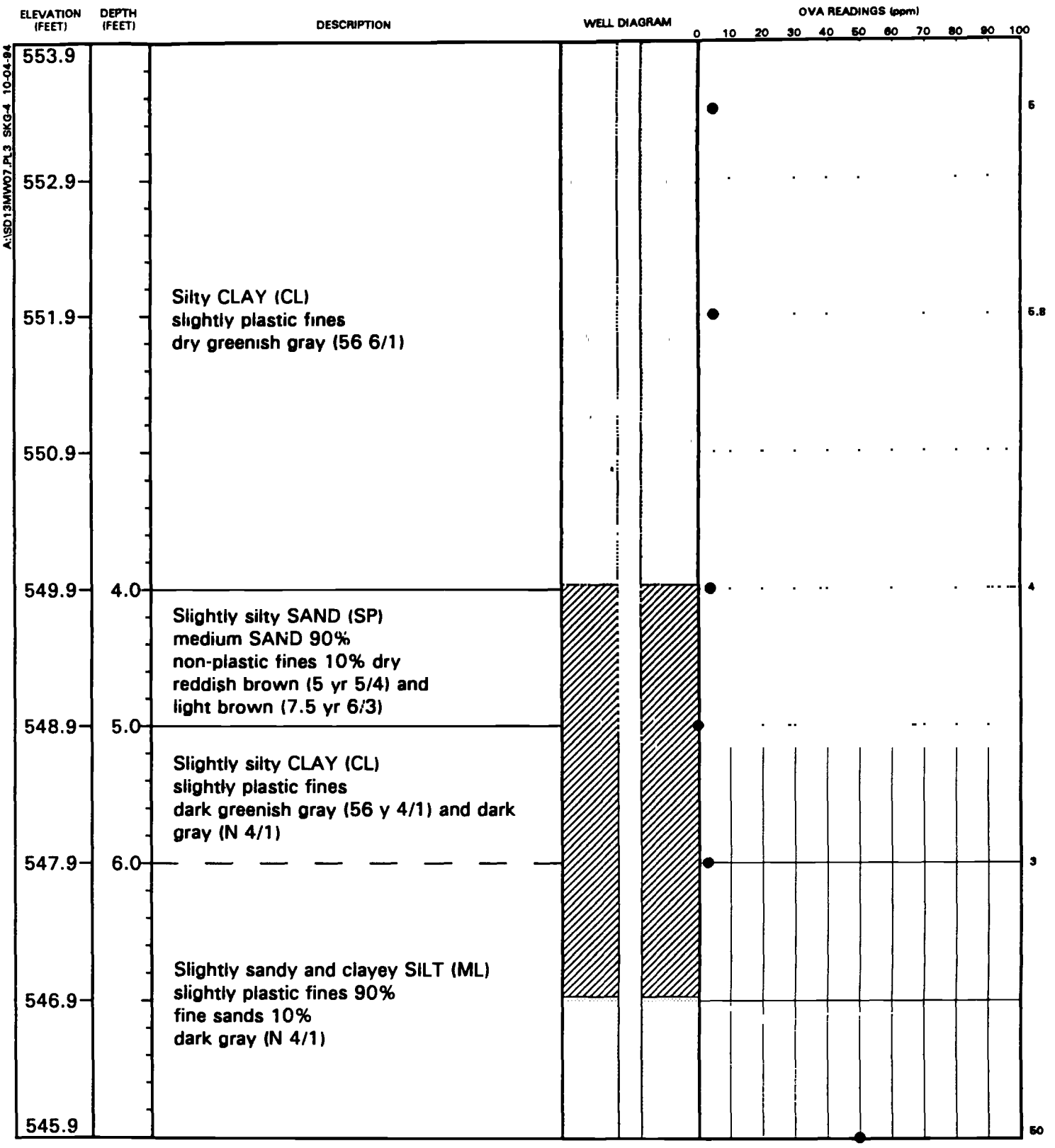
Law Environmental

269201

TEST BORING RECORD

DATUM ELEVATION: 556.30 Ft.
HEIGHT OF RISER: 2.38 Ft.

A:\SD13MW07.PL3 SKG-4 10-04-94



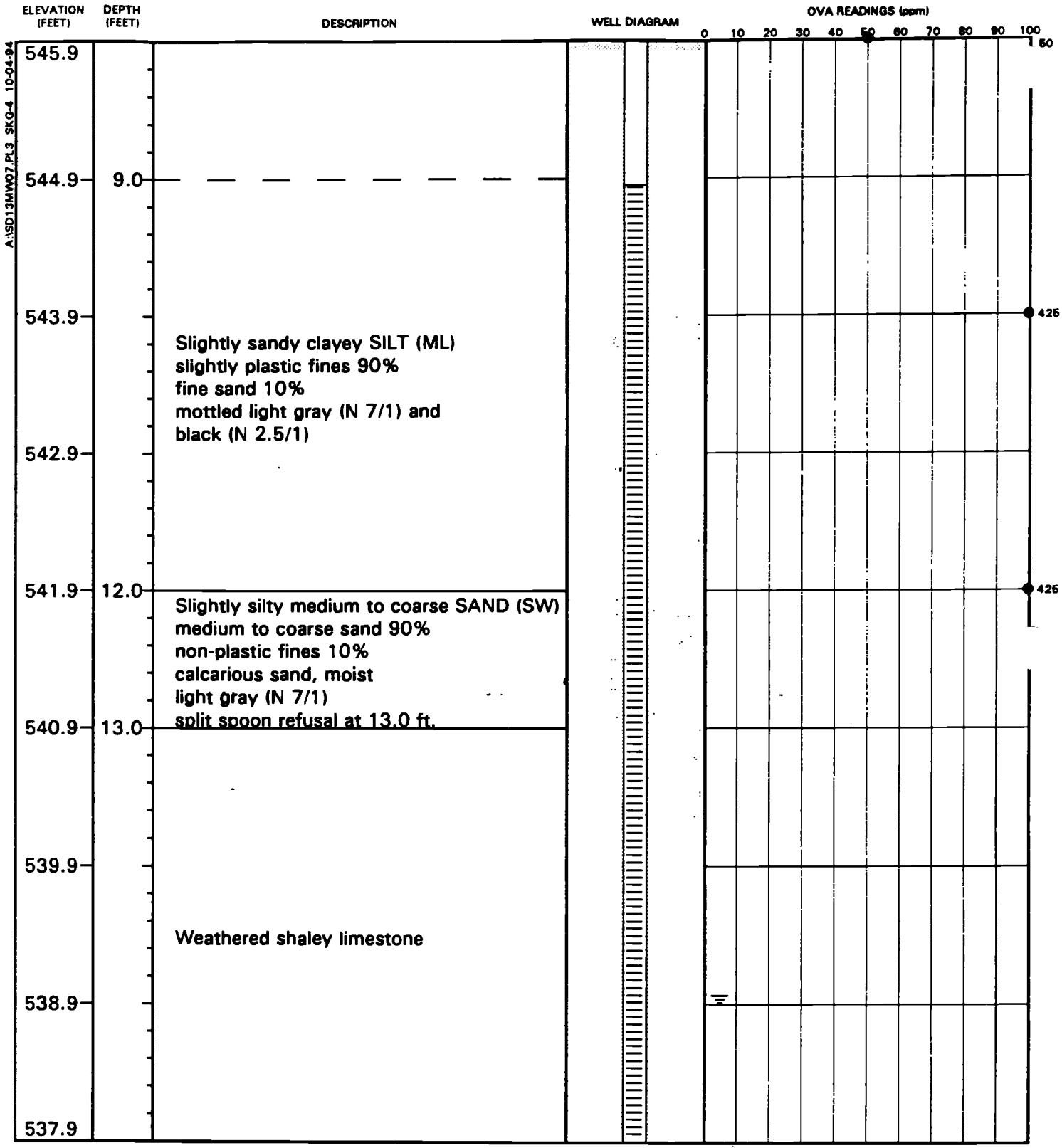
REMARKS:
1) Soil boring advanced with 8-inch I.D. hollow-stem augers.
2) Soil samples collected with California Brass Rings.
3) Following soil samples retained for chemical analyses 2-4 ft and 8-10 ft.
4) Boring completed as Type II ground-water monitoring well.

DRILLED BY	BC	BORING NUMBER	SB13-MW-07
LOGGED BY	TDM	DATE STARTED	3-24-94
CHECKED BY	JLB	DATE COMPLETED	3-24-94
		JOB NUMBER	11-3517-0111

Law Environmental

TEST BORING RECORD

269202



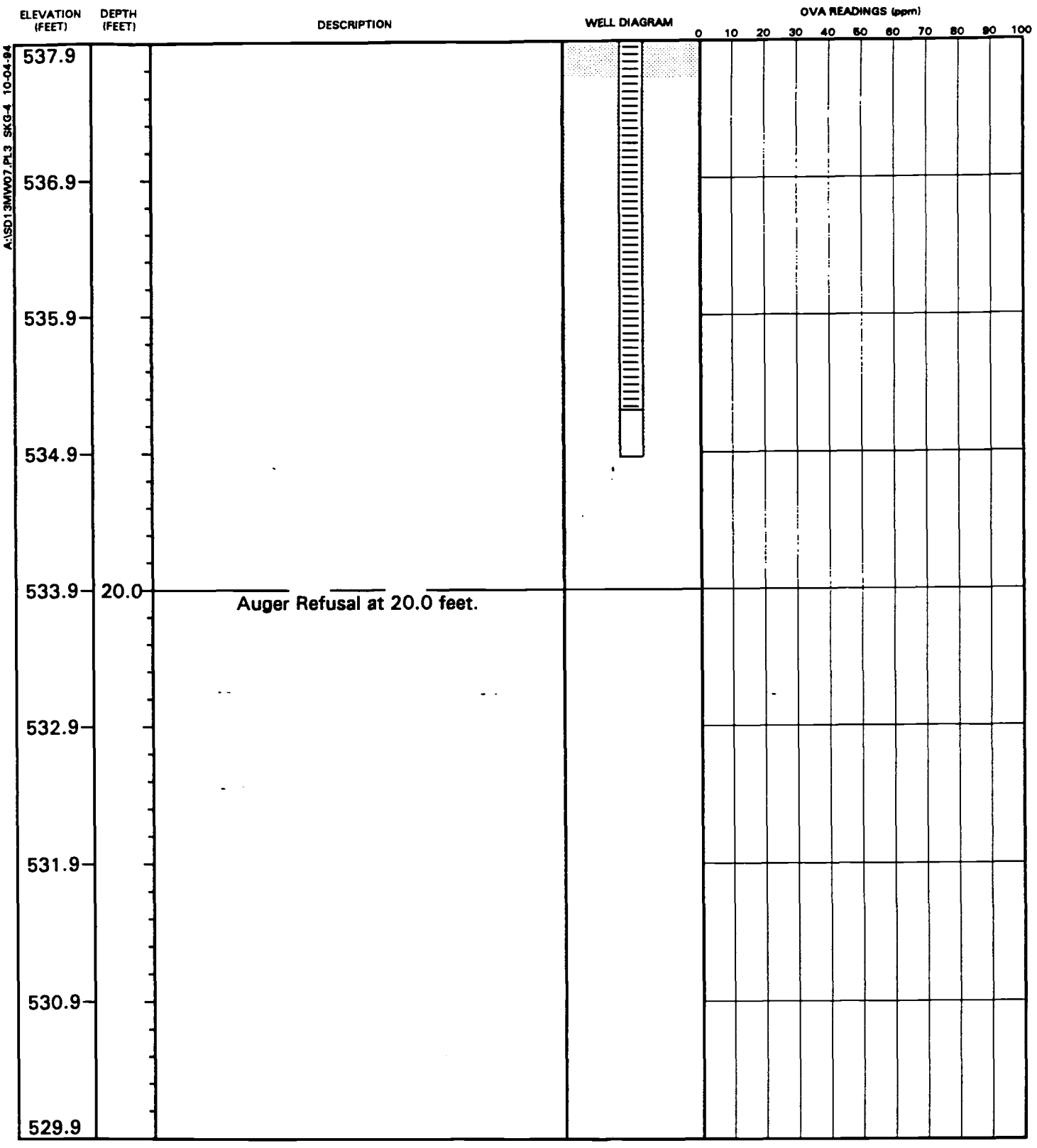
REMARKS:

DRILLED BY	BC	BORING NUMBER	SB13-MW-07
LOGGED BY	TDM	DATE STARTED	3-24-94
CHECKED BY	JLB	DATE COMPLETED	3-24-94
		JOB NUMBER	11-351 .11

Law Environmental

269203

TEST BORING RECORD



REMARKS:

DRILLED BY	BC	BORING NUMBER	SB13-MW-07
LOGGED BY	TDM	DATE STARTED	3-24-94
CHECKED BY	JLB	DATE COMPLETED	3-24-94
		JOB NUMBER	11-3517-011

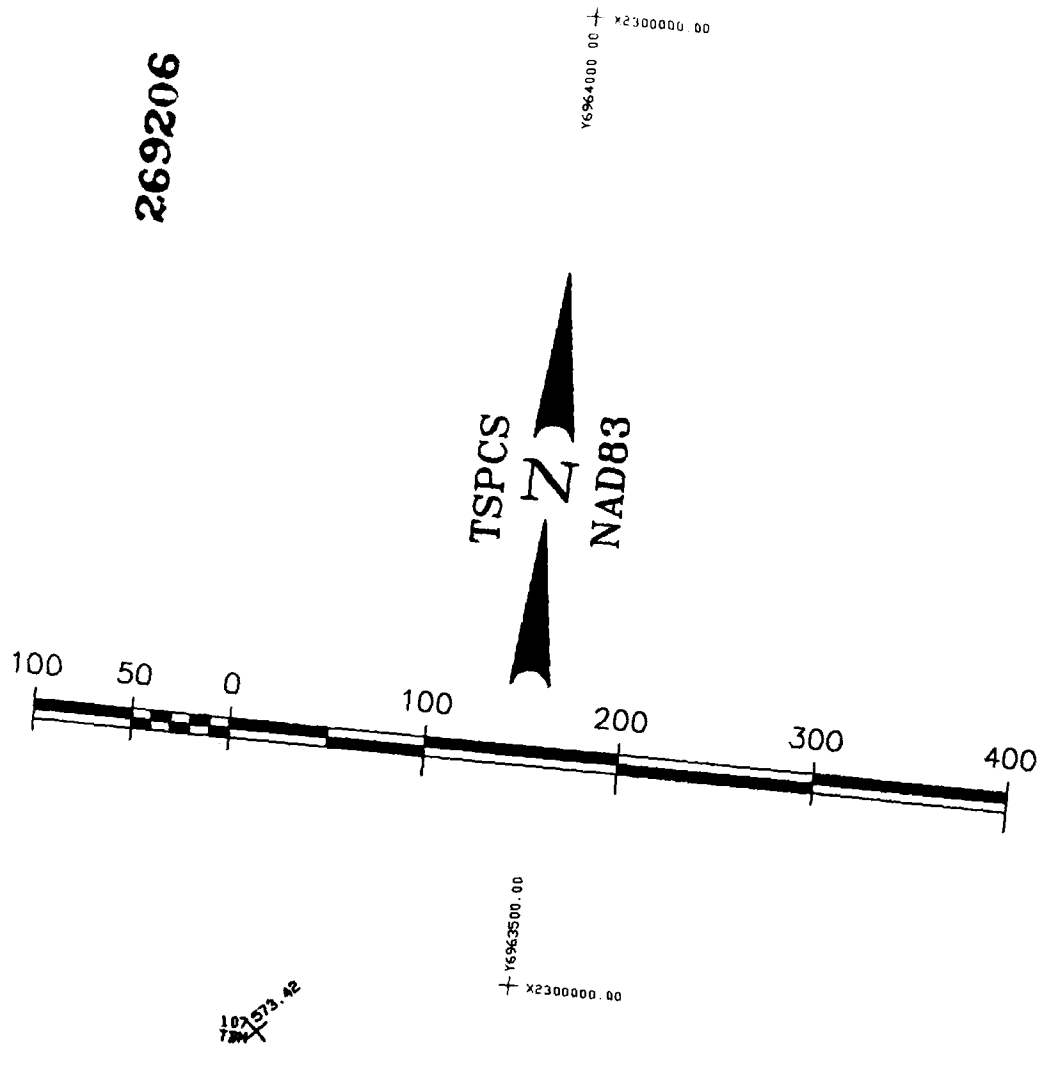
Law Environmental

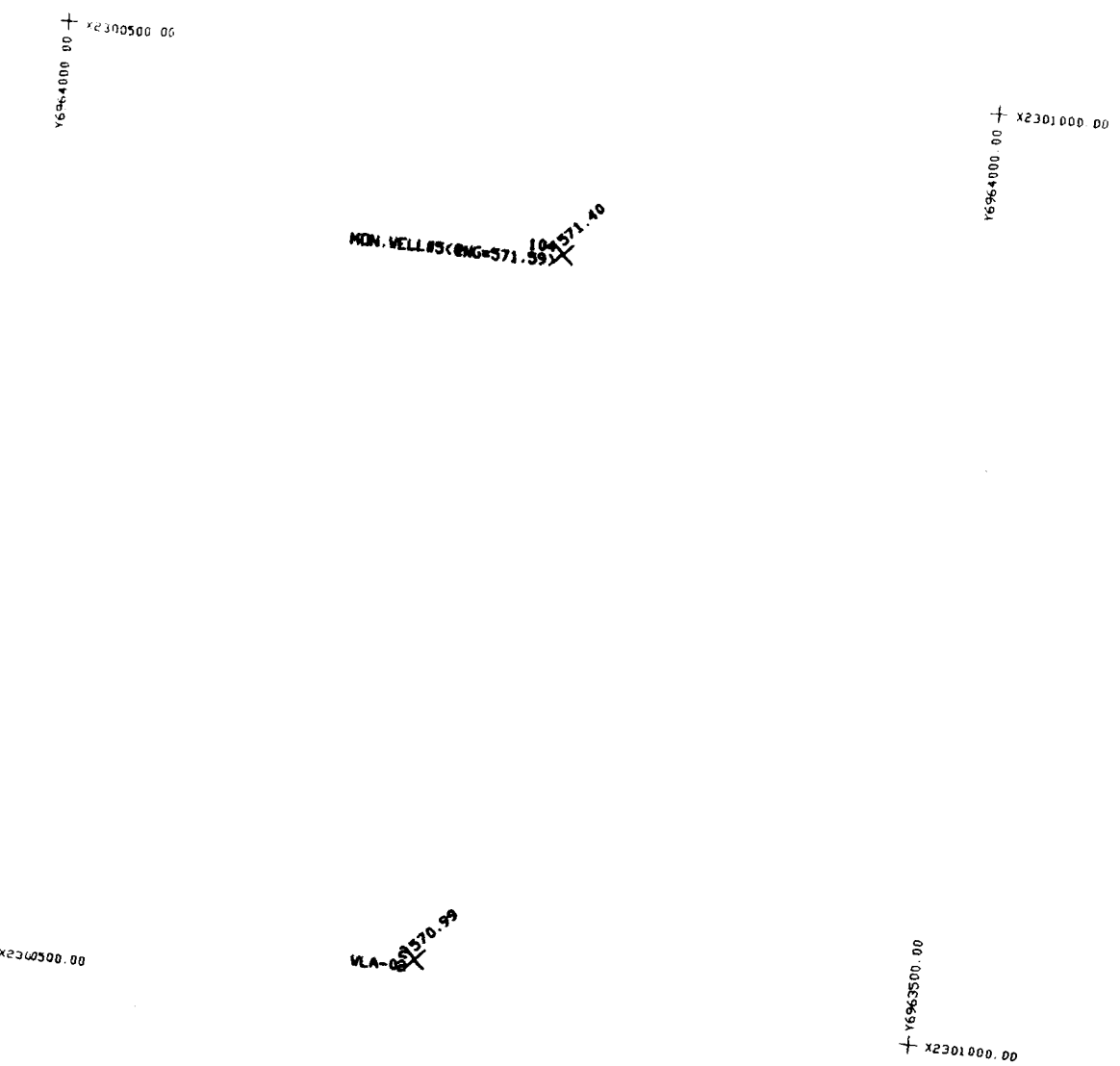
TAB

APPENDIX D

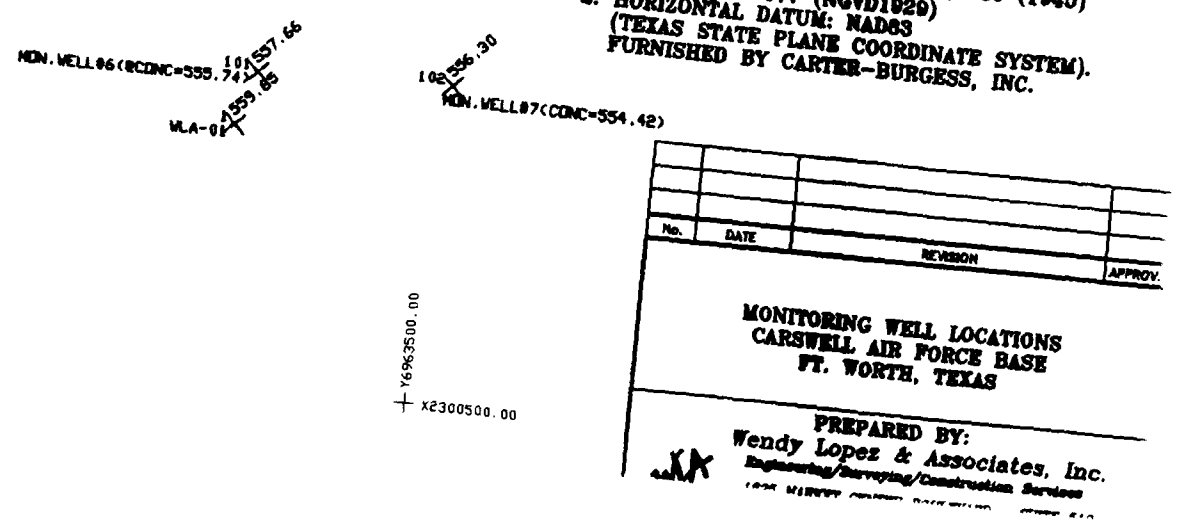
APPENDIX D

TOPOGRAPHICAL SURVEY DATA





PNT	COORDINATES		ELEVATION	DESCRIPTION
101	N 6963162.43982734	E 2300907.60935876	557.661	MON.WELL#6(@CONC=555.74)
102	N 6963164.95211374	E 2301009.44933810	556.301	MON.WELL#7(@CONC=554.42)
104	N 6963902.79293023	E 2300775.41003397	571.400	MON.WELL#5(@NG=571.59)
110	N 6965200.11953605	E 2298840.47603643	604.677	USCGS-BM



NOTES:

1. **VERTICAL DATUM: USCGS BM #J910 (1945) ELEV. = 604.677 (NGVD1929)**
2. **HORIZONTAL DATUM: NAD83 (TEXAS STATE PLANE COORDINATE SYSTEM). FURNISHED BY CARTER-BURGESS, INC.**

269207

TAB

APPENDIX E

APPENDIX E

SLUG TEST DATA

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Project Name : CARSWELL AFB

Project Number : 11-35170121 **269209**

Entered By : TDM Date : 05/5/94

Checked By : _____ Date : _____

Well Number : SD13-MW05

Test Date : 04/21/94
Test Time : 1808
Slug : OUT

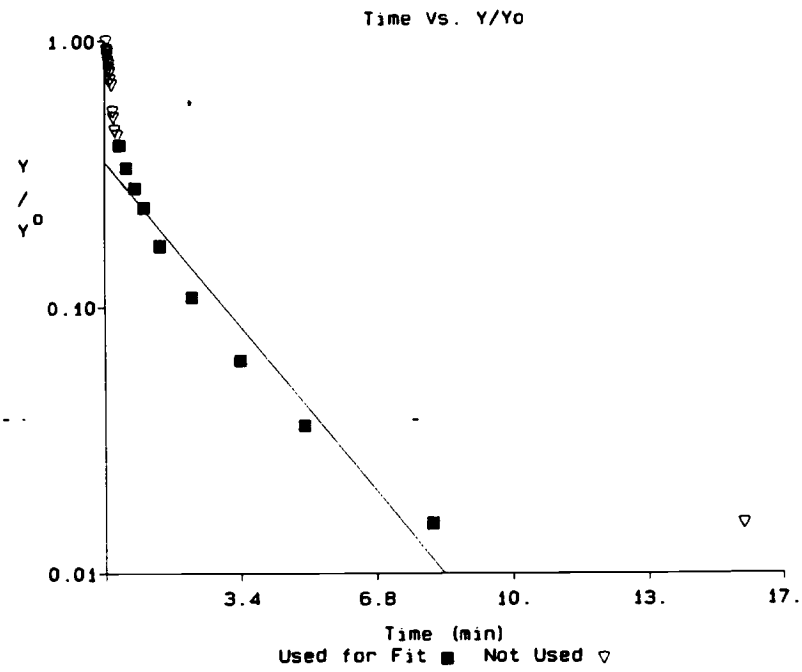
Well Constants

Static Water Level : 9.13 ft
Depth of Well : 13.71 ft
Depth of Aquifier : 20.00 ft

R or rc : 0.170 ft
L : 4.530 ft
rw : 0.500 ft
H : 4.580 ft

Point No.	Time min.	Water Level	@Water Level
1.	0.0433	10.0640	0.93*
2.	0.0600	10.0000	0.87*
3.	0.0700	9.9720	0.84*
4.	0.0766	9.9500	0.82*
5.	0.0800	9.9340	0.80*
6.	0.0900	9.9030	0.77*
7.	0.1033	9.8770	0.75*
8.	0.1100	9.8490	0.72*
9.	0.1200	9.8240	0.69*
10.	0.1266	9.8170	0.69*
11.	0.1466	9.7730	0.64*
12.	0.1833	9.7420	0.61*
13.	0.2133	9.5990	0.47*
14.	0.2333	9.5740	0.44*
15.	0.2600	9.5220	0.39*
16.	0.3266	9.5020	0.37*
17.	0.3833	9.4670	0.34
18.	0.5500	9.4010	0.27
19.	0.7666	9.3500	0.22
20.	1.0000	9.3120	0.18
21.	1.4000	9.2550	0.13
22.	2.2000	9.2050	0.07
23.	3.4000	9.1700	0.04
24.	5.0000	9.1510	0.02
25.	8.2000	9.1380	0.01
26.	16.0000	9.1380	0.01*

Point not used in Curve Fit *



Hydraulic Conductivity Results

BOUWER & RICE (1989)

K = 1.983e-003 ft/min
K = 1.008e-003 cm/sec

H < D A = 1.78
H < D B = 0.27

SD13-MW05

269210

SE1000C
Environmental Logger
04/21 18:31

Unit# 01742 Test 5

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	9.180
Linearity	0.050
Scale factor	10.040
Offset	0.010
Delay mSEC	50.000

Step 0 04/21 18:08:59

Elapsed Time	INPUT 1
0.0000	9.622
0.0033	9.659
0.0066	9.843
0.0100	9.735
0.0133	9.871
0.0166	9.830
0.0200	9.928
0.0233	9.966
0.0266	10.010
0.0300	10.013
0.0333	10.048
0.0366	10.092
0.0400	10.038
0.0433	10.064
0.0466	10.038
0.0500	10.032
0.0533	10.019
0.0566	10.010
0.0600	10.000
0.0633	9.991
0.0666	9.981
0.0700	9.972
0.0733	9.959
0.0766	9.950
0.0800	9.934
0.0833	9.918
0.0866	9.912
0.0900	9.903
0.0933	9.890
0.0966	9.880
0.1000	9.874
0.1033	9.877
0.1066	9.865
0.1100	9.849
0.1133	9.839
0.1166	9.839
0.1200	9.824
0.1233	9.814
0.1266	9.817

269211

0.1400	9.786
0.1433	9.789
0.1466	9.773
0.1500	9.764
0.1533	9.767
0.1566	9.770
0.1600	9.773
0.1633	9.770
0.1666	9.776
0.1700	9.786
0.1733	9.783
0.1766	9.779
0.1800	9.773
0.1833	9.742
0.1866	9.700
0.1900	9.710
0.1933	9.682
0.1966	9.628
0.2000	9.628
0.2033	9.618
0.2066	9.622
0.2100	9.606
0.2133	9.599
0.2166	9.599
0.2200	9.590
0.2233	9.584
0.2266	9.584
0.2300	9.546
0.2333	9.574
0.2366	9.574
0.2400	9.555
0.2433	9.565
0.2466	9.562
0.2500	9.562
0.2533	9.558
0.2566	9.552
0.2600	9.552
0.2633	9.546
0.2666	9.546
0.2700	9.543
0.2733	9.540
0.2766	9.536
0.2800	9.533
0.2833	9.530
0.2866	9.530
0.2900	9.527
0.2933	9.524
0.2966	9.521
0.3000	9.517
0.3033	9.517
0.3066	9.514
0.3100	9.511
0.3133	9.508
0.3166	9.508
0.3200	9.505
0.3233	9.502
0.3266	9.502
0.3300	9.498
0.3333	9.495
0.3500	9.486
0.3666	9.476
0.3833	9.467
0.4000	9.457

269212

[illegible]	[illegible]
0.4666	9.429
0.4833	9.423
0.5000	9.416
0.5166	9.410
0.5333	9.407
0.5500	9.401
0.5666	9.397
0.5833	9.391
0.6000	9.388
0.6166	9.382
0.6333	9.378
0.6500	9.375
0.6666	9.372
0.6833	9.366
0.7000	9.363
0.7166	9.359
0.7333	9.356
0.7500	9.353
0.7666	9.350
0.7833	9.347
0.8000	9.344
0.8166	9.341
0.8333	9.337
0.8500	9.337
0.8666	9.334
0.8833	9.331
0.9000	9.328
0.9166	9.325
0.9333	9.322
0.9500	9.318
0.9666	9.315
0.9833	9.315
1.0000	9.312
1.2000	9.277
1.4000	9.255
1.6000	9.240
1.8000	9.224
2.0000	9.214
2.2000	9.205
2.4000	9.195
2.6000	9.189
2.8000	9.183
3.0000	9.176
3.2000	9.173
3.4000	9.170
3.6000	9.164
3.8000	9.161
4.0000	9.161
4.2000	9.157
4.4000	9.154
4.6000	9.154
4.8000	9.151
5.0000	9.151
5.2000	9.148
5.4000	9.148
5.6000	9.148
5.8000	9.145
6.0000	9.145
6.2000	9.145
6.4000	9.145
6.6000	9.142
6.8000	9.142
7.0000	9.142

7.8000	9.142
8.0000	9.142
8.2000	9.138
8.4000	9.138
8.6000	9.138
8.8000	9.138
9.0000	9.138
9.2000	9.138
9.4000	9.138
9.6000	9.138
9.8000	9.138
10.0000	9.138
12.0000	9.142
14.0000	9.138
16.0000	9.138

END

269213

SE1000C
Environmental Logger
04/21 18:31

SD13-MW05
working
Copy

269214

Unit# 01742 Test 5

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	9.180
Linearity	0.050
Scale factor	10.040
Offset	0.010
Delay mSEC	50.000

Step 0 04/21 18:08:59

Elapsed Time	INPUT 1
0.0000	9.622
0.0033	9.659
0.0066	9.843
0.0100	9.735
0.0133	9.871
0.0166	9.830
0.0200	9.928
0.0233	9.966
0.0266	10.010
0.0300	10.013
0.0333	10.048
0.0366	10.092
0.0400	10.038
0.0433	10.064
0.0466	10.038
0.0500	10.032
0.0533	10.019
0.0566	10.010
0.0600	10.000
0.0633	9.991
0.0666	9.981
0.0700	9.972
0.0733	9.959
0.0766	9.950
0.0800	9.934
0.0833	9.918
0.0866	9.912
0.0900	9.903
0.0933	9.890
0.0966	9.880
0.1000	9.874
0.1033	9.877
0.1066	9.865
0.1100	9.849
0.1133	9.839
0.1166	9.839
0.1200	9.824
0.1233	9.814

269215

0.1400	9.786
0.1433	9.789
0.1466	9.773
0.1500	9.764
0.1533	9.767
0.1566	9.770
0.1600	9.773
0.1633	9.770
0.1666	9.776
0.1700	9.786
0.1733	9.783
0.1766	9.779
0.1800	9.773
0.1833	9.742
0.1866	9.700
0.1900	9.710
0.1933	9.682
0.1966	9.628
0.2000	9.628
0.2033	9.618
0.2066	9.622
0.2100	9.606
0.2133	9.599
0.2166	9.599
0.2200	9.590
0.2233	9.584
0.2266	9.584
0.2300	9.546
0.2333	9.574
0.2366	9.574
0.2400	9.555
0.2433	9.565
0.2466	9.562
0.2500	9.562
0.2533	9.558
0.2566	9.552
0.2600	9.552
0.2633	9.546
0.2666	9.546
0.2700	9.543
0.2733	9.540
0.2766	9.536
0.2800	9.533
0.2833	9.530
0.2866	9.530
0.2900	9.527
0.2933	9.524
0.2966	9.521
0.3000	9.517
0.3033	9.517
0.3066	9.514
0.3100	9.511
0.3133	9.508
0.3166	9.508
0.3200	9.505
0.3233	9.502
0.3266	9.502
0.3300	9.498
0.3333	9.495
0.3366	9.492
0.3400	9.489
0.3433	9.486

0.4666	9.429
0.4833	9.423
0.5000	9.416
0.5166	9.410
0.5333	9.407
0.5500	9.401
0.5666	9.397
0.5833	9.391
0.6000	9.388
0.6166	9.382
0.6333	9.378
0.6500	9.375
0.6666	9.372
0.6833	9.366
0.7000	9.363
0.7166	9.359
0.7333	9.356
0.7500	9.353
0.7666	9.350
0.7833	9.347
0.8000	9.344
0.8166	9.341
0.8333	9.337
0.8500	9.337
0.8666	9.334
0.8833	9.331
0.9000	9.328
0.9166	9.325
0.9333	9.322
0.9500	9.318
0.9666	9.315
0.9833	9.315
1.0000	9.312
1.2000	9.277
1.4000	9.255
1.6000	9.240
1.8000	9.224
2.0000	9.214
2.2000	9.205
2.4000	9.195
2.6000	9.189
2.8000	9.183
3.0000	9.176
3.2000	9.173
3.4000	9.170
3.6000	9.164
3.8000	9.161
4.0000	9.161
4.2000	9.157
4.4000	9.154
4.6000	9.154
4.8000	9.151
5.0000	9.151
5.2000	9.148
5.4000	9.148
5.6000	9.148
5.8000	9.145
6.0000	9.145
6.2000	9.145
6.4000	9.145
6.6000	9.142
6.8000	9.142

269216

BR. EXE

7.8000	
8.0000	9.142
8.2000	9.142
8.4000	9.138
8.6000	9.138
8.8000	9.138
9.0000	9.138
9.2000	9.138
9.4000	9.138
9.6000	9.138
9.8000	9.138
10.0000	9.138
12.0000	9.138
14.0000	9.142
16.0000	9.138
END	9.138

269217

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Project Name : CARSWELL AFB

Project Number : 11-35170121 **269218**

Entered By : T.McCone Date : 5/5/94

Checked By : _____ Date : _____

Well Number : SD13-MW06

Test Date : 04//1/9/
Test Time : 0850
Slug : OUT

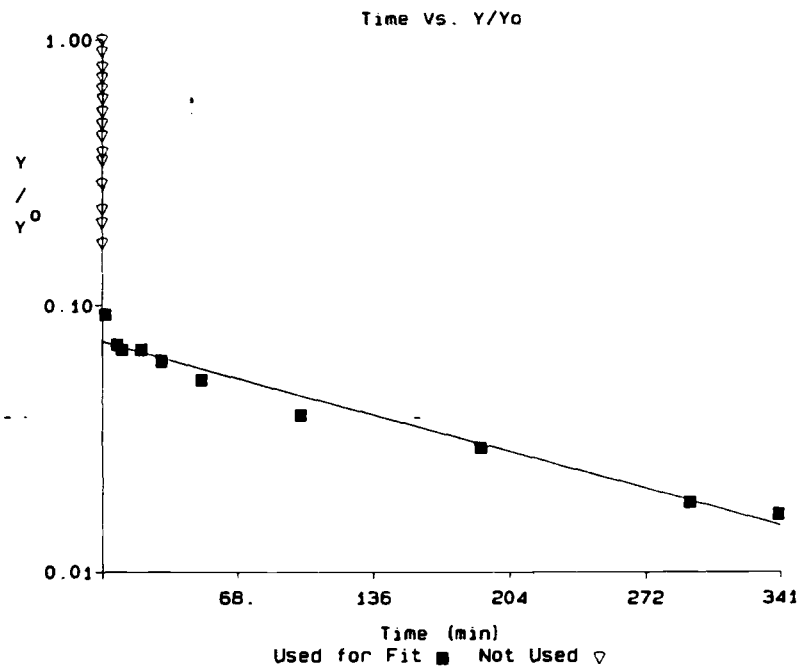
Well Constants

Static Water Level : 11.44 ft
Depth of Well : 13.81 ft
Depth of Aquifier : 14.00 ft

R or rc : 0.170 ft
L : 2.370 ft
rw : 0.500 ft
H : 2.370 ft

Point No.	Time min.	Water Level	@Water Level
1.	0.0266	12.0070	0.57*
2.	0.0300	11.9700	0.53*
3.	0.0366	11.9280	0.49*
4.	0.0433	11.9000	0.46*
5.	0.0500	11.8750	0.44*
6.	0.0566	11.8500	0.41*
7.	0.0666	11.8240	0.38*
8.	0.0766	11.7990	0.36*
9.	0.0866	11.7770	0.34*
10.	0.1000	11.7490	0.31*
11.	0.1056	11.7360	0.30*
12.	0.1300	11.7010	0.26*
13.	0.1566	11.6670	0.23*
14.	0.1800	11.6510	0.21*
15.	0.2333	11.6290	0.19*
16.	2.0000	11.5690	0.13
17.	7.6000	11.5500	0.11
18.	10.0000	11.5470	0.11
19.	20.0000	11.5470	0.11
20.	30.0000	11.5410	0.10
21.	50.0000	11.5310	0.09
22.	100.0000	11.5150	0.08
23.	190.0000	11.5030	0.06
24.	295.0000	11.4870	0.05
25.	340.0000	11.4840	0.04

Point not used in Curve Fit *



Hydraulic Conductivity Results

BOUWER & RICE (1989)

K = 1.752e-005 ft/min
K = 8.900e-006 cm/sec

H < D A = 1.69
H < D B = 0.24

SD13-MW06

269219

SE1000C
Environmental Logger
04/20 15:08

Unit# 01742 Test 3

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	11.440
Linearity	0.050
Scale factor	10.040
Offset	0.010
Delay mSEC	50.000

Step 0 04/19 08:50:46

Elapsed Time	INPUT 1
0.0000	11.440
0.0033	11.664
0.0066	11.376
0.0100	11.465
0.0133	11.853
0.0166	11.531
0.0200	11.985
0.0233	11.840
0.0266	12.007
0.0300	11.947
0.0333	11.935
0.0366	11.928
0.0400	11.919
0.0433	11.900
0.0466	11.900
0.0500	11.875
0.0533	11.865
0.0566	11.850
0.0600	11.840
0.0633	11.837
0.0666	11.824
0.0700	11.818
0.0733	11.809
0.0766	11.799
0.0800	11.787
0.0833	11.783
0.0866	11.777
0.0900	11.764
0.0933	11.761
0.0966	11.755
0.1000	11.749
0.1033	11.742
0.1066	11.736

269220

0.1166	11.717
0.1200	11.714
0.1233	11.708
0.1266	11.705
0.1300	11.701
0.1333	11.695
0.1366	11.698
0.1400	11.689
0.1433	11.682
0.1466	11.686
0.1500	11.673
0.1533	11.676
0.1566	11.667
0.1600	11.667
0.1633	11.667
0.1666	11.664
0.1700	11.664
0.1733	11.657
0.1766	11.654
0.1800	11.651
0.1833	11.651
0.1866	11.648
0.1900	11.645
0.1933	11.645
0.1966	11.645
0.2000	11.641
0.2033	11.641
0.2066	11.638
0.2100	11.638
0.2133	11.638
0.2166	11.635
0.2200	11.635
0.2233	11.632
0.2266	11.632
0.2300	11.632
0.2333	11.629
0.2366	11.629
0.2400	11.629
0.2433	11.629
0.2466	11.626
0.2500	11.626
0.2533	11.626
0.2566	11.623
0.2600	11.623
0.2633	11.623
0.2666	11.623
0.2700	11.623
0.2733	11.619
0.2766	11.619
0.2800	11.619
0.2833	11.619
0.2866	11.619
0.2900	11.616
0.2933	11.616
0.2966	11.616
0.3000	11.616
0.3033	11.616
0.3066	11.616
0.3100	11.616
0.3133	11.613
0.3166	11.613
0.3200	11.613
0.3233	11.613
0.3266	11.613

269221

0.3500	11.613
0.3666	11.610
0.3833	11.607
0.4000	11.607
0.4166	11.604
0.4333	11.604
0.4500	11.600
0.4666	11.600
0.4833	11.600
0.5000	11.597
0.5166	11.597
0.5333	11.597
0.5500	11.597
0.5666	11.594
0.5833	11.594
0.6000	11.594
0.6166	11.594
0.6333	11.591
0.6500	11.591
0.6666	11.591
0.6833	11.591
0.7000	11.591
0.7166	11.588
0.7333	11.588
0.7500	11.588
0.7666	11.588
0.7833	11.588
0.8000	11.588
0.8166	11.588
0.8333	11.585
0.8500	11.585
0.8666	11.585
0.8833	11.585
0.9000	11.585
0.9166	11.585
0.9333	11.585
0.9500	11.585
0.9666	11.582
0.9833	11.582
1.0000	11.582
1.2000	11.578
1.4000	11.575
1.6000	11.572
1.8000	11.572
2.0000	11.569
2.2000	11.569
2.4000	11.566
2.6000	11.566
2.8000	11.566
3.0000	11.563
3.2000	11.563
3.4000	11.563
3.6000	11.563
3.8000	11.559
4.0000	11.559
4.2000	11.559
4.4000	11.559
4.6000	11.559
4.8000	11.556
5.0000	11.556
5.2000	11.556
5.4000	11.556
5.6000	11.556
5.8000	11.556

269222

6.4000	11.553
6.6000	11.553
6.8000	11.553
7.0000	11.553
7.2000	11.553
7.4000	11.553
7.6000	11.550
7.8000	11.550
8.0000	11.550
8.2000	11.550
8.4000	11.550
8.6000	11.550
8.8000	11.550
9.0000	11.550
9.2000	11.550
9.4000	11.550
9.6000	11.550
9.8000	11.550
10.0000	11.547
12.0000	11.553
14.0000	11.550
16.0000	11.550
18.0000	11.547
20.0000	11.547
22.0000	11.544
24.0000	11.544
26.0000	11.541
28.0000	11.541
30.0000	11.541
32.0000	11.537
34.0000	11.537
36.0000	11.537
38.0000	11.534
40.0000	11.534
42.0000	11.534
44.0000	11.531
46.0000	11.531
48.0000	11.531
50.0000	11.531
52.0000	11.531
54.0000	11.528
56.0000	11.528
58.0000	11.528
60.0000	11.528
62.0000	11.525
64.0000	11.525
66.0000	11.525
68.0000	11.525
70.0000	11.525
72.0000	11.525
74.0000	11.522
76.0000	11.522
78.0000	11.522
80.0000	11.522
82.0000	11.522
84.0000	11.518
86.0000	11.518
88.0000	11.518
90.0000	11.518
92.0000	11.518
94.0000	11.518
96.0000	11.515
98.0000	11.518
100.000	11.515

[illegible]	11.506
190.000	11.503
205.000	11.499
220.000	11.496
235.000	11.493
250.000	11.490
265.000	11.490
280.000	11.490
295.000	11.487
310.000	11.487
325.000	11.484
340.000	11.484

END

269223

SD13- MW00
Working Copy

269224

SE1000C
Environmental Logger
04/20 15:08

Unit# 01742 Test 3

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	11.440
Linearity	0.050
Scale factor	10.040
Offset	0.010
Delay mSEC	50.000

Step 0 04/19 08:50:46

Elapsed Time	INPUT 1
0.0000	11.440
0.0033	11.664
0.0066	11.376
0.0100	11.465
0.0133	11.853
0.0166	11.531
0.0200	11.985
0.0233	11.840
0.0266	12.007
0.0300	11.947
0.0333	11.935
0.0366	11.928
0.0400	11.919
0.0433	11.900
0.0466	11.900
0.0500	11.875
0.0533	11.865
0.0566	11.850
0.0600	11.840
0.0633	11.837
0.0666	11.824
0.0700	11.818
0.0733	11.809
0.0766	11.799
0.0800	11.787
0.0833	11.783
0.0866	11.777
0.0900	11.764
0.0933	11.761
0.0966	11.755
0.1000	11.752

269225

0.1200	11.714
0.1233	11.708
0.1266	11.705
0.1300	11.701
0.1333	11.695
0.1366	11.698
0.1400	11.689
0.1433	11.682
0.1466	11.686
0.1500	11.673
0.1533	11.676
0.1566	11.667
0.1600	11.667
0.1633	11.667
0.1666	11.664
0.1700	11.664
0.1733	11.657
0.1766	11.654
0.1800	11.651
0.1833	11.651
0.1866	11.648
0.1900	11.645
0.1933	11.645
0.1966	11.645
0.2000	11.641
0.2033	11.641
0.2066	11.638
0.2100	11.638
0.2133	11.638
0.2166	11.635
0.2200	11.635
0.2233	11.632
0.2266	11.632
0.2300	11.632
0.2333	11.629
0.2366	11.629
0.2400	11.629
0.2433	11.629
0.2466	11.626
0.2500	11.626
0.2533	11.626
0.2566	11.623
0.2600	11.623
0.2633	11.623
0.2666	11.623
0.2700	11.623
0.2733	11.619
0.2766	11.619
0.2800	11.619
0.2833	11.619
0.2866	11.619
0.2900	11.616
0.2933	11.616
0.2966	11.616
0.3000	11.616
0.3033	11.616
0.3066	11.616
0.3100	11.616
0.3133	11.613
0.3166	11.613
0.3200	11.613
0.3233	11.613

269226

0.3666	11.610
0.3833	11.607
0.4000	11.607
0.4166	11.604
0.4333	11.604
0.4500	11.600
0.4666	11.600
0.4833	11.600
0.5000	11.597
0.5166	11.597
0.5333	11.597
0.5500	11.597
0.5666	11.594
0.5833	11.594
0.6000	11.594
0.6166	11.594
0.6333	11.591
0.6500	11.591
0.6666	11.591
0.6833	11.591
0.7000	11.591
0.7166	11.588
0.7333	11.588
0.7500	11.588
0.7666	11.588
0.7833	11.588
0.8000	11.588
0.8166	11.588
0.8333	11.585
0.8500	11.585
0.8666	11.585
0.8833	11.585
0.9000	11.585
0.9166	11.585
0.9333	11.585
0.9500	11.585
0.9666	11.582
0.9833	11.582
1.0000	11.582
1.2000	11.578
1.4000	11.575
1.6000	11.572
1.8000	11.572
2.0000	11.569
2.2000	11.569
2.4000	11.566
2.6000	11.566
2.8000	11.566
3.0000	11.563
3.2000	11.563
3.4000	11.563
3.6000	11.563
3.8000	11.559
4.0000	11.559
4.2000	11.559
4.4000	11.559
4.6000	11.559
4.8000	11.556
5.0000	11.556
5.2000	11.556
5.4000	11.556

269227

6.6000	11.553
6.8000	11.553
7.0000	11.553
7.2000	11.553
7.4000	11.553
7.6000	11.550
7.8000	11.550
8.0000	11.550
8.2000	11.550
8.4000	11.550
8.6000	11.550
8.8000	11.550
9.0000	11.550
9.2000	11.550
9.4000	11.550
9.6000	11.550
9.8000	11.550
10.0000	11.547
12.0000	11.553
14.0000	11.550
16.0000	11.550
18.0000	11.547
20.0000	11.547
22.0000	11.544
24.0000	11.544
26.0000	11.541
28.0000	11.541
30.0000	11.541
32.0000	11.537
34.0000	11.537
36.0000	11.537
38.0000	11.534
40.0000	11.534
42.0000	11.534
44.0000	11.531
46.0000	11.531
48.0000	11.531
50.0000	11.531
52.0000	11.531
54.0000	11.528
56.0000	11.528
58.0000	11.528
60.0000	11.528
62.0000	11.525
64.0000	11.525
66.0000	11.525
68.0000	11.525
70.0000	11.525
72.0000	11.525
74.0000	11.522
76.0000	11.522
78.0000	11.522
80.0000	11.522
82.0000	11.522
84.0000	11.518
86.0000	11.518
88.0000	11.518
90.0000	11.518
92.0000	11.518
94.0000	11.518
96.0000	11.515
98.0000	11.518

190.000	11.503
205.000	11.499
220.000	11.496
235.000	11.493
250.000	11.490
265.000	11.490
280.000	11.490
295.000	11.487
310.000	11.487
325.000	11.484
340.000	11.484

END

269228

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Project Name : CARSWELL AFB

Project Number : 11-35170121 **269229**

Entered By : TDM Date : 05/5/94

Checked By : _____ Date : _____

Well Number : SD13-MW07

Test Date : 04/21/94
Test Time : 0700
Slug : OUT

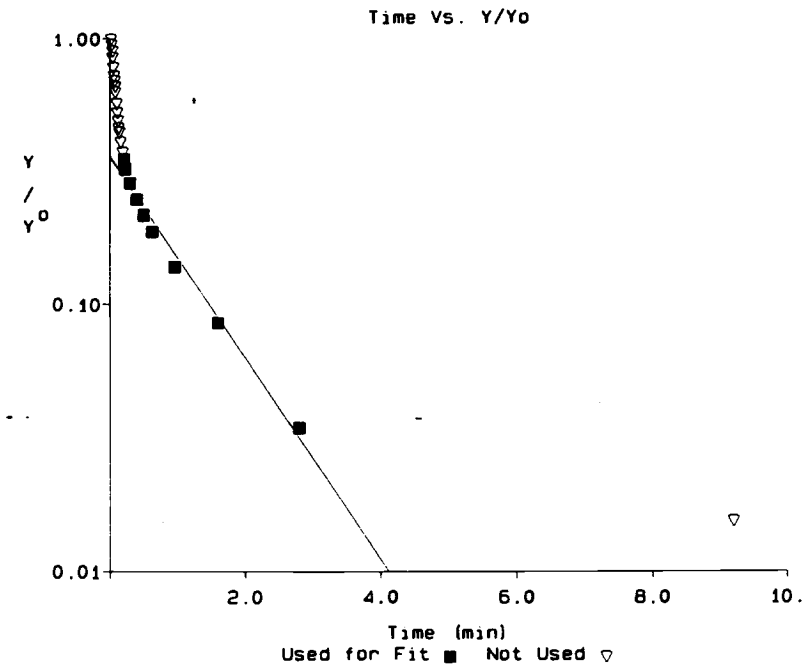
Well Constants

Static Water Level : 17.34 ft
Depth of Well : 21.51 ft
Depth of Aquifer : 22.00 ft

R or rc : 0.170 ft
L : 4.170 ft
rw : 0.500 ft
H : 4.170 ft

Point No.	Time min.	Water Level	@Water Level
1.	0.0266	18.2170	0.88*
2.	0.0333	18.1540	0.81*
3.	0.0400	18.0970	0.76*
4.	0.0466	18.0440	0.70*
5.	0.0566	17.9680	0.63*
6.	0.0666	17.9080	0.57*
7.	0.0733	17.8760	0.54*
8.	0.0800	17.8380	0.50*
9.	0.0866	17.8070	0.47*
10.	0.1000	17.7500	0.41*
11.	0.1133	17.7060	0.37*
12.	0.1266	17.6710	0.33*
13.	0.1333	17.6460	0.31*
14.	0.1466	17.6300	0.29*
15.	0.1666	17.5980	0.26*
16.	0.1900	17.5700	0.23*
17.	0.2133	17.5510	0.21
18.	0.2366	17.5290	0.19
19.	0.3033	17.5010	0.16
20.	0.4000	17.4720	0.13
21.	0.5000	17.4500	0.11
22.	0.6333	17.4310	0.09
23.	0.9666	17.4000	0.06
24.	1.6000	17.3710	0.03
25.	2.8000	17.3490	0.01
26.	9.2000	17.3430	0.00*

Point not used in Curve Fit *



Hydraulic Conductivity Results

BOUWER & RICE (1989)

K = 5.610e-003 ft/min
K = 2.850e-003 cm/sec

H < D A = 1.77
H < D B = 0.26

SD13-MW07

269230

SE1000C
Environmental Logger
04/21 07:24

Unit# 01742 Test 4

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	17.340
Linearity	0.050
Scale factor	10.040
Offset	0.010
Delay mSEC	50.000

Step 0 04/21 07:00:21

Elapsed Time	INPUT 1
0.0000	17.703
0.0033	17.561
0.0066	17.576
0.0100	17.826
0.0133	17.933
0.0166	17.993
0.0200	18.145
0.0233	18.274
0.0266	18.217
0.0300	18.182
0.0333	18.154
0.0366	18.122
0.0400	18.097
0.0433	18.072
0.0466	18.044
0.0500	18.018
0.0533	17.990
0.0566	17.968
0.0600	17.946
0.0633	17.930
0.0666	17.908
0.0700	17.883
0.0733	17.876
0.0766	17.854
0.0800	17.838
0.0833	17.823
0.0866	17.807
0.0900	17.791
0.0933	17.778
0.0966	17.763
0.1000	17.750
0.1033	17.740
0.1066	17.728
0.1100	17.718
0.1133	17.708

0.1233	17.681
0.1266	17.671
0.1300	17.662
0.1333	17.648
0.1366	17.649
0.1400	17.643
0.1433	17.633
0.1466	17.630
0.1500	17.621
0.1533	17.617
0.1566	17.614
0.1600	17.608
0.1633	17.605
0.1666	17.598
0.1700	17.595
0.1733	17.589
0.1766	17.586
0.1800	17.586
0.1833	17.576
0.1866	17.573
0.1900	17.570
0.1933	17.567
0.1966	17.564
0.2000	17.561
0.2033	17.557
0.2066	17.554
0.2100	17.554
0.2133	17.551
0.2166	17.548
0.2200	17.545
0.2233	17.542
0.2266	17.538
0.2300	17.532
0.2333	17.535
0.2366	17.529
0.2400	17.529
0.2433	17.529
0.2466	17.526
0.2500	17.526
0.2533	17.523
0.2566	17.523
0.2600	17.520
0.2633	17.516
0.2666	17.516
0.2700	17.513
0.2733	17.513
0.2766	17.510
0.2800	17.510
0.2833	17.507
0.2866	17.507
0.2900	17.504
0.2933	17.504
0.2966	17.504
0.3000	17.501
0.3033	17.501
0.3066	17.497
0.3100	17.497
0.3133	17.494
0.3166	17.494
0.3200	17.494
0.3233	17.491
0.3266	17.491
0.3300	17.491
0.3333	17.488

269231

269232

0.3833	17.475
0.4000	17.472
0.4166	17.466
0.4333	17.463
0.4500	17.460
0.4666	17.456
0.4833	17.453
0.5000	17.450
0.5166	17.447
0.5333	17.444
0.5500	17.444
0.5666	17.441
0.5833	17.437
0.6000	17.437
0.6166	17.434
0.6333	17.431
0.6500	17.431
0.6666	17.428
0.6833	17.425
0.7000	17.425
0.7166	17.422
0.7333	17.422
0.7500	17.406
0.7666	17.418
0.7833	17.415
0.8000	17.415
0.8166	17.412
0.8333	17.409
0.8500	17.409
0.8666	17.409
0.8833	17.406
0.9000	17.406
0.9166	17.406
0.9333	17.403
0.9500	17.403
0.9666	17.400
0.9833	17.400
1.0000	17.400
1.2000	17.384
1.4000	17.377
1.6000	17.371
1.8000	17.365
2.0000	17.362
2.2000	17.355
2.4000	17.355
2.6000	17.352
2.8000	17.349
3.0000	17.349
3.2000	17.349
3.4000	17.346
3.6000	17.346
3.8000	17.346
4.0000	17.346
4.2000	17.346
4.4000	17.343
4.6000	17.343
4.8000	17.343
5.0000	17.343
5.2000	17.343
5.4000	17.343
5.6000	17.343
5.8000	17.343
6.0000	17.343
6.2000	17.343

7.0000	17.343
7.2000	17.343
7.4000	17.343
7.6000	17.343
7.8000	17.343
8.0000	17.340
8.2000	17.343
8.4000	17.343
8.6000	17.340
8.8000	17.343
9.0000	17.343
9.2000	17.343
9.4000	17.340
9.6000	17.340
9.8000	17.343
10.0000	17.340
12.0000	17.340

END

269233

SD13-MW07
Working Copy

269234

SE1000C
Environmental Logger
04/21 07:24

Unit# 01742 Test 4

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	00000
Reference	17.340
Linearity	0.050
Scale factor	10.040
Offset	0.010
Delay mSEC	50.000

Step 0 04/21 07:00:21

Elapsed Time	INPUT 1
0.0000	17.703
0.0033	17.561
0.0066	17.576
0.0100	17.826
0.0133	17.933
0.0166	17.993
0.0200	18.145
0.0233	18.274
0.0266	18.217
0.0300	18.182
0.0333	18.154
0.0366	18.122
0.0400	18.097
0.0433	18.072
0.0466	18.044
0.0500	18.018
0.0533	17.990
0.0566	17.968
0.0600	17.946
0.0633	17.930
0.0666	17.908
0.0700	17.883
0.0733	17.876
0.0766	17.854
0.0800	17.838
0.0833	17.823
0.0866	17.807
0.0900	17.791
0.0933	17.778
0.0966	17.763
0.1000	17.750
0.1033	17.740
0.1066	17.723
[illegible]	[illegible]

0.1266	17.671
0.1300	17.662
0.1333	17.646
0.1366	17.649
0.1400	17.643
0.1433	17.633
0.1466	17.630
0.1500	17.621
0.1533	17.617
0.1566	17.614
0.1600	17.608
0.1633	17.605
0.1666	17.598
0.1700	17.595
0.1733	17.589
0.1766	17.586
0.1800	17.586
0.1833	17.576
0.1866	17.573
0.1900	17.570
0.1933	17.567
0.1966	17.564
0.2000	17.561
0.2033	17.557
0.2066	17.554
0.2100	17.554
0.2133	17.551
0.2166	17.548
0.2200	17.545
0.2233	17.542
0.2266	17.538
0.2300	17.532
0.2333	17.535
0.2366	17.529
0.2400	17.529
0.2433	17.529
0.2466	17.526
0.2500	17.526
0.2533	17.523
0.2566	17.523
0.2600	17.520
0.2633	17.516
0.2666	17.516
0.2700	17.513
0.2733	17.513
0.2766	17.510
0.2800	17.510
0.2833	17.507
0.2866	17.507
0.2900	17.504
0.2933	17.504
0.2966	17.504
0.3000	17.501
0.3033	17.501
0.3066	17.497
0.3100	17.497
0.3133	17.494
0.3166	17.494
0.3200	17.494
0.3233	17.491
0.3266	17.491

269235

269236

0.4000	17.472
0.4166	17.466
0.4333	17.463
0.4500	17.460
0.4666	17.456
0.4833	17.453
0.5000	17.450
0.5166	17.447
0.5333	17.444
0.5500	17.444
0.5666	17.441
0.5833	17.437
0.6000	17.437
0.6166	17.434
0.6333	17.431
0.6500	17.431
0.6666	17.428
0.6833	17.425
0.7000	17.425
0.7166	17.422
0.7333	17.422
0.7500	17.406
0.7666	17.418
0.7833	17.415
0.8000	17.415
0.8166	17.412
0.8333	17.409
0.8500	17.409
0.8666	17.409
0.8833	17.406
0.9000	17.406
0.9166	17.406
0.9333	17.403
0.9500	17.403
0.9666	17.400
0.9833	17.400
1.0000	17.400
1.2000	17.384
1.4000	17.377
1.6000	17.371
1.8000	17.365
2.0000	17.362
2.2000	17.355
2.4000	17.355
2.6000	17.352
2.8000	17.349
3.0000	17.349
3.2000	17.349
3.4000	17.346
3.6000	17.346
3.8000	17.346
4.0000	17.346
4.2000	17.346
4.4000	17.343
4.6000	17.343
4.8000	17.343
5.0000	17.343
5.2000	17.343
5.4000	17.343
5.6000	17.343
5.8000	17.343

7.0000	17.343
7.2000	17.343
7.4000	17.343
7.6000	17.343
7.8000	17.343
8.0000	17.340
8.2000	17.343
8.4000	17.343
8.6000	17.340
8.8000	17.343
9.0000	17.343
9.2000	17.343
9.4000	17.340
9.6000	17.340
9.8000	17.343
10.0000	17.340
12.0000	17.340

END

269237

TAB

APPENDIX F

269239

APPENDIX F

ANALYTICAL DATA SUMMARY TABLES

TABLE 1-3
ANALYTICAL DATA SUMMARY TABLE
DO #11 SOIL BORINGS
CARSWELL AFB

PARAMETER		SD13MW05A		SD13MW05B		Sample SD13MW05C		Duplicate SD13MWDP1		SD13MW05D		SD13MW06A	
	Date Sampled:	03/25/94		03/25/94		03/25/94		03/25/94		03/25/94		03/24/94	
	Depth:	0-2'		2-4'		4-6'		4-6'		6-8'		0-2'	
D2216/METHOD,PERCENT													
SOLIDS, PERCENT		84		86		86		85		82		91	
E418.1/SW9071,MG/KG													
PETROLEUM HYDROCARBONS		90		2500		110		210		40		440	
Metals (SW6010/SW3050), MG/KG													
ALUMINUM		6600		4100		4100		4900		350		4800	
ANTIMONY		<4.8	JL	<4.7		<4.8		<4.7		<4.7		<4.5	
ARSENIC		3.7		12		6.0		7.5		<3.5		4.6	
BARIUM		106		110		130		120		4.9		53	
BERYLLIUM		0.52		<1.7		<1.7		<1.7		<0.17		<1.6	
CADMIUM		1.2		1.5		0.85		0.76		<0.34		1.2	
CALCIUM		27000	JH	210000	JH	160000	JH	150000	JH	350	JH	87000	JH
CHROMIUM, TOTAL		6.6		4.4		3.8		4.9		<0.67		9.7	
COBALT		3.4		4.4		2.0		2.5		<1.1		3.9	
COPPER		21	J	66	JH	44	JH	37	JH	20	JH	19	JH
IRON		8000		8000		4200		4800		543		7800	JH
LEAD		11	JH	6.5		6.1		6.8		<3.1		36	
MAGNESIUM		1200		1500		1100		1100		65		1400	
MANGANESE		108	JH	340		100		94		1.8		260	
MOLYBDENUM		<3.1	JL	<3.0		<3.1		<3.0		<3.0		<2.9	
NICKEL		7.6		6.2		3.0		4.2		<2.1		7.8	
POTASSIUM		990		420		410		540		90		720	
SELENIUM		<6.8		<6.6		<6.7		<6.6		<6.6		<6.3	
SILVER		<0.69		<0.67		<0.68		<0.67		<0.67		<0.64	
SODIUM		47		110		80	J	15	J	<22		72	
THALLIUM		<6.2		<6.0		<6.1		<6.0		<6.0		<5.8	
VANADIUM		13		16		<8.5		<8.4		1.0		14	
ZINC		19	JH	30	JH	24	JH	21	JH	10	JH	21	
Volatile Organics (SW8020/SW5030), MG/KG													
BENZENE		<0.0005		<0.0005		<0.0005		<0.0005		<0.0005		<0.0005	
ETHYLBENZENE		<0.0005		<0.0005		<0.0005		<0.0005		<0.0005		<0.0005	
TOTAL XYLENE		<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
TOLUENE		0.0008		<0.0005		<0.0005		<0.0005		0.0012		<0.0017	
SURROGATES, (%)													
4-CHLOROTOLUENE		100		100		103		103		105		103	
FLUOROBENZENE		105		100		98		98		105		105	

269240

TABLE 1-3
ANALYTICAL DATA SUMMARY TABLE
DO #11 SOIL BORINGS
CARSWELL AFB

PARAMETER		SD13MW05A		SD13MW05B		Sample SD13MW05C		Duplicate SD13MWDP1		SD13MW05D		SD13MW06A	
	Date Sampled:	03/25/94		03/25/94		03/25/94		03/25/94		03/25/94		03/24/94	
	Depth:	0-2'		2-4'		4-6'		4-6'		6-8'		0-2'	
Volatile Organics (SW8240/SW5030), MG/KG													
1,1,1-TRICHLOROETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
1,1,2,2-TETRACHLOROETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
1,1,2-TRICHLOROETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
1,1-DICHLOROETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
1,1-DICHLOROETHENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
1,2-DICHLOROETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
1,2-DICHLOROPROPANE		<0.0012		<0.0012		<0.0011		<0.0011		<0.0012		<0.0011	
2-CHLOROETHYL VINYL ETHER		<0.012	J	<0.012	J	<0.011	J	<0.011	J	<0.012	J	<0.011	J
2-HEXANONE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
ACETONE		<0.012		<0.012		0.023		0.022		<0.012		<0.011	
BENZENE		<0.0012		<0.0012		<0.0011		<0.0011		<0.0012		<0.0011	
BROMODICHLOROMETHANE		<0.0012		<0.0012		<0.0011		<0.0011		<0.0012		<0.0011	
BROMOFORM		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
BROMOMETHANE		<0.0012		<0.0012		<0.0011		<0.0011		<0.0012		<0.0011	
CARBON DISULFIDE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
CARBON TETRACHLORIDE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
CHLOROBENZENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
CHLOROETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
CHLOROFORM		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
CHLOROMETHANE		<0.0012		<0.0012		<0.0011		<0.0011		<0.0012		<0.0011	
DIBROMOCHLOROMETHANE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
ETHYLBENZENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
TOTAL XYLENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
METHYL ETHYL KETONE		<0.012		<0.012	J	<0.011	J	<0.011	J	<0.012	J	<0.011	J
METHYL ISOBUTYL KETONE		<0.012		<0.012		<0.011		<0.011		<0.012		<0.011	
METHYLENE CHLORIDE		0.014		0.0098		0.014		0.0092		0.016		0.0069	JH
STYRENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
TETRACHLOROETHYLENE(PCE)		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
TOLUENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<<0.0012	
TRICHLOROETHYLENE (TCE)		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
VINYL ACETATE		<0.012		<0.012		<0.011		<0.011		<0.012		<0.011	
VINYL CHLORIDE		<0.0023		<0.0024		<0.0022		<0.0022		<0.0023		<0.0022	
cis-1,3-DICHLOROPROPENE		<0.0012		<0.0012		<0.0011		<0.0011		<0.0012		<0.0011	
trans-1,2-DICHLOROETHENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
trans-1,3-DICHLOROPROPENE		<0.0058		<0.006		<0.0056		<0.0056		<0.0058		<0.0054	
SURROGATES, (%)													
1,2-DICHLOROETHANE-D4		110		86		91		98		94		101	
1-BROMO-4-FLUOROBENZENE		102		90		95		97		94		86	
TOLUENE-D8		97		106		104		105		101		93	

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.

269241

TABLE 1-3
ANALYTICAL DATA SUMMARY TABLE
DO #11 SOIL BORINGS
CARSWELL AFB

PARAMETER		SD13MW06D		SD13MW07B		SD13MW07E	
	Date Sampled:	03/24/94		03/24/94		03/24/94	
	Depth:	6-8'		2-4'		8-10'	
D2216/METHOD,PERCENT							
SOLIDS, PERCENT		81		81		80	
E418.1/SW9071,MG/KG							
PETROLEUM HYDROCARBONS		670		54		8800	
Metals (SW6010/SW3050), MG/KG							
ALUMINUM		5800		5900		7200	
ANTIMONY		<4.5		<4.6		<5.2	
ARSENIC		12		5.7		12	
BARIUM		100		83		110	
BERYLLIUM		<1.6		<1.6		<1.9	
CADMIUM		1.2		1.3		1.0	
CALCIUM		10000	JH	86000	JH	120000	JH
CHROMIUM, TOTAL		7.9		7.1		8.8	
COBALT		5.0		4.9		5.4	
COPPER		19	JH	17	JH	42	JH
IRON		6900	JH	7700	JH	7500	JH
LEAD		14		9.3		13	
MAGNESIUM		1800		1700		2400	
MANGANESE		280		320		360	
MOLYBDENUM		<2.9		<3.0		<3.3	
NICKEL		9.5		8.9		10	
POTASSIUM		820		860		1100	
SELENIUM		<6.4		<6.5		<7.3	
SILVER		<0.65		<0.66		<0.74	
SODIUM		110		54		290	
THALLIUM		<5.8		<5.9		<6.7	
VANADIUM		20		23		20	
ZINC		33		16		32	
Volatile Organics (SW8020/SW5030), MG/KG							
BENZENE		<0.0025		<0.0005		<2.5	
ETHYLBENZENE		0.036		<0.0005		30	
TOTAL XYLENE		0.052		<0.001		29	
TOLUENE		0.013		0.0032		<2.5	
SURROGATES, (%)							
4-CHLOROTOLUENE		115		103		100	
FLUOROBENZENE		98		110		93	

269242

TABLE 1-3
ANALYTICAL DATA SUMMARY TABLE
DO #11 SOIL BORINGS
CARSWELL AFB

PARAMETER		SD13MW06D		SD13MW07B		SD13MW07E	
	Date Sampled:	03/24/94		03/24/94		03/24/94	
	Depth:	6-8'		2-4'		8-10'	
Volatile Organics (SW8240/SW5030), MG/KG							
1,1,1-TRICHLOROETHANE		<0.0057		<0.0062		<1.6	
1,1,2,2-TETRACHLOROETHANE		<0.0057		<0.0062		<1.6	
1,1,2-TRICHLOROETHANE		<0.0057		<0.0062		<1.6	
1,1-DICHLOROETHANE		<0.0057		<0.0062		<1.6	
1,1-DICHLOROETHENE		<0.0057		<0.0062		<1.6	
1,2-DICHLOROETHANE		<0.0057		<0.0062		<1.6	
1,2-DICHLOROPROPANE		<0.0011		<0.0012		<0.31	
2-CHLOROETHYL VINYL ETHER		<0.011	J	<0.012	J	<3.1	J
2-HEXANONE		<0.0057		<0.0062		<1.6	
ACETONE		0.034		<0.012		<3.1	
BENZENE		<0.0011		<0.0012		<0.31	
BROMODICHLOROMETHANE		<0.0011		<0.0012		<0.31	
BROMOFORM		<0.0057		<0.0062		<1.6	
BROMOMETHANE		<0.0011		<0.0012		<0.31	
CARBON DISULFIDE		<0.0057		<0.0062		<1.6	
CARBON TETRACHLORIDE		<0.0057		<0.0062		<1.6	
CHLOROBENZENE		<0.0057		<0.0062		<1.6	
CHLOROETHANE		<0.0057		<0.0062		<1.6	
CHLOROFORM		<0.0057		<0.0062		<1.6	
CHLOROMETHANE		<0.0011		<0.0012		<0.31	
DIBROMOCHLOROMETHANE		<0.0057		<0.0062		<1.6	
ETHYLBENZENE		<0.0057		<0.0062		<1.6	
TOTAL XYLENE		<0.0057		<0.0062		<1.6	
METHYL ETHYL KETONE		<0.011	J	<0.012	J	<3.1	
METHYL ISOBUTYL KETONE		<0.011		<0.012		<3.1	
METHYLENE CHLORIDE		0.013	JH	0.0073	JH	<1.6	
STYRENE		<0.0057		<0.0062		<1.6	
TETRACHLOROETHYLENE(PCE)		<0.0057		<0.0062		<1.6	
TOLUENE		<0.0057		<0.0036		<1.6	
TRICHLOROETHYLENE (TCE)		<0.0057		<0.0062		<1.6	
VINYL ACETATE		<0.011		<0.012		<3.1	
VINYL CHLORIDE		<0.0023		<0.0025		<0.63	
cis-1,3-DICHLOROPROPENE		<0.0011		<0.0012		<0.31	
trans-1,2-DICHLOROETHENE		<0.0057		<0.0062		<1.6	
trans-1,3-DICHLOROPROPENE		<0.0057		<0.0062		<1.6	
SURROGATES, (%)							
1,2-DICHLOROETHANE-D4		101		92		98	
1-BROMO-4-FLUOROBENZENE		103		89		96	
TOLUENE-D8		98		99		110	

J -Estimated quantitation based upon QC data.
JH -Estimated quantitation - possibly biased high based upon QC data.

2.69243

TABLE 1-2
ANALYTICAL DATA SUMMARY TABLE
DO #11 SEDIMENTS
CARSWELL AFB

PARAMETER	Sample		Duplicate					
Date Sampled:	SD13SD01 03/27/94		SD13SDDUP1 03/27/94		SD13SD02 03/27/94		SD13SD03 03/27/94	
D2216/METHOD,PERCENT								
SOLIDS, PERCENT	63		65		65		59	
METALS (SW6010/SW3050), MG/KG								
ALUMINUM	380	J	3600	J	5400	JH	5800	JH
ANTIMONY	<5.9	JL	<5.7		<6.1		<7.1	
ARSENIC	15		13		35		57	
BARIUM	97		88		130		110	
BERYLLIUM	<21	J	<0.2		<0.22		<0.25	
CADMIUM	1.5		1.2		1.7		110	
CALCIUM	120000	JH	120000	JH	110000	JH	90000	JH
CHROMIUM, TOTAL	8.5		6.8		7.6		7.9	
COBALT	4.6		4.5		4.1		3.8	
COPPER	27	J	12	J	10		11	
IRON	5.8	J	8500	J	17000	JH	16000	JH
LEAD	34	JH	32		19		11	
MAGNESIUM	1700		1300		1600		1700	
MANGANESE	188	JH	140	JH	200	JH	100	JH
MOLYBDENUM	<3.8		<3.7		<3.9		<4.6	
NICKEL	10		9.6		11		10	
POTASSIUM	660		620		820		1100	
SELENIUM	<8.4		<8.1		8.7		<10	
SILVER	<0.85		<0.82		<0.87		<1.0	
SODIUM	110		88		130		110	
THALLIUM	<7.6		<7.3		<7.8		<9.1	
VANADIUM	21		14		17		17	
ZINC	103	J	34	J	24	JH	22	JH

J -Estimated quantitation based upon QC data.
JH -Estimated quantitation - possibly biased high based upon QC data.
JL -Estimated quantitation - possibly biased low based upon QC data.

TABLE 1-1
ANALYTICAL DATA SUMMARY TABLE
DO #11 SURFACE WATERS
CARSWELL AFB

PARAMETER	Sample	Duplicate			
Date Sampled:	SD13-SW01 03/27/94	SD13-SWDUP1 03/27/94		SD13-SW02 03/27/94		SD13-SW03 03/27/94	
E418.1/METHOD, MG/L							
PETROLEUM HYDROCARBONS	1.2	<1.0		<1.0		1.2	
Volatile Organics (SW8240/SW5030), UG/L							
1,1,1-TRICHLOROETHANE	<5.0	<5.0		<5.0		<5.0	
1,1,2,2-TETRACHLOROETHANE	<5.0	<5.0		<5.0		<5.0	
1,1,2-TRICHLOROETHANE	<5.0	<5.0		<5.0		<5.0	
1,1-DICHLOROETHANE	<5.0	<5.0		<5.0		<5.0	
1,1-DICHLOROETHENE	<5.0	<5.0		<5.0		<5.0	
1,2-DICHLOROETHANE	<5.0	<5.0		<5.0		<5.0	
1,2-DICHLOROPROPANE	<1.0	<1.0		<1.0		<1.0	
2-CHLOROETHYL VINYL ETHER	<10	<10	JL	<10	JL	<10	JL
2-HEXANONE	<5.0	<5.0		<5.0		<5.0	
ACETONE	<10	<10		<10		<10	
BENZENE	<1.0	<1.0		<1.0		<1.0	
BROMODICHLOROMETHANE	<1.0	<1.0		<1.0		<1.0	
BROMOFORM	<5.0	<5.0		<5.0		<5.0	
BROMOMETHANE	<1.0	<1.0		<1.0		<1.0	
CARBON DISULFIDE	<5.0	<5.0		<5.0		<5.0	
CARBON TETRACHLORIDE	<5.0	<5.0		<5.0		<5.0	
CHLOROBENZENE	<5.0	<5.0		<5.0		<5.0	
CHLOROETHANE	<5.0	<5.0		<5.0		<5.0	
CHLOROFORM	<5.0	<5.0		<5.0		<5.0	
CHLOROMETHANE	<1.0	<1.0		<1.0		<1.0	
DIBROMOCHLOROMETHANE	<5.0	<5.0		<5.0		<5.0	
ETHYLBENZENE	<5.0	<5.0		<5.0		<5.0	
TOTAL XYLENE	<5.0	<5.0		<5.0		<5.0	
METHYL ETHYL KETONE (2-BUTANONE)	<10	<10		<10		<10	
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	<10	<10		<10		<10	
METHYLENE CHLORIDE	<5.0	6.5	JB	<5.0		6.9	JB
STYRENE	<5.0	<5.0		<5.0		<5.0	
TETRACHLOROETHYLENE(PCE)	<5.0	<5.0		<5.0		<5.0	
TOLUENE	<5.0	<5.0		<5.0		<5.0	
TRICHLOROETHYLENE (TCE)	<5.0	<5.0		<5.0		<5.0	
VINYL ACETATE	<10	<10		<10		<10	
VINYL CHLORIDE	<2.0	<2.0		<2.0		<2.0	
cis-1,3-DICHLOROPROPENE	<1.0	<1.0		<1.0		<1.0	
trans-1,2-DICHLOROETHENE	<5.0	<5.0		<5.0		<5.0	
trans-1,3-DICHLOROPROPENE	<5.0	<5.0		<5.0		<5.0	
SURROGATES, (%)							
1,2-DICHLOROETHANE-D4	109	107		108		108	
1-BROMO-4-FLUOROBENZENE	101	102		102		103	
TOLUENE-D8	106	107		104		109	
OIL AND GREASE, MG/L							
OIL & GREASE, TOTAL REC	<1.0	1.2		<1.0		<1.0	

JL -Estimated quantitation – possibly biased low based upon QC data.
JB -Estimated quantitation: possible biased high or false positive based upon blank data.

TABLE 1-4
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - MARCH
CARSWELL AFB

PARAMETER	Sample Date:	OT12-15B 03/30/94		OT12-15C 03/29/94		SD13-MW01 03/29/94		SD13-MW02 03/29/94		SD13-MW03 03/29/94		Sample SD13-MW05 03/30/94		Duplicate SD13-MWDUP1 03/30/94	
E418.1/METHOD, MG/L															
PETROLEUM HYDROCARBONS		<1.0		<1.0		4.4		<1.1		5.2		<1.0		<1.0	
METALS (SW6010/SW3005), MG/L															
ALUMINUM		<0.1		1.5		0.241	JB	0.14	JB	0.68	JB	<0.1		<0.1	
ANTIMONY		<0.056		<0.056		<0.056		<0.056		<0.056		<0.056		<0.056	
ARSENIC		<0.042		<0.042		0.047		<0.042		0.044		<0.042		<0.042	
BARIUM		0.22		0.27		0.298		0.37		0.44		0.2		0.21	
BERYLLIUM		<0.002		<0.002		<0.002		<0.002		<0.002		<0.002		<0.002	
CADMIUM		<0.004		<0.004		0.004		0.004		0.004		<0.004		<0.004	
CALCIUM		330		280		140		140		180		140		140	
CHROMIUM, TOTAL		0.008		<0.008		0.008		0.012		0.008		<0.008		<0.008	
COBALT		<0.013		<0.013		<0.013		<0.013		<0.013		<0.013		<0.013	
COPPER		0.018		0.029		0.01		0.016		0.009		<0.008		<0.008	
IRON		0.22		1.2	J	15	J	0.740	J	17	J	0.05	JB	<0.05	
LEAD		<0.037		<0.037		<0.037		<0.037		7.3		<0.037		<0.037	
MAGNESIUM		9.6		5.6		5.9		5.8		7.3		4.5		4.4	
MANGANESE		0.17		0.5		0.129		0.35		0.2		0.044		0.041	
MOLYBDENUM		<0.036		<0.036		<0.036		<0.036		<0.036		<0.036		<0.036	
NICKEL		<0.025		<0.025		<0.025		<0.025		<0.025		<0.025		<0.025	
POTASSIUM		2.4		2.6		0.9	JB	2.1		1.3		1.7		1.6	
SELENIUM		<0.079		<0.079		<0.079		<0.079		<0.079		<0.079		<0.079	
SILVER		<0.008		<0.008		<0.008		<0.008		<0.008		<0.008		<0.008	
SODIUM		26		27		20		23		21		26		25	
THALLIUM		<0.072		<0.072		<0.072		<0.072		<0.072		<0.072		<0.072	
VANADIUM		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01		<0.01	
ZINC		0.066		0.044		0.032		0.14		0.076		0.011		0.01	
METALS (SW7060/SW3005), MG/L															
ARSENIC		<0.002		<0.002		0.059		0.0023		0.042		<0.002		<0.002	
METALS (SW7421/SW3005), MG/L															
LEAD		<0.001		0.0023	JB	0.0014	JB	0.0013	JB	0.0049	JB	<0.001		<0.001	
METALS (SW7470/METHOD), MG/L															
MERCURY		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002		<0.0002	
METALS (SW7740/SW3005), MG/L															
SELENIUM		0.0025		0.0014		<0.001		<0.001		<0.001		0.0014		0.0014	
METALS (SW7841/SW3005), MG/L															
THALLIUM		<0.001	JL	<0.001	JL	<0.001	JL	<0.001	JL	<0.001	JL	<0.001	JL	<0.001	

269246

TABLE 1-4
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - MARCH
CARSWELL AFB

PARAMETER		OT12-15B		OT12-15C		SD13-MW01		SD13-MW02		SD13-MW03		Sample SD13-MW05		Duplicate SD13-MWDUP1	
	Sample Date:	03/30/94		03/29/94		03/29/94		03/29/94		03/29/94		03/30/94		03/30/94	
Volatile Organics (SW8020/SW5030), µg/L															
BENZENE		<0.5		<0.5		<2.5		<0.5		<0.5		<0.5		<0.5	
ETHYLBENZENE		<0.5		<0.5		4.9		<0.5		3.5	JL	<0.5		<0.5	
TOTAL XYLENE		<1.0		<1.0		<5.0		<1.0		4.7	JL	<1.0		<1.0	
TOLUENE		<0.5		<0.5		<2.5		<0.5		<0.5		<0.5		<0.5	
SURROGATES, (%)															
4-CHLOROTOLUENE		103		100		95		103		95		100		100	
FLUOROBENZENE		98		100		95		93		85		100		98	
Volatile Organics (SW8240/SW5030), µg/L															
1,1,1-TRICHLOROETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
1,1,2,2-TETRACHLOROETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
1,1,2-TRICHLOROETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
1,1-DICHLOROETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
1,1-DICHLOROETHENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
1,2-DICHLOROETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
1,2-DICHLOROPROPANE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
2-CHLOROETHYL VINYL ETHER		<10	J	<10	J	<10	J	<10	J	<10		<10	J	<10	
2-HEXANONE		<5.0		<5.0		<5.0	J	<5.0	J	<5.0	J	<5.0		<5.0	
ACETONE		<10		<10		<10		<10		<10		<10		<10	
BENZENE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
BROMODICHLOROMETHANE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
BROMOFORM		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
BROMOMETHANE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
CARBON DISULFIDE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CARBON TETRACHLORIDE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CHLOROBENZENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CHLOROETHANE		<5.0		<5.0		<5.0	JH	<5.0		<5.0		<5.0		<5.0	
CHLOROFORM		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CHLOROMETHANE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
DIBROMOCHLOROMETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
ETHYLBENZENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TOTAL XYLENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
METHYL ETHYL KETONE		<10		<10		<10	JH	<10		<10		<10		<10	
METHYL ISOBUTYL KETONE		<10		<10		<10		<10		<10		<10		<10	
METHYLENE CHLORIDE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
STYRENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TETRACHLOROETHYLENE(PCE)		9.1		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TOLUENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TRICHLOROETHYLENE (TCE)		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
VINYL ACETATE		<10		<10		<10		<10		<10		<10		<10	
VINYL CHLORIDE		<2.0		<2.0		<2.0		<2.0		<2.0		<2.0		<2.0	

269247

TABLE 1-4
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES – MARCH
CARSWELL AFB

PARAMETER							Sample		Duplicate
Sample Date:	OT12-15B 03/30/94	OT12-15C 03/29/94	SD13-MW01 03/29/94	SD13-MW02 03/29/94	SD13-MW03 03/29/94	SD13-MW05 03/30/94		SD13-MWDUP1 03/30/94
cis-1,3-DICHLOROPROPENE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		<1.0
trans-1,2-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0
trans-1,3-DICHLOROPROPENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		<5.0
SURROGATES, (%)								
1,2-DICHLOROETHANE-D4	106	107	111	106	108	106		108
1-BROMO-4-FLUOROBENZENE	99	99	110	100	104	100		99
TOLUENE-D8	104	102	102	102	109	102		104
OIL AND GREASE, MG/L								
OIL & GREASE, TOTAL REC	2.1	<1.1	1.2	1.3	<1.1	<1.0	J	5.8

J –Estimated quantitation based upon QC data
JH –Estimated quantitation – possibly biased high based upon QC data
JL –Estimated quantitation – possibly biased low based upon QC data
JB –Estimated quantitation – possible biased high or false positive based upon blank data
NA–Not Analyzed

269248

TABLE 1-4
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - MARCH
CARSWELL AFB

PARAMETER		SD13-MW06		SD13-MW07		SD13-MW05DW
Sample Date:		03/30/94		03/30/94		Drilling Water
E418.1/METHOD, MG/L						
PETROLEUM HYDROCARBONS		<1.0		1.9		<1.0
METALS (SW6010/SW3005), MG/L						
ALUMINUM		0.14	JB	<0.1		22
ANTIMONY		<0.056		<0.056		<0.056
ARSENIC		<0.042		<0.042		<0.042
BARIUM		0.25		0.31		0.22
BERYLLIUM		<0.002		<0.002		<0.002
CADMIUM		0.004		<0.004		<0.004
CALCIUM		190		160		550
CHROMIUM, TOTAL		<0.008		<0.008		0.09
COBALT		<0.013		<0.013		0.085
COPPER		0.013		0.008		0.23
IRON		1.1	JB	4.1		22
LEAD		<0.037		<0.037		<0.037
MAGNESIUM		12		6.3		13
MANGANESE		0.39		0.57		0.38
MOLYBDENUM		<0.036		<0.036		0.092
NICKEL		<0.025		<0.025		0.51
POTASSIUM		2.9		1.3		9.5
SELENIUM		<0.079		<0.079		<0.079
SILVER		<0.008		<0.008		<0.008
SODIUM		26		27		23
THALLIUM		<0.072		<0.072		<0.072
VANADIUM		<0.01		<0.01		0.28
ZINC		0.1		0.068		0.15
METALS (SW7060/SW3005), MG/L						
ARSENIC		0.0024		<0.002		NA
METALS (SW7421/SW3005), MG/L						
LEAD		0.0017	JL	<0.001	JL	NA
METALS (SW7470/METHOD), MG/L						
MERCURY		<0.0002		<0.0002		NA
METALS (SW7740/SW3005), MG/L						
SELENIUM		<0.001		<0.001		NA
METALS (SW7841/SW3005), MG/L						
THALLIUM	JL	<0.001	JL	<0.001	JL	NA

269249

TABLE 1-4
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - MARCH
CARSWELL AFB

PARAMETER	Sample Date:	SD13-MW06 03/30/94		SD13-MW07 03/30/94		SD13-MW05DW Drilling Water	
Volatile Organics (SW8020/SW5030), µg/L							
BENZENE		<0.5		<0.5		<0.5	
ETHYLBENZENE		2.4		3.7		1.5	
TOTAL XYLENE		2.5		3.4		7.9	
TOLUENE		<0.5		<0.5		4.0	
SURROGATES, (%)							
4-CHLOROTOLUENE		93		98		103	
FLUOROBENZENE		90		90		100	
Volatile Organics (SW8240/SW5030), µg/L							
1,1,1-TRICHLOROETHANE		<5.0		<5.0		<5.0	
1,1,2,2-TETRACHLOROETHANE		<5.0		<5.0		<5.0	
1,1,2-TRICHLOROETHANE		<5.0		<5.0		<5.0	
1,1-DICHLOROETHANE		<5.0		<5.0		<5.0	
1,1-DICHLOROETHENE		<5.0		<5.0		<5.0	
1,2-DICHLOROETHANE		<5.0		<5.0		<5.0	
1,2-DICHLOROPROPANE		<1.0		<1.0		<1.0	
2-CHLOROETHYL VINYL ETHER	J	<10	J	<10	J	<10	
2-HEXANONE		<5.0		<5.0		<5.0	
ACETONE		<10		<10		<10	
BENZENE		<1.0		<1.0		<1.0	
BROMODICHLOROMETHANE		<1.0		<1.0		<1.0	
BROMOFORM		<5.0		<5.0		<5.0	
BROMOMETHANE		<1.0		<1.0		<1.0	
CARBON DISULFIDE		<5.0		<5.0		<5.0	
CARBON TETRACHLORIDE		<5.0		<5.0		<5.0	
CHLOROBENZENE		<5.0		<5.0		<5.0	
CHLOROETHANE		<5.0		<5.0		<5.0	
CHLOROFORM		<5.0		<5.0		<1.0	
CHLOROMETHANE		<1.0		<1.0		<1.0	
DIBROMOCHLOROMETHANE		<5.0		<5.0		<5.0	
ETHYLBENZENE		<5.0		<5.0		<0.78	
TOTAL XYLENE		<5.0		<5.0		<5.0	
METHYL ETHYL KETONE		<10		<10		<10	
METHYL ISOBUTYL KETONE		<10		<10		<10	
METHYLENE CHLORIDE		<5.0		<5.0		<5.0	
STYRENE		<5.0		<5.0		<5.0	
TETRACHLOROETHYLENE(PCE)		<5.0		<5.0		<5.0	
TOLUENE		<5.0		<5.0		<1.3	
TRICHLOROETHYLENE (TCE)		<5.0		<5.0		<5.0	
VINYL ACETATE		<10		<10		<10	
VINYL CHLORIDE		<2.0		<2.0		<2.0	

TABLE 1-4
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - MARCH
CARSWELL AFB

PARAMETER	Sample Date:		SD13-MW06 03/30/94	SD13-MW07 03/30/94	SD13-MW05DW Drilling Water
cis-1,3-DICHLOROPROPENE			<1.0	<1.0	<1.0
trans-1,2-DICHLOROETHENE			<5.0	<5.0	<5.0
trans-1,3-DICHLOROPROPENE			<5.0	<5.0	<5.0
SURROGATES, (%)					
1,2-DICHLOROETHANE-D4			104	110	100
1-BROMO-4-FLUOROBENZENE			102	103	100
TOLUENE-D8			107	107	105
OIL AND GREASE, MG/L					
OIL & GREASE, TOTAL REC		J	7.4	<1.0	NA

J - Estimated quantitation based upon QC data
JH - Estimated quantitation - possibly biased high based upon QC data
JL - Estimated quantitation - possibly biased low based upon QC data
JB - Estimated quantitation - possible biased high or false positive based upon blank data
NA - Not Analyzed

2.69251

TABLE 1-1
ANALYTICAL DATA SUMMARY TABLE
DO #11 GROUNDWATERS - JUNE
CARSWELL AFB

PARAMETER	Sample Date:	OT1215B 06/22/94	OT1215C 06/22/94	SD13MW01 06/21/94	SD13MW02 06/21/94	SD13MW03 06/21/94	SD13MW05 06/23/94	SD13MW06 06/24/94	Sample SD13MW07 06/22/94	Duplicate SD13DUP1 06/22/94
E418.1/METHOD,MG/L										
PETROLEUM HYDROCARBONS		<1.1	<1.2	3.2 JH	<1.1	3.5	<1.0	<1.0	1.6	1.9
Metals (SW6010/SW3005), MG/L										
ALUMINUM		0.14	<0.1	<0.1	<0.1	0.32	<0.1	<0.1	<0.1 J	0.26 J
ANTIMONY		<0.056	<0.056	<0.056	<0.056	<0.056	<0.056	<0.056	<0.056	<0.056
ARSENIC		<0.042	<0.042	0.047	<0.042	0.043	<0.042	<0.042	<0.042	<0.042
BARIUM		0.26	0.28	0.34	0.26	0.42	0.29	0.42	0.33	0.29
BERYLLIUM		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CADMIUM		<0.004	<0.004	0.004	<0.004	0.004	<0.004	<0.004	0.004	<0.004
CALCIUM		140	140	140	140	150	120	170	160	170
CHROMIUM, TOTAL		<0.008	<0.008	0.011	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
COBALT		<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
COPPER		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
IRON		<0.05	0.052	12	0.98	16	<0.05	2.0	6.0	5.7
LEAD		<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037	<0.037
MAGNESIUM		7.6	4.4	6.1	6.5	7.3	3.6	12	6.8	6.7
MANGANESE		0.095	0.19	0.16	0.47	0.22	0.09	0.33	0.67	0.66
MOLYBDENUM		<0.036	<0.036	<0.036	<0.036	<0.036	<0.036	<0.036	<0.036	<0.036
NICKEL		<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
POTASSIUM		2.6	2.3	0.92	2.1	1.1	1.6	1.6	1.2	1.2
SELENIUM		<0.079	<0.079	<0.079	<0.079	<0.079	<0.079	<0.079	<0.079	<0.079
SILVER		<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
SODIUM		26	27	22	24	22	32	26	28	27
THALLIUM		<0.072	<0.072	<0.072	<0.072	<0.072	<0.072	<0.072	<0.072	<0.072
VANADIUM		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
ZINC		0.066	0.048	0.04	0.038	0.059	0.063	0.098	0.051	0.011
Metals (SW7060/SW3005), MG/L										
ARSENIC		<0.002	<0.002	0.059	<0.002	0.046	<0.002	0.0026	0.0033	0.0037
Metals (SW7421/SW3005), MG/L										
LEAD		<0.001	<0.001	<0.001	<0.001	0.0021	<0.001	0.0029	<0.001	<0.001
Metals (SW7470/METHOD), MG/L										
MERCURY		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Metals (SW7740/SW3005), MG/L										
SELENIUM		0.0016	0.0027	0.0012	<0.001	<0.001	0.002	0.0012	<0.001	<0.001
Metals (SW7841/SW3005), MG/L										
THALLIUM		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Volatile Organics (SW8240/SW5030), UG/L										
1,1,1-TRICHLOROETHANE		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-TETRACHLOROETHANE		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-TRICHLOROETHANE		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHANE		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHENE		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROETHANE		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROPROPANE		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

269252

TABLE 1-1
ANALYTICAL DATA SUMMARY TABLE
DO #11 GROUNDWATERS - JUNE
CARSWELL AFB

PARAMETER	Sample Date:	OT1215B 06/22/94		OT1215C 06/22/94		SD13MW01 06/21/94		SD13MW02 06/21/94		SD13MW03 06/21/94		SD13MW05 06/23/94		SD13MW06 06/24/94		Sample SD13MW07 06/22/94		Duplicate SD13DUP1 06/22/94	
2-CHLOROETHYL VINYL ETHER		<10		<10		<10		<10		<10		<10	J	<10	J	<10		<10	
2-HEXANONE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
ACETONE		<10		<10		<10		<10		<10		<10		<10		<10		<10	
BENZENE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
BROMODICHLOROMETHANE		<1.0		<1.0		<1.0		<1.0		<1.0		3.8		<1.0		<1.0		<1.0	
BROMOFORM		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
BROMOMETHANE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
CARBON DISULFIDE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CARBON TETRACHLORIDE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CHLOROBENZENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CHLOROETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
CHLOROFORM		2.5	JB	<5.0		<5.0		<5.0		<5.0		5.2	JB	<5.0		<5.0		<5.0	
CHLOROMETHANE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
DIBROMOCHLOROMETHANE		<5.0		<5.0		<5.0		<5.0		<5.0		0.47		<5.0		<5.0		<5.0	
ETHYLBENZENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TOTAL XYLENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
METHYL ETHYL KETONE (2-BUTANONE)		<10		<10		<10		<10		<10		<10		<10		<10		<10	
METHYL ISOBUTYL KETONE		<10		<10		<10		<10		<10		<10		<10		<10		<10	
METHYLENE CHLORIDE		<5.0		<5.0		5.9	JB	4.4	JB	4.7	JB	1.8	JB	12	JB	7.9	JB	7.1	JB
STYRENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TETRACHLOROETHYLENE(PCE)		8.3		0.96		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TOLUENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
TRICHLOROETHYLENE (TCE)		0.85		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
VINYL ACETATE		<10		<10		<10		<10		<10		<10		<10		<10		<10	
VINYL CHLORIDE		<2.0		<2.0		<2.0		<2.0		<2.0		<2.0		<2.0		<2.0		<2.0	
cis-1,3-DICHLOROPROPENE		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0		<1.0	
trans-1,2-DICHLOROETHENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
trans-1,3-DICHLOROPROPENE		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0		<5.0	
SURROGATES (%)																			
1,2-DICHLOROETHANE-D4		92		94		99		92		98		94		96		95		95	
1-BROMO-4-FLUOROBENZENE		98		98		101		99		103		98		100		100		97	
TOLUENE-D8		102		102		108		101		109		100		101		105		109	
OIL AND GREASE, MG/L																			
OIL & GREASE, TOTAL REC		<1.5		<1.0		<1.1		<1.1		<1.2		<1.0		<1.1		<1.0		<1.0	

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.
JL - Estimated quantitation - possibly biased low based upon QC data.
JB - Estimated quantitation: possible biased high or false positive based upon blank data.

26925

**** NOT VALIDATED

TABLE 1-2
ANALYTICAL DATA SUMMARY TABLE
DO #11 AMBIENT/TRIP BLANK SAMPLES - JUNE
CARSWELL AFB

DESCRIPT	AB062194 06/21/94	AB062294 06/22/94	AB062394 06/23/94	AB062494 06/24/94	TB062194 06/21/94	TB062294 06/22/94	TB062394 06/23/94	TB062494 06/24/94
Volatile Organics (SW8240/SW5030), UG/L								
1,1,1-TRICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-TETRACHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-TRICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROPROPANE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-CHLOROETHYL VINYL ETHER	<10	<10	<10	<10	<10	<10	<10	<10
2-HEXANONE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
ACETONE	<10	<10	<10	<10	<10	<10	<10	<10
BENZENE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BROMODICHLOROMETHANE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BROMOFORM	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
BROMOMETHANE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
CARBON DISULFIDE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CARBON TETRACHLORIDE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CHLOROBENZENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CHLOROFORM	<2.7	5.5	<3.6	<4.1	<5.0	<5.0	<5.0	<5.0
CHLOROMETHANE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
DIBROMOCHLOROMETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
ETHYLBENZENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TOTAL XYLENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
METHYL ETHYL KETONE (2-BUTANONE)	<10	<10	<10	<10	<10	<10	<10	<10
METHYL ISOBUTYL KETONE	<10	<10	<10	<10	<10	<10	<10	<10
METHYLENE CHLORIDE	<5.0	<5.0	<5.0	<5.0	<2.7	<2.7	<3.9	5.3
STYRENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TETRACHLOROETHYLENE(PCE)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TOLUENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TRICHLOROETHYLENE (TCE)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
VINYL ACETATE	<10	<10	<10	<10	<10	<10	<10	<10
VINYL CHLORIDE	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
cis-1,3-DICHLOROPROPENE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,3-DICHLOROPROPENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
SURROGATES (%)								
1,2-DICHLOROETHANE-D4	93	92	93	95	90	93	95	91
1-BROMO-4-FLUOROBENZENE (4-BROMOFLUOROBE	100	98	96	96	96	99	97	95
TOLUENE-D8	101	102	100	99	98	102	100	97

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.
JL - Estimated quantitation - possibly biased low based upon QC data.
JB - Estimated quantitation: possible biased high or false positive based upon blank data.

PREPARED BY/DATE: _____
CHECKED BY/DATE: _____
APPROVED BY/DATE: _____

269254

TABLE 1-5
ANALYTICAL DATA SUMMARY TABLE
PRODUCT ANALYSIS OF MW04 - MARCH
CARSWELL AFB

269253

PARAMETER	SD13-MW04 Sample Date: 03-30-94
M8015/M3510,MG/L	
DIESEL COMPONENTS	96000
GASOLINE COMPONENTS	9000
SW1010/METHOD,DEG	
IGNITABILITY	78

TABLE 1-1
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - SEPTEMBER
CARSWELL AFB

PARAMETER	OT1215B Date: 08-SEP-94	OT1215C 08-SEP-94	Sample SD13MW01 07-SEP-94	Duplicate DUP1 07-SEP-94	SD13MW02 08-SEP-94	SD13MW03 07-SEP-94	SD13MW05 07-SEP-94	SD13MW06 08-SEP-94	SD13MW07 07-SEP-94
E418.1/METHOD, mg/L									
PETROLEUM HYDROCARBONS	<1.0	<1.0	2.5	3.2	<1.1	3.1	<1.0	<1.1	4.2
METALS (SW6010/SW3005) mg/L									
ALUMINUM	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
ANTIMONY	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024
ARSENIC	<0.037	<0.037	0.073	0.075	<0.037	0.048	<0.037	<0.037	<0.037
BARIUM	230	260	0.32 JB	0.31 JB	0.3	0.37 JB	0.29 JB	0.28	0.35 JB
BERYLLIUM	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
CADMIUM	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
CALCIUM	130000	140000	120 JB	120 JB	130	120 JB	140 JB	160	160 JB
CHROMIUM	<0.01	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	0.034
COBALT	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
COPPER	5.0	5.0	<0.004	0.004	0.006	0.005	0.009	0.006	0.006
IRON	<0.05	<0.05	12 JH	11 JH	0.19 JH	12 JH	<0.05	6.3 JH	5.1 JH
LEAD	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017
MAGNESIUM	6900	4400	5.6 JB	5.5 JB	6.2	6.2 JB	4.1 JB	13	6.6 JB
MANGANESE	70	220	0.14 JB	0.13 JB	0.35	0.16 JB	0.078 JB	0.29	0.64 JB
MOLYBDENUM	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	0.017
NICKEL	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	<0.023	0.14
POTASSIUM	2900	2700	1 JB	1 JB	2.3 JB	1.1 JB	2 JB	1.3	1.4 JB
SELENIUM	<0.064	<0.064	<0.064	<0.064	<0.064	<0.064	<0.064	<0.064	<0.064
SILVER	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SODIUM	29000	28000	22 JB	21 JB	24	21 JB	33 JB	24	29 JB
THALLIUM	<0.042	<0.042	<0.042	<0.042	<0.042	<0.042	<0.042	<0.042	<0.042
VANADIUM	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
ZINC	37	48	0.042 JB	0.037 JB	0.036	0.036 JB	0.045 JB	0.049	0.044 JB
METALS (SW7060/SW3005) mg/L									
ARSENIC	<0.005	<0.005	0.065	0.065	<0.005	0.045	<0.005	0.011	<0.005
METALS (SW7421/SW3005) mg/L									
LEAD	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
METALS (SW7470/METHOD) mg/L									
MERCURY	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
METALS (SW7740/SW3005) mg/L									
SELENIUM	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
METALS (SW7841/SW3005) mg/L									
THALLIUM	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VOLATILE ORGANIC (SW8020/SW5030) µg/L									
BENZENE	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ETHYLBENZENE	<0.5	<0.5	<1.0	<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
M,P-XYLENE (SUM OF ISOMERS)	<1.0	<1.0	4.2	<1.0	<1.0	1.8	<1.0	2.6	2.4
TOLUENE	<0.5	<0.5	3.4	2.4	<2.0	<2.0	<2.0	4.8	<2.0
SURROGATES									
4-CHLOROTOLUENE	100	104	85	96	101	86	102	97	95
FLUOROBENZENE	101	101	89	95	98	85	101	96	100

2692526

TABLE 1-1
ANALYTICAL DATA SUMMARY TABLE
GROUND-WATER SAMPLES - SEPTEMBER
CARSWELL AFB

PARAMETER	OT1215B Date: 08-SEP-94	OT1215C 08-SEP-94	Sample SD13MW01 07-SEP-94	Duplicate DUP1 07-SEP-94	SD13MW02 08-SEP-94	SD13MW03 07-SEP-94	SD13MW05 07-SEP-94	SD13MW06 08-SEP-94	SD13MW07 07-SEP-94
VOLATILE ORGANICS (SW8240/SW5030) µg/L									
1,1,1-TRICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-TETRACHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-TRICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROPROPANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-CHLOROETHYL VINYL ETHER	<10 J	<10 J	<10 J	<10 J	<10 J	<10 J	<10 J	<10 J	<10 J
2-HEXANONE	<10 J	<10 J	<10	<10	<10 J	<10 J	<10	<10 J	<10
ACETONE	<10 J	<10 J	<10	<10	<10 J	<10 J	<10	<10 J	<10
BENZENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
BROMODICHLOROMETHANE	1.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
BROMOFORM	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
BROMOMETHANE	<10	<10	<10	<10	<10	<10	<10	<10	<10
CARBON DISULFIDE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CARBON TETRACHLORIDE	<5.0	<5.0	<5.0 J	<5.0 J	<5.0	<5.0	<5.0 J	<5.0	<5.0 J
CHLOROBENZENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CHLOROETHANE	<10	<10	<10	<10	<10	<10	<10	<10	<10
CHLOROFORM	3.4	0.35	<5.0	<5.0	<5.0	<5.0	0.74 JB	<5.0	<5.0
CHLOROMETHANE	<10	<10	<10	<10	<10	<10	<10	<10	<10
DIBROMOCHLOROMETHANE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
ETHYLBENZENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
M,P-XYLENE (SUM OF ISOMERS)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
METHYL ETHYL KETONE (2-BUTANONE)	<10 J	<10 J	<10	<10	<10 J	<10 J	<10	<10 J	<10
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTA	<10	<10	<10	<10	<10	<10	<10	<10	<10
METHYLENE CHLORIDE	4.2	5.8	4.0 JB	2.6 JB	<5.0	<5.0	5.4 JB	0.93	4.7 JB
STYRENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TETRACHLOROETHYLENE(PCE)	6.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TOLUENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TRICHLOROETHYLENE (TCE)	1.4	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
VINYL ACETATE	<10 JL	<10 JL	<10 JL	<10 JL	<10 JL	<10 JL	<10 JL	<10 JL	<10 JL
VINYL CHLORIDE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,3-DICHLOROPROPENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,2-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,3-DICHLOROPROPENE	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
SURROGATES									
1,2-DICHLOROETHANE-D4	97	96	106	107	96	100	106	97	105
1-BROMO-4-FLUOROBENZENE	96	96	92	86	96	102	101	99	104
TOLUENE-D8	108	108	110	110	107	107	101	110	106
SW9070/METHOD, mg/L									
OIL & GREASE, TOTAL REC	<1.0	1.1	<1.0	<1.1	<10	<1.0	<1.0	<1.0	<1.0

J - Estimated quantitation based upon QC data.
JH - Estimated quantitation - possibly biased high based upon QC data.
JL - Estimated quantitation - possibly biased low based upon QC data.
JB - Estimated quantitation: possible biased high or false positive based upon blank data.

26925

PREPARED/DATE: _____
CHECKED/DATE: _____

TABLE 1-2
ANALYTICAL DATA SUMMARY TABLE
EQUIPMENT/AMBIENT/TRIP BLANKS - SEPTEMBER
CARSWELL AFB

PARAMETER	EB1090794 07-SEP-94	EB1090894 08-SEP-94	TB1090794 07-SEP-94	TB1090894 08-SEP-94	TB2090894 08-SEP-94
E418.1/METHOD, mg/L					
PETROLEUM HYDROCARBONS	<1.1	<1.0	NS	NS	NS
METALS (SW6010/SW3005) mg/L					
ALUMINUM	<0.1	<0.1	NS	NS	NS
ANTIMONY	<0.024	<0.024	NS	NS	NS
ARSENIC	<0.037	<0.037	NS	NS	NS
BARIUM	0.26	<0.008	NS	NS	NS
BERYLLIUM	<0.003	<0.003	NS	NS	NS
CADMIUM	<0.005	<0.005	NS	NS	NS
CALCIUM	140	0.14	NS	NS	NS
CHROMIUM	<0.01	<0.01	NS	NS	NS
COBALT	<0.011	<0.011	NS	NS	NS
COPPER	0.005	<0.004	NS	NS	NS
IRON	<0.05	<0.05	NS	NS	NS
LEAD	<0.017	<0.017	NS	NS	NS
MAGNESIUM	4.4	<0.2	NS	NS	NS
MANGANESE	0.22	<0.003	NS	NS	NS
MOLYBDENUM	<0.01	<0.01	NS	NS	NS
NICKEL	<0.023	<0.023	NS	NS	NS
POTASSIUM	2.7	<0.2	NS	NS	NS
SELENIUM	<0.064	<0.064	NS	NS	NS
SILVER	<0.002	<0.002	NS	NS	NS
SODIUM	28	1.1	NS	NS	NS
THALLIUM	<0.042	<0.042	NS	NS	NS
VANADIUM	<0.007	<0.007	NS	NS	NS
ZINC	0.048	<0.014	NS	NS	NS
METALS (SW7060/SW3005) mg/L					
ARSENIC	<0.005	<0.005	NS	NS	NS
METALS (SW7421/SW3005) mg/L					
LEAD	<0.005	<0.005	NS	NS	NS
METALS (SW7470/METHOD) mg/L					
MERCURY	<0.0002	<0.0002	NS	NS	NS
METALS (SW7740/SW3005) mg/L					
SELENIUM	<0.005	<0.005	NS	NS	NS
METALS (SW7841/SW3005) mg/L					
THALLIUM	<0.001	<0.001	NS	NS	NS
VOLATILE ORGANIC (SW8020/SW5030) µg/L					
BENZENE	<1.0	<1.0	<1.0	<1.0	<0.5
ETHYLBENZENE	<1.0	<1.0	<1.0	<1.0	<0.5
M,P-XYLENE	<1.0	<1.0	<1.0	<1.0	<1.0
TOLUENE	<2.0	<2.0	<2.0	<2.0	<0.5
SURROGATES					
4-CHLOROTOLUENE	103	101	102	101	101
FLUOROBENZENE	101	101	100	101	101

269258

TABLE 1-2
ANALYTICAL DATA SUMMARY TABLE
EQUIPMENT/AMBIENT/TRIP BLANKS – SEPTEMBER
CARSWELL AFB

PARAMETER	EB1090794 07-SEP-94	EB1090894 08-SEP-94	TB1090794 07-SEP-94	TB1090894 08-SEP-94	TB2090894 08-SEP-94
VOLATILE ORGANICS (SW8240/SW5030) µg/L					
1,1,1-TRICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-TETRACHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2-TRICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
1,1-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
1,2-DICHLOROPROPANE	<5.0	<5.0	<5.0	<5.0	<5.0
2-CHLOROETHYL VINYL ETHER	<10	<10	<10	<10	<10
2-HEXANONE	<10	<10	<10	<10	<10
ACETONE	<10	<10	<10	<10	<10
BENZENE	<5.0	<5.0	<5.0	<5.0	<5.0
BROMODICHLOROMETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
BROMOFORM	<5.0	<5.0	<5.0	<5.0	<5.0
BROMOMETHANE	<10	<10	<10	<10	<10
CARBON DISULFIDE	<5.0	<5.0	<5.0	<5.0	<5.0
CARBON TETRACHLORIDE	<5.0	<5.0	<5.0	<5.0	<5.0
CHLOROBENZENE	<5.0	<5.0	<5.0	<5.0	<5.0
CHLOROETHANE	<10	<10	<10	<10	<10
CHLOROFORM	0.71	<5.0	<5.0	<5.0	<5.0
CHLOROMETHANE	<10	<10	<10	<10	<10
DIBROMOCHLOROMETHANE	<5.0	<5.0	<5.0	<5.0	<5.0
ETHYLBENZENE	<5.0	<5.0	<5.0	<5.0	<5.0
M,P-XYLENE (SUM OF ISOMERS)	<5.0	<5.0	<5.0	<5.0	<5.0
METHYL ETHYL KETONE (2-BUTANONE)	<10	<10	<10	<10	<10
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTA	<10	<10	<10	<10	<10
METHYLENE CHLORIDE	11	1.8	4.2	0.56	0.5
STYRENE	<5.0	<5.0	<5.0	<5.0	<5.0
TETRACHLOROETHYLENE(PCE)	<5.0	<5.0	<5.0	<5.0	<5.0
TOLUENE	<5.0	<5.0	<5.0	<5.0	<5.0
TRICHLOROETHYLENE (TCE)	<5.0	<5.0	<5.0	<5.0	<5.0
VINYL ACETATE	<10	<10	<10	<10	<10
VINYL CHLORIDE	<5.0	<5.0	<5.0	<5.0	<5.0
cis-1,3-DICHLOROPROPENE	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,2-DICHLOROETHENE	<5.0	<5.0	<5.0	<5.0	<5.0
trans-1,3-DICHLOROPROPENE	<5.0	<5.0	<5.0	<5.0	<5.0
SURROGATES					
1,2-DICHLOROETHANE-D4	101	97	103	96	96
1-BROMO-4-FLUOROBENZENE	98	95	101	97	96
TOLUENE-D8	101	109	102	109	109
SW9070/METHOD, mg/L					
OIL & GREASE, TOTAL REC	<1.1	<1.0	NA	NA	NA

PREPARED/DATE:_____
CHECKED/DATE:_____

269259

269260

TAB

APPENDIX 6

269261

APPENDIX G

TEXAS RISK REDUCTION RULES

Appendix 4

7-Day Distilled Water Leachate Test

This test is intended only for dry, solid wastes, i.e., waste materials without any free liquids.

1. Place a 250 gm. (dry weight) representative sample of the waste material in a 1500 ml. Erlenmeyer flask.

2. Add 1 liter of deionized or distilled water into the flask and mechanically stir the material at a low speed for five (5) minutes.

3. Stopper the flask and allow to stand for seven (7) days.

4. At the end of seven (7) days, filter the supernatant solution through a .45 micron filter, collecting the supernatant into a separate flask.

5. Subject the filtered leachate to the appropriate analysis.

Subchapter S. Risk Reduction Standards

§335.551. Purpose, Scope, and Applicability.

(a) Purpose. This subchapter specifies the information and procedures necessary to demonstrate compliance with the three risk reduction standards of §335.8 of this title (relating to Closure and Remediation).

(b) Scope. The requirements of this subchapter will, when adequately carried out, assure adequate protection of human health and the environment from potential exposure to contaminants associated with releases from solid waste management facilities or other areas. Cleanup levels are specified for different types of contaminated media such as air, surface water, ground water, and soil, and for cross-media contamination pathways such as soil to ground water and soil to air. General procedures based on scientific principles are provided or referenced by these regulations so that specific numeric cleanup levels can be generated. The commission will periodically review the general procedures and revise these regulations as necessary.

(c) Applicability. The requirements of this subchapter apply to persons who undertake a closure or remediation in accordance with §335.8 of this title.

§335.552. Definitions. The following words and terms, when used in this subchapter, shall have the following meanings, unless the context clearly indicates otherwise.

Carcinogen—Substances which have been classified for human carcinogenic risk based on the United States Environmental Protection Agency's Weight of Evidence System of Carcinogenicity as Group A-Human Carcinogen; Group B-Probable Human Carcinogen; or Group C-Possible Human Carcinogen.

Carcinogen Classification—The basis by which substances are classified for human carcinogenic risk based on the United States Environmental Protection Agency's Weight of Evidence System for Carcinogenicity: Group A-Human Carcinogen; Group B-Probable Human Carcinogen; Group C-Possible Human Carcinogen; Group D-Not Classifiable as to Human Carcinogenicity; and Group E-Evidence of Non-Carcinogenicity for Humans.

Long-term effectiveness—The ability of a remediation or corrective action to maintain over time the required level of protection of human health and the environment.

Non-residential property—Any real property or portion of a property not currently being used for human habitation or for other purposes with a similar potential for human exposure, at which activities have been or are being conducted, having the primary Standard Industrial Classification (SIC) major group numbers 01–48 inclusive, 49 except 4941, 50–67 inclusive, 72–79 inclusive, 80 except 8051, 8059, 8062, 8063, 8069, 81 and 82 except 8211, 8221, 8222, 83 except 8351, 8361, 84–86 except 8661, 87–91 inclusive, 92 except 9223, and 93–97 inclusive. Non-residential property includes all of the block(s) and lot(s) controlled by the same owner or operator that are vacant land, or that are used in conjunction with such business. For leased properties, non-residential property includes the leasehold and any external tank, surface impoundment, septic system, or any other structure, vessel, contrivance, or unit that provides, or are utilized, for the management of contaminants to or from the leasehold.

Permanence/permanent/permanently—The property of achieving the maximum degree of long-term effectiveness and of enduring indefinitely without posing the threat of any future release that would increase the risk above levels established for the facility or area.

Point of exposure—A location where human or environmental receptors can come into contact with contaminants; also, a location which can be arbitrarily determined for purposes of estimating or measuring the concentration of contaminants available for exposure.

Practical quantitation limit/PQL—The lowest concentration of an analyte which can be reliably quantified within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL minimizes to the extent possible the effects of instrument and operator variability and the influences of the sample matrix and other contaminants or substances upon the quantitation of the analyte. "Specified limits of precision and accuracy" are the criteria which have been included in applicable regulations or which are listed in the quality control sections of the analytical method. The PQL may be directly obtained or derived from the following sources with preference given to the most recent, scientifically valid method: federal regulations; EPA guidance documents; calculation from interlaboratory studies; and experimentally determined analytical methods not available from other existing sources.

Residential property—Any property that does not exclusively meet the definition of non-residential property. Also, a portion of non-residential property that is used in part for residential activities, such as a day care center, is defined as residential.

Systemic toxicant—Substances shown either through epidemiological studies or through laboratory studies to cause adverse health effects other than cancer.

§335.553. Required Information.

(a) For risk reduction standard Number 1 or 2. The person shall provide a final report that documents attainment of the risk reduction standard in accordance with §335.554 or §335.555 of this title (relating to Attainment of Risk Reduction Standard Number 1 and Attainment of Risk Reduction Standard Number 2). The report shall include, but is not limited to, descriptions of procedures and conclusions of the investigation to characterize the nature, extent, direction, rate of movement, volume, composition and concentration of contaminants in environmental media; basis for selecting environmental media of concern; documentation supporting selection of exposure factors; descriptions of removal or decontamination proce-

dures performed in closure or remediation; summaries of sampling methodology and analytical results which demonstrate that contaminants have been removed or decontaminated to applicable levels; and a document that the person proposes to use to fulfill the requirements of §335.560(b) of this title (relating to Post Closure Care and Deed Certification), as applicable.

(b) Risk reduction standard Number 3, the person shall conduct the activities set forth in paragraphs (1)–(4) of this subsection. The results of activities required by paragraphs (1)–(3) of this subsection may be combined to address a portion of a facility or one or more facilities of a similar nature or close proximity. The submittal shall be subject to review and approval by the executive director prior to carrying out the closure or remediation. Upon completion of the approved activity, the person shall submit the final report required by paragraph (4) of this subsection.

(1) The person shall prepare a remedial investigation report which contains sufficient documentation such as, but not limited to, descriptions of procedures and conclusions of the investigation to characterize the nature, extent, direction, rate of movement, volume, composition, and concentration of contaminants in environmental media of concern, including summaries of sampling methodology and analytical results. Information obtained from attempts to attain Risk Reduction Standard Numbers 1 or 2 may be submitted for this purpose.

(2) The person shall prepare a baseline risk assessment report which describes the potential adverse effects under both current and future conditions caused by the release of contaminants in the absence of any actions to control or mitigate the release. The report shall also discuss the degree of uncertainty associated with the baseline risk assessment. Residential land use with on-site exposure shall be assumed to evaluate the future use condition unless the person demonstrates to the satisfaction of the executive director that a different land use assumption such as industrial use is more appropriate. The standard exposure factors set forth in Table 1 (located following paragraph (4) of this subsection) shall be used unless the person documents to the executive director's satisfaction that site-specific exposure data should be used instead.

(3) The person shall evaluate the relative abilities and effectiveness of poten remedies to achieve the requirements remedies described in §335.561 of this title (relating to Attainment of Risk Reduction Standard Number 3) when considering the evaluation factors described in §335.562 of this title (relating to Remedy Evaluation Factors). Using this information, the person shall prepare a corrective measure study which recommends the remedy which best achieves the requirements for remedies described in §335.561 of this title. Persons may seek to satisfy the requirements of §335.564 of this title (relating to Post Closure Care not required for Risk Reduction Standard Number 3) by demonstrating in the corrective measure study using the procedures of §335.563 of this title (relating to Media Cleanup Requirements for Risk Reduction Standard Number 3) that no remedy needs to be performed since the existing conditions of the facility or area conform to the media cleanup requirements without the use of removal, decontamination or control measures. Persons may also seek to satisfy the requirements of §335.564 by demonstrating in the corrective measure

Table 1. Standard Exposure Factors (for use with §335.553(b)(2) and §335.563(e)).

Land Use	Exposure Pathway	Daily Intake Rate	Exposure Frequency	Exposure Duration	Body Weight
Residential	Ingestion of Potable Water	2 liters	350 daysyr	30 years	70 kg
	Ingestion of Soil and Dust*	200 mg-child, age 1–6 100 mg-adult, age 7–31	350 days/yr	6 years* 24 years**	15.1 kg* 70 kg** (*=child, **=adult)
	+These factors yield the age-adjusted soil ingestion factor of 114 mg-yr/kg-day				
	Inhalation of Contaminants	20 cu.m.-total 15 cu.m.-indoor	350 days/yr	30 years	70 kg
Commercial/ Industrial	Ingestion of Potable Water	1 liter	250 days/yr	25 years	70 kg
	Ingestion of Soil and Dust	50 mg	250 days/yr	25 years	70 kg
	Inhalation of Volatiles	20 cu.m./workday	250 days/yr	25 years	70 kg
Agricultural	Consumption of Homegrown Produce	42 g-fruit 80 g-vegetables	350 days/yr	30 years	70 kg
	Factors for ingestion of potable water, soil and dust, and inhalation of volatiles: Use the Residential Land Use of factors.				
Recreational	Consumption of Locally Caught Fish	10 g-freshwater 15 g-saltwater	350 days	30 years	70 kg

study that following completion of their recommended removal and/or decontamination activities the conditions of the facility or area will conform to the media cleanup requirements of §335.563 without the use of control measures. Upon review of the corrective measure study, the executive director may require the person to further evaluate the proposed remedy or to evaluate one or more additional remedies.

(4) The person shall submit to the executive director, for review and acceptance, a final report containing sufficient documentation which demonstrates that the remedy has been completed in accordance with the approved plan and also a document that the person proposed to use to fulfill the requirements of §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3).

(c) For risk reduction standards Numbers 1, 2, and 3. In order for a treatment process to achieve decontamination in contrast to being a control measure, the person must demonstrate to the satisfaction of the executive director that the treatment process permanently alters all contaminants to levels that will not pose a substantial present or future threat to human health and the environment, and must further demonstrate that any residue remaining in place from the treatment will not pose the threat of any future release that would increase the concentrations of contaminants in environmental media above the cleanup levels determined for that particular risk reduction standard.

(d) For risk reduction standards Numbers 1, 2, and 3, attainment of cleanup levels shall be demonstrated by collection and analysis of samples from the media of concern. Persons shall utilize techniques described in SW 846, Test Methods for Evaluating Solid Waste, United States Environmental Protection Agency, or other available guidance in developing a sampling and analysis plan appropriate for the distribution, composition and heterogeneity of contaminants and environmental media. A sufficient number of samples shall be collected and analyzed for individual compounds to both accurately assess the risk to human health and the environment posed by the facility or area and to demonstrate the attainment of cleanup levels. Non compound-specific analytical techniques (e.g., Total Petroleum Hydrocarbons, Total Organic Carbon, etc.) may, where appropriate for the nature of the wastes or contaminants, be used to aid in the determination of the lateral and vertical extent and volume of contaminated media; however, such non compound-specific analyses will serve only as indicator measures and must be appropriately supported by compound-specific analyses. Comparisons may be based on the following methods:

(1) direct comparison of the results of analysis of discrete samples of the medium of concern with the cleanup level;

(2) for a data set of ten or more samples, statistical comparison of the results of analysis utilizing the 95% confidence limit of the mean concentration of the contaminant as determined by the following expression: Cleanup Level $\geq \bar{x} + \frac{s \cdot t}{\sqrt{n}}$ where $\bar{x}$ is the mean concentration, s is the standard deviation and t is a value from Table 2 (located following paragraph (3) of this subsection) based on the number of samples, and sqrt (n) is the square root of the sample size; or

(3) other statistical methods appropriate for the distribution of the data, subject to prior approval by the executive director.

Table 2. Values for "t" (for use with §335.553(d)).

n	t	n	t	n	t
10	1.812	20	1.725	50	1.676
11	1.796	21	1.721	60	1.671
12	1.782	22	1.717	70	1.667
13	1.771	23	1.714	80	1.664
14	1.761	24	1.711	90	1.662
15	1.753	25	1.708	100	1.661
16	1.746	30	1.697	120	1.658
17	1.740	35	1.690	145	1.656
18	1.734	40	1.684		
19	1.729	45	1.680		

(e) For Risk Reduction Standards Numbers 2 and 3, in determining toxicity information for contaminants (e.g., Environmental Protection Agency carcinogen classification, type of toxicant, reference doses, carcinogenic slope factors, etc.), persons shall utilize values from the following sources in the order indicated. For Risk Reduction Standard Number 2, persons may utilize data from these sources that are more current than those used to derive the unadjusted MSCs listed in §335.568 of this title (relating to Appendix II), provided that substantiating information is furnished to the executive director in the report required by §335.555(f) of this title (relating to Attainment of Risk Reduction Standard Number 2):

(1) integrated Risk Information System (IRIS);

(2) health Effects Assessment Summary Table (HEAST);

(3) United States Environmental Protection Agency Criteria Documents;

(4) agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles; and

(5) other scientifically valid published sources.

(f) For risk reduction standards Numbers 2 and 3, persons determining cleanup levels for contaminated media characterized by non compound-specific analytical techniques (e.g., Total Petroleum Hydrocarbons, Total Organic Carbon, etc.) and for which individual compounds such as hazardous constituents are not present as contaminants, must at a minimum consider other scientifically valid published numeric criteria to address: adverse impacts on environmental quality; adverse impacts on the public welfare and safety; conditions that present objectionable characteristics (e.g. taste, odor, etc.); or conditions that make a natural resource unfit for use.

§335.554. Attainment of Risk Reduction Standard Number 1: Closure/Remediation to Background.

(a) Compliance with this standard is attained when the criteria set forth in subsections (b)-(g) of this section are met.

(b) For closure of hazardous waste management units and response to unauthorized discharges of hazardous waste, all hazardous waste and hazardous waste residues and contaminated design and operating system components such as liners, leachate collection systems and dikes must be removed from the unit or area of the unauthorized discharge. For remediation of media that have become contaminated by releases from a hazardous waste management unit or by other unauthorized discharge of hazardous waste, the contaminated media must be removed or decontaminated to cleanup levels specified in this section.

(c) For closure of non-hazardous industrial solid waste management units, response to unauthorized discharges of non-hazardous industrial solid waste, and the remediation of media that have become contaminated by discharges of non-hazardous industrial solid waste or other contaminants, all waste and waste residues, contaminated design and operating system components such as liners, leachate collection system and dikes, and contaminated media must be removed or decontaminated to cleanup levels specified in this section.

(d) Background as represented by results of analyses of samples taken from media that are unaffected by waste management or industrial activities shall be used to determine compliance with the requirements of this section. If the Practical Quantitation Limit (PQL) is greater than background, then the PQL rather than background shall be used as the cleanup level provided that the person satisfactorily demonstrates to the executive director that lower levels of quantation of a contaminant are not possible.

(e) Attainment of cleanup levels shall be demonstrated by collection and analysis of samples from the media of concern using the procedures of §335.553(d) of this title (relating to Required Information).

(f) The person must submit a report to the executive director in accordance with §335.553(a) of this title (relating to Required Information) that documents compliance with the requirements of this section.

(g) Provided that attainment of this risk reduction standard for the facility or area can be demonstrated to the executive director pursuant to this section, the person is released from deed recordation requirements of §335.5 of this title (relating to Deed Recordation of Waste Disposal) and post-closure care responsibilities.

§335.555. Attainment of Risk Reduction Standard Number 2: Closure/Remediation to Health-Based Standards and Criteria.

(a) Compliance with this standard is attained when the criteria set forth in subsections (b)-(f) of this section are met.

(b) For closure of hazardous waste management units and response to unauthorized discharges of hazardous waste, all hazardous waste and hazardous waste residues must be removed from the unit or area of the unauthorized discharge. Contaminated design and operating system components such as liners, leachate collection systems and dikes must be removed from the unit or area of the unauthorized discharge. For remediation of media that have become contaminated by releases from a hazardous waste management unit or by other unauthorized discharge of hazardous waste, the contaminated media must be removed or decontaminated to cleanup levels specified in this section or such other lower levels necessary to be in conformance with current hazardous waste regulations.

(c) For closure of non-hazardous industrial solid waste management units, response to unauthorized discharges of non-hazardous industrial solid waste, and the remediation of media that have become contaminated by discharges of non-hazardous industrial solid waste or other contaminants, all waste and waste residues, contaminated design and operating system components such as liners, leachate collection systems and dikes, and contaminated media must be removed or decontaminated to cleanup levels specified in this section.

(d) The concentration of a contaminant in contaminated media of concern such as ground water, surface water, air or soil shall not exceed cleanup levels as defined in §335.556 of this title (relating to Determination of Cleanup Levels for Risk Reduction Standard Number 3).

(1) If the Practical Quantitation Limit (PQL) and/or the background concentration, determined in a manner consistent with §335.554 of this title (relating to Attainment of Risk Reduction Standard Number 1) for a contaminant is greater than the cleanup level, the greater of the PQL or background shall be used for determining compliance with the requirements of this section.

(2) Attainment of cleanup levels shall be demonstrated by collection and analysis of samples from the contaminated media of concern using the procedures of §335.553(d) of this title (relating to Required Information).

(e) The person must prepare a document that he intends to use to fulfill the deed certification requirements of §335.560 of this title (relating to Post Closure Care and Deed Certification for Risk Reduction Standard Number 2) and include this document as part of the report of subsection (f) of this section.

(f) The person must submit a report to the executive director in accordance with §335.553(a) of this title (relating to Required Information) that documents compliance with the requirements of this section. The executive director may require additional information or analysis, such as but not limited to, consideration of cumulative health effects and cross-media contamination, prior to accepting a certification of closure or remediation under this

performance standard. Upon approval of the report by the executive director, the person shall comply with the requirements of §335.560 of this title (relating to Post Closure Care and Deed Certification for Risk Reduction Standard Number 2).

§335.556. Determination of Cleanup Levels for Risk Reduction Standard Number 2.

(a) For purposes of this risk reduction standard, cleanup levels for individual contaminants are represented by Texas or federal promulgated health-based standards, or, when these are not available or do not provide appropriate protection for human health or the environment, persons must develop cleanup levels based on procedures specified or referenced in this section for determining other numeric criteria, referred to as Medium Specific Concentration (MSCs), and are required to perform any necessary adjustments to these numeric criteria. The MSCs address a single contaminant in a medium and consider one or more exposure pathways, specifically, water ingestion (Water MSC) and soil ingestion with inhalation of volatiles and particulates (Soil MSC). Where a contaminant in one medium has the potential to contaminate another medium, defined as cross-media contamination, additional numeric criteria are developed as cleanup levels (e.g., the soil-to-ground water contaminant pathways). To determine cleanup levels for contaminated media of concern, persons must perform the evaluation of subsections (b)–(e) of this section.

(b) In addition to the exposure pathways defined or referenced in this section, the person must evaluate other exposure pathways at or near the facility (e.g., dermal absorption, ingestion of contaminated fish, etc.) by which human populations (including sensitive subgroups) or environmental receptors (e.g., aquatic organisms, food-chain crops, etc.) are likely to be exposed to contaminants. If such evaluation indicates the need for additional remediation at the facility to adequately protect human health or environmental receptors, then the person shall develop numeric criteria by utilizing available guidance or scientific literature to serve in place of, or in addition to, cleanup levels determined pursuant to this section.

(c) The person must determine the appropriate exposure factors from §335.557 of this title (relating to Criteria for Selection of Non-Residential Soil Requirements for Risk Reduction Standard Number 2); and.

(d) The person must calculate MSCs in accordance with §335.558 of this title (relating to Medium Specific Concentrations for Risk Reduction Standard Number 2); and.

(e) The person must determine any cross-media requirements and modifications to cleanup levels in accordance with §335.559 of this title (relating to Medium Specific Requirements and Adjustments for Risk Reduction Standard Number 2).

§335.557. Criteria for Selection of Non-Residential Soil Requirements for Risk Reduction Standard Number 2. All facilities or areas shall be subject to the residential soil requirements unless one of the conditions of paragraphs (1)–(3) of this section is satisfied for use of the non-residential soil requirements.

(1) For property located within the jurisdictional area of a zoning authority, persons may provide documentation that the property is zoned for commercial or industrial use.

(2) For property not located within the jurisdictional area of a zoning authority, persons may provide documentation that the activities being conducted on the property satisfy the definition for non-residential property (§335.553) of this title (relating to Definitions)).

(3) For government-owned (local, state, or federal) property which does not satisfy either of the conditions of subsections (a) or (b) of this section but does have non-residential activities occurring on all or portions of the property, the person may provide documentation that access will be restricted such that the exposure assumptions remain valid for the duration of government control.

§335.558. Medium Specific Concentrations for Risk Reduction Standard Number 2.

(a) Medium specific concentrations (MSCs) for ingestion of surface water and ground water, and soil ingestion along with inhalation of volatiles and particulates are calculated according to the procedures specified in subsections (b)–(d) of this section based on residential exposure factors. MSCs are subject to additional numeric criteria and adjustments of §335.559 of this title (relating to Medium Specific Requirements and Adjustments for Risk Reduction Standard Number 2). The derivation of all equations is presented in §335.567 of this title (relating to Appendix I).

(b) For a contaminant which is a carcinogen, the MSC is the concentration which represents an excess upper bound lifetime cancer Target Risk (TR) of 0.000001 (also expressed as one in one million) for Class A and B carcinogens, or 0.00001 (also expressed as one in 100,000) for Class C carcinogens due to continuous lifetime exposure as calculated using the equations and factors listed in paragraphs (1) and (2) of this subsection.

(1) Water MSC for Ingestion, in units of milligrams per liter (mg/L):

$$MSC = \frac{85.16\ (TR)}{SF_o} \qquad \text{Equation 1}$$

where SF_o is the chemical-specific oral cancer slope factor.

(2) Soil MSC for Ingestion with Inhalation of volatiles and particulates, in units of milligram per kilogram (mg/kg):

$$MSC = \frac{5510\ (TR)}{[((7.98 \times 10^{-3}) \times (SF_o)(SF_i \times [(450/VF) + (9.72 \times 10^{-6})])]} \qquad \text{Equation 2}$$

where VF is the chemical-specific soil-to-air volatilization factor.

(c) For a contaminant which is a systemic toxicant, the MSC is the concentration to which human populations (including sensitive subgroups) could be exposed by direct ingestion or inhalation on a daily basis without appreciable risk or deleterious effects during a lifetime. The MSC is calculated using the equations and factors listed in paragraphs (1) and (2) of this subsection.

(1) Water MSC for Ingestion in units of milligram per liter (mg/L):

$$MSC = 36.5\ RfD_o \quad mg/L \qquad \text{Equation 3}$$

where RfD_o is the chemical-specific oral reference dose.

(2) Soil MSC for Ingestion with Inhalation of volatiles and particulates, in units of milligram per kilogram (mg/kg):

Equation 4

$$MSC = \frac{2190\ mg/kg}{[(7.98 \times 10^{-3}/RfD_o) + ((1/RfD_i) \times [(450/VF) + (9.72 \times 10^{-8})])]}$$

where VF is the chemical-specific soil-to-air volatilization factor.

(d) Examples of unadjusted MSCs, standards and criteria are listed in §335.568 of this title (relating to Appendix II: "Examples of Medium Specific Concentrations, Standards and Criteria for Health-Based Closure/Remediation (§335.558)." The Commission will revise Appendix II on an annual base to reflect newly promulgated standards and MSCs based on current toxicological data.

§335.559. Medium Specific Requirements and Adjustments for Risk Reduction Standard Number 2.

(a) Numeric cleanup levels. The subsections (b)-(h) of this section specify requirements that can define or modify numeric cleanup levels such as MSCs or require non-health based criteria to be addressed.

(b) Surface water. In determining the necessity for remediation at the facility, persons shall utilize Chapter 307 of this title (relating to Texas Surface Water Quality Standards) or, if those values are not available, Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act, or if MCLs are not available or appropriate, MSCs based upon human ingestion of the water. Any discharge or release into or adjacent to surface water, including storm water run-off, occurring during or after attainment of Risk Reduction Standard Number 2, shall be compliant with the Texas Surface Water Quality Standards of Chapter 307 of this title and may be subject to the permitting requirements of Chapter 305 of this title (relating to Consolidated Permits) or other authorization from the commission.

(c) Air. In determining the necessity for remediation at the facility, persons shall observe limitations established by the National Ambient Air Quality Standards (NAAQS) and the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as found in the 40 Code of Federal Regulations Parts 50 and 61, respectively, and other applicable federal standards and guidelines of the United States Environmental Protection Agency. Also, limitations established by the Texas Air Control Board (TACB) under the Texas Clean Air Act, the State Implementation Plan or other federal requirements must be observed. Permit requirements, limitations established by Standard Exemptions, or other requirements of the TACB relative to atmospheric emissions and/or air quality may also apply.

(d) Ground water. The groundwater cleanup levels shall be determined by a consideration of the following.

(1) For residential exposure, the concentration of a contaminant dissolved in ground water must not exceed the Maximum Contaminant Level (MCL), if promulgated pursuant the Federal Safe Drinking Water Act, §141, otherwise the water MSC for ingestion determined pursuant to §335.556 of this title (relating to Determination of Cleanup Levels for Risk Reduction Standard Number 2). Phase-separated non-aqueous liquids released from the unit that is undergoing closure or remediation must be removed or decontaminated.

(2) For non-residential exposure, the concentration of a contaminant dissolved in ground water must not exceed the Maximum Contaminant Level (MCL) if promulgated pursuant to the Federal Safe Drinking Water Act, §141. If no MCL has been promulgated, the ground water concentration shall not exceed the water MSC for ingestion determined pursuant to §335.556 of this title (relating to Determi-

nation of Cleanup Levels for Risk Reduction Standard Number 2), which has been multiplied by a factor of 3.36 for carcinogens or 2. 8 for systemic toxicants to account for lower ingestion rates associated with non-residential worker exposure. Persons must be able to demonstrate that the quality of ground water at the facility property boundary will be protective for residential exposure. Phase-separated non-aqueous liquids released from the unit that is undergoing closure or remediation must be removed or decontaminated to the extent practicable.

(3) For residential and non-residential exposure, if the ground water at the facility or area has a naturally occurring background Total Dissolved Solids concentration greater than 10,000 milligrams per liter, the cleanup level for a contaminant dissolved in this ground water determined pursuant to paragraph (1) or (2) of this subsection, as appropriate, may be adjusted by multiplying by 100. The resulting value becomes the maximum concentration for ground water for residential and non-residential exposure, respectively.

(4) The executive director may require the evaluation of additional exposure pathways or environmental receptors as part of the adjustment of paragraph (3) of this subsection.

(e) Soil. For all situations, concentrations of contaminants in soils must be protective of surface water, air and ground water as specified in subsections (b), (c), and (d) of this section. No soil remaining in place shall exhibit the hazardous waste characteristics of ignitability, corrosivity, or reactivity as defined in 40 Code of Federal Regulations, Part 261, Subpart C. The sum of concentrations of the volatile organic compounds in vapor phase in soil shall not exceed 1,000 parts per million by weight or volume, as measured by EPA Test Method 8015 or calculated by using soil concentrations and Henry's Law constants.

(f) Residential soil requirements. In addition to the requirements of subsection (e) of this section, the concentration of a contaminant throughout the soil column (i.e., surface and subsurface soils) shall not exceed the lower of the Soil MSC, based upon residential human ingestion of soil and inhalation of particulates and volatiles (as defined in the preceeding section), and the Residential Soil-to-Ground Water Cross-Media Protection Concentration, a numeric value which is determined as follows:

(1) a value which is one hundred times the residential ground water cleanup level determined by the procedures of paragraph (1) of subsection (d) of this section. Examples of such values are listed in Appendix II; or

(2) a concentration in soil that does not produce a leachate in excess of MCLs or MSCs for ground water when subjected to the Synthetic Precipitation Leaching Procedure, Method 1312 of SW 846, Test Methods for Evaluating Solid Waste, United States Environmental Protection Agency. Other test methods that more accurately simulate conditions at the facility may be used in the demonstration in place of this method, subject to prior approval of the executive director.

(g) Non-residential soil requirements. Non-residential soils shall conform to the requirements of subsection (e) of this section. The concentration of a contaminant in near-surface soils (i.e., within two feet of the land surface) shall not exceed the lower of the Non-Residential Soil MSC defined in paragraph (1) of this subsection, based upon worker ingestion of soil and inhalation of particulates and volatiles, and the Non-Residential Soil-to-Ground Water Cross-Media Protection Concentration defined in paragraph (2) of this subsection. In no event shall compliance be achieved with the surface soil criteria by applying two feet of clean soil onto the surface of a facility or area without prior approval from the executive director. The concentration of a contaminant in subsurface soils (i.e., greater than two feet in depth from the land surface) shall not exceed the Non-Residential Soil-to-Ground Water Cross-Media Protection Concentration.

(1) Non-residential soil MSC. The MSC is calculated using the equations and factors listed in subparagraphs (A) and (B) of this paragraph. The chemical-specific factors Sf_o, SF_i, RfD_o, RfD_i and VF are the same as for the soil MSCs of the preceding section. The derivation of all equations is presented in Appendix I.

(A) Carcinogenic Effects Equation, in units of milligram per kilogram (mg/kg):

Equation 5

$$MSC = \frac{286.16\ (TR)}{[((5 \times 10^{-3}) \times SF_o) + (SF_i \times [(20/VF) + (4.3 \times 10^{-9})])]} \quad mg/kg$$

(B) Systemic: C Toxicant Effects Equation, in units of milligram per kilogram (mg/kg):

Equation 6

$$MSC = \frac{102.2}{[(5 \times 10^{-5}/RfD_o) + ((1/RfD_i) \times [(20/VF) + (4.3 \times 10^{-9})])]} \quad mg/kg$$

(2) Non-residential soil to-ground water cross-media protection concentration. Persons must demonstrate that a contaminant in soil does not pose the potential for a future release of leachate in excess of the ground-water concentration considered to be protective for non-residential worker exposure. Persons may make this demonstration by showing that a contaminant occurs in soil at least than the concentration described in either subparagraph (A) or (B) of this paragraph:

(A) a concentration which is 100 times the non-residential ground-water cleanup level determined by the procedures of

paragraphs (2) or (3), as applicable, of subsection (d) of this section;

(B) a concentration in soil that does not produce a leachate in excess of the ground-water concentration of this paragraph when subjected to the Synthetic Precipitation Leaching Procedure, Method 1312 of SW 846, Test Methods for Evaluation Solid Waste, U.S. Environmental Protection Agency. Other test methods that more accurately simulate conditions at the facility may be used in the demonstration in place of this method, subject to prior approval by the executive director.

(h) Other criteria. For contaminants that do not exceed standards or criteria protective of human health and environmental receptors as determined by the procedures of this section but otherwise adversely impact environmental quality, or the public welfare and safety, or present objectionable characteristics (e.g., taste, odor, etc.), or make a natural resource unfit for use, other scientifically valid published criteria may be utilized such as, but not limited to, Threshold Limit Values for air and secondary maximum contaminant levels for water.

§335.560. Post Closure Care and Deed Certification for Risk Reduction Standard Number 2.

(a) Provided that attainment of this risk reduction standard for the facility can be demonstrated to the executive director pursuant to §335.555 of this title (relating to Attainment of Risk Reduction Standard Number 2), the conditions of subsections (b) and (c) of this section apply.

(b) The person is required to place in the county deed records of the county or counties in which such activities take place the information specified in paragraphs (1)-(4) of this subsection. The statements should be worded such that a lay person can easily understand them. An example format is provided in §335.569 of this title (relating to Appendix III). Proof of deed certification of the required information shall be provided to the executive director in writing no later than 90 days after acceptance of the report required by §335.555(f) of this title (relating to Attainment of Risk Reduction Standard Number 2):

(1) a certification signed by the person, showing the person's full name and title, and stating that closure or remediation of the facility or area was carried out in accordance with a plan designed to meet §335.555 of this title (relating to Risk Reduction Standard Number 2), which mandates that the remedy be designed to eliminate substantial present and future risk, such that no post-closure care or engineering or institutional control measures are required to protect human health and the environment;

(2) a metes and bounds description of the portion or portions of the tract of land on which closure or remediation of industrial solid waste, municipal hazardous waste or contaminants was achieved;

(3) for a facility that satisfies the conditions of §335.557 of this title (relating to Criteria for Selection of Non-Residential Soil Requirements for Risk Reduction Standard Number 2) for use of non-residential soil requirements, a statement that current or future owners of the facility must undertake actions as necessary to protect human health and the environment in accordance with the rules of the commission;

(4) a statement that information and documents concerning the closure or remediation of the facility or area are available for inspection upon request at the Texas Water Commission. The statement shall further describe the jurisdiction of the Texas Water Commission to review the establishment of the final cleanup criteria.

(c) The person is released from post-closure care responsibilities upon acceptance by the executive director of the proof of deed certification required by subsection (b) of this section.

§335.561. Attainment of Risk Reduction Standard Number 3: Closure/Remediation With Controls.

(a) Compliance with this standard is attained when, in the evaluation of the executive director, the person recommends the remedy which best achieves the requirements of subsections (b)-(d) of this section taking into consideration the evaluation factors of §335.562 of this title (relating to Remedy Evaluation Factors) and then following approval subsequently completes the remedy.

(b) A remedy must be permanent or, if that is not practicable, achieve the highest degree of long-term effectiveness possible.

(c) A remedy must be cost-effective in that it achieves the best balance between long-term effectiveness and cost for alternative remedies which meet the cleanup objectives for a facility.

(d) A remedy must achieve media cleanup requirements as specified pursuant to §335.563 of this title (relating Media Cleanup Requirements for Risk Reduction Standard Number 3).

§335.562. Remedy Evaluation Factors for Risk Reduction Standard Number 3.

(a) General. For closure/remediation in accordance with Risk Reduction Standard Number 3, persons shall consider the evaluation factors set forth in subsections (b)-(g) of this section when evaluating the relative abilities and effectiveness of potential remedies to achieve the requirements for remedies described in §335.561 of this title (relating to Attainment of Risk Reduction Standard Number 3). A description of the evaluation for these factors for the proposed remedy shall be included in the corrective measure study prepared pursuant to §335.553(b)(3) of this title (relating to Required Information). Persons performing these evaluations shall submit to the executive director upon request such additional information as may reasonably be required to enable the executive director to determine whether such evaluation has been conducted in a manner compliant with this section.

(b) Compliance with other laws and regulations. Remedies shall be evaluated to determine attainment of cleanup requirements for other Texas or federal environmental laws which are either legally applicable to the facility or that address problems or situations that are sufficiently similar to those encountered at the facility that their use is well suited to the facility.

(c) Long-term effectiveness and permanence. Remedies shall be evaluated for lont-term effectiveness. Factors that shall be considered in this evaluation include:

(1) magnitude of risks remaining after completion of the closure or remedial action;

(2) the type, degree, and duration of post-closure care required including, but not limited to, operation and maintenance, monitoring, inspections, and reports and their frequencies, or other activities which will be necessary to protect human health and the environment;

(3) potential for exposure of humans and environmental receptors to contaminants remaining at the facility;

(4) long-term reliability of any engineering and voluntary institutional controls; and

(5) potential need for replacement of components of the remedy.

(d) Reduction of toxicity, mobility, or volume. Remedies shall be evaluated to determine the degree to which treatment could be used to significantly and irreversibly reduce the toxicity, mobility, or volume of contaminants. Factors to be considered in this evaluation include:

(1) the amount of contaminants that will be treated or destroyed;

(2) the degree of expected reduction in toxicity, mobility, or volume;

(3) the type, quantity, toxicity, and mobility of contaminants remaining after treatment; and

(4) the degree to which the treatment is irreversible.

(e) Short-term effectiveness. The short-term effects of remedies shall be evaluated considering the following:

(1) short-term risks that might be posed to the community, workers, or the environment during implementation of the remedy and the effectiveness and reliability of protective measures; and

(2) time until protection is achieved.

(f) Implementability. The ease or difficulty of implementing the remedies shall be evaluated by considering the following types of factors:

(1) degree of difficulty associated with constructing the remedy;

(2) expected operational reliability of the remedy;

(3) availability of necessary equipment and specialists;

(4) available capacity and location of needed treatment, storage, and disposal services.

(g) Cost. The types of costs that shall be evaluated include the following:

(1) capital costs;

(2) operation and maintenance costs; and

(3) net present value of capital and operation and maintenance costs.

§335.563. Media Cleanup Requirements for Risk Reduction Standard Number 3.

(a) General. For closure/remediation in accordance with Risk Reduction Standard Number 3, persons shall propose media cleanup levels in accordance with the conditions set forth in subsections (b)–(j) of this section.

(b) Carcinogens. For known or suspected carcinogens, media cleanup levels shall be established at concentrations which represent an excess upperbound lifetime risk of between one in 10,000 and one in million. The executive director will use one in million as a goal in establishing such concentration limits. The cumulative excess risk to exposed populations (including sensitive subgroups) shall not be greater than one in 10,000.

(c) Systemic toxicants. For systemic toxicants, media cleanup levels shall represent concentrations to which the human population (including sensitive subgroups) could be exposed on a daily basis without appreciable risk of deleterious effect during a lifetime or part of a lifetime and where:

(1) the hazard quotient which is the ratio of a single systemic toxicant exposure level for a specified time period to a reference dose for that systemic toxicant derived from the same time period, shall not exceed one; and

(2) the hazard index shall not exceed one. The hazard index is the sum of the hazard quotients for a single or multiple systemic toxicants which affect the same target organ or act by the same method of toxicity and act through a single or multiple medial exposure pathways.

(d) Additional considerations. In establishing media cleanup levels pursuant to subsections (b) and (c) of this section, the executive director may consider and may direct persons who submit plans or reports in accordance with §335.553(b) of this title (relating to Required Information) to address the following:

(1) multiple contaminants in a medium;

(2) exposure to multiple contaminated media;

(3) reasonable expected future exposure conditions at the facility; and

(4) the technical limitations, effectiveness, practicability, or other relevant features of available remedies.

(e) Standard exposure factors. In determining media cleanup levels pursuant to subsections (b) and (c) of this section, persons shall use the standard exposure factors for residential use of the facility as set forward in Table 1 (located following §335.553) unless the person documents to the satisfaction of the executive director that:

(1) site-specific data warrant deviation from the standard exposure factors; or

(2) a land use other than residential is more appropriate based on:

(A) historical, current, and probable future land use; and

(B) effectiveness of institutional or legal controls placed on the future use of the land.

(f) Air. Media cleanup levels for air will be established to meet the requirements of paragraphs (1) and (2) of this subsection.

(1) Concentrations of contaminants in air that emanate from a facility, area of soil contamination, or plume of contaminated ground water shall not exceed:

(A) National Ambient Air Quality Standards (NAAQS), National Emission Standards for Hazardous Pollutants (NESHPAS) (as found in 40 Code of Federal Regulations Parts 50 and 61 respectively, and as adopted by the Texas Clean Air Act);

(B) concentrations established by the Texas Air Control Board (TACB) under the Texas Clean Air Act, the State Implementation Plan or other federal requirements. Permit requirements, limitations established by Standard Exemptions, or other requirements of the TACB relative to atmospheric emissions and/or air quality may also apply.

(2) For residential exposure conditions, concentrations of contaminants in air that emanate from a facility, area of soil contamination, or plume of contaminated ground water shall not exceed concentrations that satisfy subsections (b)-(e) of this section at exposure points located both within the contaminated area and at the property boundary.

(3) For nonresidential exposure conditions, concentrations of contaminants in air that manage from a facility, area of soil contamination, or plume of contaminated ground water shall not exceed either OSHA permissible exposure limits, threshold limit values or other criteria applicable to an industrial exposure setting within the facility boundaries or concentrations that satisfy subsections (b)-(e) of this section at the property boundary.

(g) Surface water. In determining the necessity for remediation at the facility, persons shall utilize Chapter 307 of this title (relating to Texas Surface Water Quality Standards) or, if those values are not available, Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act or, if MCLs are not available or applicable, values calculated pursuant to subsections (b)–(e) of this section based upon human ingestion of the water or other site-specific exposure pathway. Any discharge or release into or adjacent to surface water, including storm water runoff, occurring during or after attainment of Risk Reduction Standard Number 3, shall be compliant with the Texas Surface Water Quality Standards of Chapter 307 of this title and may be subject to the permitting requirements of Chapter 305 of this title (relating to Consolidated Permits) or other authorization from the Commission.

(h) Ground water. Media cleanup levels for ground water that is a current or potential source of drinking water as defined in paragraph (1) of this subsection

shall not exceed Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act or, if MCLs are not available, values calculated according to subsections (b)-(e) of this section based upon human ingestion of the water. Cleanup levels for ground water may be subject to the modifications of paragraphs (2)-(4) of this subsection.

(1) Ground water that has a background Total Dissolved Solids (TDS) content less than or equal to 10,000 milligrams per liter (mg/L) and that occurs within a geologic zone that is sufficiently permeable to transmit water to a pumping well in usable quantities shall be considered a current or potential source of drinking water for the purpose of determining cleanup levels.

(2) The cleanup levels shall be achieved throughout the plume of contaminated ground water, with the exception of the circumstances described in subparagraphs (A)-(C) of this paragraph:

(A) when Alternate Concentration Limits of §335.160(b) of this title (relating to Alternate Concentration Limits) have been approved in a permit issued by the Commission for a hazardous waste management facility;

(B) when the selected remedy calls for waste to be left in place and when appropriate control measures are installed or operated, the executive director may authorize the zone underlying the area encompassing the original source(s) of release to be excluded from this requirement;

(C) when the person documents to the executive director's satisfaction pursuant to subsection (e) of this section that a future land use other than residential is appropriate for the facility or area and further demonstrates that institutional or legal controls will effectively prevent use of the contaminated ground water, the extent of plume remediation may be determined in a manner consistent with §335.160(b) of this title (relating to Alternate Concentration Limits).

(3) The executive director may determine that remediation of ground water to the extent required in paragraphs (1) or (2) of this subsection is not necessary if the person demonstrates to the executive director's satisfaction that:

(A) the contaminant is present in ground water that is not a current or potential source of drinking water and the contaminated ground water is not hydraulically connected with or is not likely to migrate to either surface water or to ground water that is a current or potential source of drinking water.

(B) restoration of the ground water to these levels is technically impracticable.

(4) If a determination is made pursuant to paragraph (3) of this subsection, the executive director may require any alternative measures or cleanup levels that are necessary to protect human health and the environment. At a minimum, for all cases described in this subsection, phase-separated non-aqueous liquids shall be removed from ground water zones to the extent practicable.

(i) Soil. Concentrations of contaminants in soil shall not exceed the following values:

(1) the values calculated pursuant to subsections (b)-(d) of this section based upon human ingestion of the soils at all points where direct contact exposure to the soils may occur; and

(2) values which will allow the air, surface water, and ground-water cleanup levels specified in subsections (f), (g), and (h) of this section, respectively, to be maintained over time taking into account the effects of engineering controls.

(A) Such determinations shall be based on sound scientific principles including fate and transport evaluation of contaminant migration. Procedures and conclusions shall be documented to the satisfaction of the executive director.

(B) The executive director may require the evaluation of additional migration pathways beyond those listed in this section if determined necessary. Such additional pathways may include but are not limited to food chain contamination, impairment of soil for agricultural purposes, phytotoxicity, accumulations of contaminants in sediment of surface water bodies, or other impairments of natural resources, land, or water use.

(j) Other adjustments. Cleanup levels may be adjusted according to paragraphs (1)-(3) of this subsection.

(1) If the Practical Quantitation Limit (PQL) or the background concentration (represented by results of analyses of samples taken from media that are not affected by waste management or industrial activities) for a contaminant is greater than the cleanup level determined by procedures of this section, then the greater the PQL or background shall become t. cleanup level.

(2) Other scientifically valid published criteria, such as, but not limited to. Threshold Limit Values for air and secondary maximum contaminant levels for water, shall be utilized as cleanup levels for contaminants for which the procedures of this section are not appropriate (e.g., mixtures or substances that do not have toxicological data) or that do not exceed standards or criteria protective of human health as determined by the procedures of this section but otherwise adversely impact environmental quality, or the public welfare and safety, or present objectionable characteristics (e.g., taste, odor, etc.), or make a natural resource unfit for use.

(3) More stringent cleanup levels may be established for a facility than are specified in this section if, by utilizing available guidance or scientific literature, the executive director determines that it is necessary to protect environmental receptors.

§335.564. Post Closure Care Not Required for Risk Reduction Standard Number 3. In cases under Risk Reduction Standard Number 3 where the executive director determines that neither engineering nor institutional control measures a required to protect human health and t. environment, the person is released from post closure care responsibilities but is required to deed record the facility in accordance with §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3).

§335.565. Post Closure Care Required for Risk Reduction Standard Number 2. In case under Risk Reduction Standard Number 3 where the executive director determines that either engineering or institutional control measures are required to protect human health and the environment, the person shall comply with the requirements of paragraphs (1) and (2) in this section, as applicable, and deed record the facility in accordance with §335.566 of this title (relating to Deed Recordation for Risk Reduction Standard Number 3):

(1) carry out the post-closure requirements as evaluated and approved by the remedy evaluation process described in §335.562 of this title (relating to Remedy Evaluation Factors);

(2) for hazardous waste management facilities, the person must also satisfy the applicable requirements of Subchapter E and F of this chapter (relating to Interim Standards for Hazardous Waste Storage, Processing, or Disposal Facilities; and Permitting Standards for Owners and Operators of Hazardous Waste Storage, Processing, or Disposal Facilities, respectively).

§335.566. Deed Recordation for Risk Reduction Standard Number 3.

(a) Within 90 days after acceptance by the executive director of the final report referenced in §335.561(a) of this title (relating to Attainment of Risk Reduction Standard Number 3), the person must record in the county deed records of the county or counties in which such activities take place the information specified in subsections (b)-(e) of this section and submit written proof of such recordation to the executive director. The statements should be worded such that a lay person can easily understand them. An example format is provided in §335.569 of this title (relating to Appendix III).

(b) A certification, signed by the person, showing the person's full name and title, and stating: that remediation of the facility or area was carried out in accordance with a plan designed to meet §335.561 of this title (relating to Risk Reduction Standard Number 3), which mandates that the remedy be designed to eliminate or reduce to the maximum extent practicable, substantial present and future risk; and whether continued post-closure care or engineering or institutional control measures (Post-Closure Measures) are required to protect human health and the environment together with a description of any required Post-Closure Measures:

(c) a description of any institutional or legal controls placed by the person on the future use of the property. The notice shall indicate that the current or future owner must undertake actions as necessary to protect human health and the environment in accordance with the rules of the commission.

(d) a metes and bounds description of the portion or portions of the tract of land on which closure or remediation of industrial solid waste, municipal hazardous waste, or contaminants was achieved; and

(e) A statement that information and documents concerning the closure or remediation of the facility or area are available for inspection upon request at the Texas Water Commission. The statement shall further describe the jurisdiction of the Texas Water Commission to review the establishment of the final cleanup criteria.

§335.567. Appendix I. Derivation of Reduced Equations for Calculation of Medium Specific Concentrations of Risk Reduction Standard Number 2.

Equation 1 — MSC for Ingestion of Water; Carcinogenic Effects:

$$MSC = \frac{85.16\ TR}{SF_o}$$

is derived from the following expression:

$$MSC = \frac{TR \times BW \times AT_o \times 365\ days/yr}{SF_o \times IR_w \times EF \times ED \times A}$$

Equation 2 — MSC for Ingestion of Soils and Inhalation of Volatiles and Particulates; Residential Scenario; Carcinogenic Effects:

$$MSC = \frac{5110\ TR}{[((7.98 \times 10^{-3}) \times SF_o) + (SF_i \times [(450/VF) + (9.72 \times 10^{-3})])]}$$

is derived from the following expression:

$$MSC = \frac{TR \times BW \times AT_o \times 365\ days/yr}{EF\ [(BW \times SF_o \times 10^{-6}\ Kg/mg \times IF_{soil/adj.}) + (SF_i \times ED \times IR_{air} \times [1/VF + 1/PEF])]}$$

Equation 3 — MSC for Ingestion of Water; Systemic Toxicant Effects:

$$MSC = 36.5\ RfD_o$$

is derived from the following expression:

$$MSC = \frac{THI \times RfD_o \times BW \times AT_o \times 365\ days/yr}{IR_w \times EF \times ED \times A}$$

Equation 4 — MSC for Ingestion of Soils and Inhalation of Volatiles and Particulates; Residential Scenario; Systemic Toxicant Effects:

$$MSC = \frac{2190}{[(7.98 \times 10^{-3}/RfD_o) + ((1/RfD_i \times [(450/VF) + (9.72 \times 10^{-6})])]}$$

is derived from the following expression:

$$MSC = \frac{THI \times BW \times AT_o \times 365\ days/yr}{EF\ [((1/RfD_o) \times BW \times 10^{-6}\ Kg/mg \times IF_{soil/adj.}) + ((1/RfD_i) \times ED \times IR_{air}\ [1/VF + 1/PEF])]}$$

Equation 5 — MSC for Worker Ingestion of Soils and Inhalation of Volatiles and Particulates; Carcinogenic Effects:

$$MSC = \frac{286.16\ TR}{[((5 \times 10^{-5}) \times SF_o) + (SF_i) \times [(20/VF) + (4.3 \times 10^{-9})])]}$$

is derived from the following expression:

$$MSC = \frac{TR \times BW \times AT_o \times 365\ days/yr}{EF \times ED \times [SF_o \times 10^{-6}\ Kg/mg \times IR_{soil}) + (SF_i \times IR_{air} \times [1/VF + 1/PEF])]}$$

Equation 6 — MSC for Worker Ingestion of Soils and Inhalation of Volatiles and Particulates; Systemic Toxicant Effects:

$$MSC = \frac{102.2}{[(5 \times 10^{-5}/ \times RfD_o) + ((1/RfD_i) \times [(20/VF) + (4.3 \times 10^{-9})])]}$$

is derived from the following expression:

$$MSC = \frac{THI \times BW \times AT_o \times 365\ days/yr}{EF \times ED \times [((1/RfD_o) \times 10^{-6}\ Kg/mg \times IR_{soil/}) + ((1/RfD_i) \times IR_{air} \times (1/VF + 1/PEF))]}$$

VF: Parameters, Definitions and Values for the Soil to Air Volatilization Factor

$$VF(m^3/kg) = \frac{(LS \times V \times DH)}{A} \times \frac{(3.14 \times \alpha \times T)^{1/2}}{(2 \times D_{ci} \times E \times K_{as} \times 10^{-3}\ kg/g)}$$

STATE DATE/DEFAULT FACTORS:

LS	Length of contaminated area (M)	=	45
E	true soil porosity (unitless)	=	0.35
V	wind speed in mixing zone (M/s)	=	2.25
ps	true soil density (g/cm^3)	=	2.65
DH	diffusion height (m)	=	2
T	exposure interval (s)	=	7.90e+08
A	area of contamination (cm^2)	=	2.03e+07
OC	organic carbon content, soil fraction (unitless)	=	0.02

CHEMICAL SPECIFIC DATA:

D_i Molecular Diffusivity (cm^2/s).

H Henry's Law Constant ($atm\text{-}m^3/mol$).

K_{oc} Organic Carbon Partition Coefficient (cm^3/g).

D_{ci} Effective Diffusivity (cm^2/sec), calculated from $Di \times E^{0.33}$.

Kd Soil-water partition coefficient (cm^3/g), calculated from $Koc \times OC$.

α Alpha, $(cm^2/s) = \frac{(Dei \times E)}{E + (p_3)\ (1\text{-}E)/K_{as}}$

K_{as} Soil/air partition coefficient (g soil/cm^3 air, calculated from $K_{as} = (H/Kd) \times 41$.

Parameters, Definitions and Values used in Equations 1 through 6 are displayed in the following table:

Parameters	Definitions (Units)	Values
MSC	Medium Specific Concentration (mg/Kg)	chemical-specific
TR	Target excess individual lifetime cancer risk (unitless)	10^{-6} for Class A and B carcinogens; 10^{-5} for Class C carcinogens
THI	Target hazard index (unitless)	1
SF_o	Oral cancer slope factor ((mg/Kg-day)$^{-1}$)	chemical-specific
SF_i	Inhalation cancer slope factor ((mg/Kg-day)$^{-1}$)	chemical-specific
RfD_o	Oral chronic reference dose (mg/Kg-day)	chemical-specific
RfD_i	Inhalation chronic reference dose (mg/Kg-day)	chemical-specific
BW	Adult body weight (Kg)	70 Kg
AT_c	Averaging time for carcinogens (yr)	70 yr
AT_s	Averaging time for systemic toxicants (yr)	30 yr residential 25 yr worker
EF	Exposure frequency (days/yr)	350 residential 250 worker
ED	Exposure duration (yr)	30 yr residential 25 yr worker
IR_w	Daily water ingestion rate (liter/day)	2 l/day residential 1 l/day worker
IR_{soil}	Workday soil ingestion rate (mg/day)	50 mg/day
$IF_{soil/adj}$	Age-adjusted ingestion factor (mg-yr/Kg-day)	114 mg-yr/Kg-day
IR_{air}	Daily indoor inhalation rate (m^3/day)	15 m^3/day residential 20 m^3/8 hr day worker
PEF	Particulate emission factor (m^3/Kg)	4.63×10^9 m^3/Kg
VF	Soil-to-air volatilization factor	chemical-specific
A	Absorption factor	1

Reference: U.S. EPA, OSWER Directive 92857-01B, Decmeber 13, 1991, Human Health Evaluation Manual, Part B: "Development of Risk-based Preliminary Remediation Goals"

§335.568. Appendix II. Examples of Medium-Specific Concentrations, Standards, and Criteria for Health-Based Closure/Remediation (See §335.558 of this title (relating to Medium Specific Concentration of Risk Reduction Standards Number 2.)) CAS # = Chemical Abstracts Service Number for the Specific Compound.

GW = Groundwater. Maximum Concentration in Ground water (mg/L) for residential exposure conditions.

GWP-Res = Ground-Water Protection Standard for residential Use. Concentration in Residential Soil Assumed Protective of Groundwater Considering Cross-media Contamination of Groundwater from Contaminated Soil (mg/kg).

GWP-Ind = Groundwater Protection Standard for Industrial Use. Concentration in Industrial Soil Assumed Protective of Groundwater Considering Cross-media Contamination of Groundwater from Contaminated Soil (mg/kg).

SAI-Res = Soil/Air and Ingestion St ard for Residential Use. Maximum C centration in Residential Soil Considering Cross-media Contamination of Air and the Human Ingestion and Inhalation Pathways (mg/kg). SAI-Ind = Soil/Air and Ingestion Standard for Industrial Use. Maximum Concentraton in Industrial Soil.

Considering Cross-media Contamination of Air and the human Ingestion and Inhalation Pathways (mg/kg).

0013-9211/94/$0+$1.00

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Acenaphthene	83-32-9	2.19e+00	2.19e+02	6.13e+02	1.34e+04 (13)	4.43e+04 (13)
Acetone	67-64-1	3.65e+00	3.65e+02	1.02e+03	3.82e+03 (13)	4.16e+03 (13)
Acetonitrile	75-05-8	2.19e-01	2.19e+01	6.13e+01	1.65e+03	1.23e+04
Acetophenone	98-86-2	3.65e+00	3.65e+02	1.02e+03	2.26e+04	8.15e+04
Acrolein	107-02-8	7.30e-01 (12)	7.30e+01	2.04e+02	1.56e+03 (12)	2.04e+04 (12)
Acrylamide	79-06-1	1.89e-05	1.89e-03	6.36e-03	1.42e-01	1.27e+00
Acrylonitrile	107-13-1	1.58e-04	1.58e-02	5.30e-02	1.19e-01 (13)	1.44e-01 (13)
Alachlor	15972-60-8	2.00e-03 (9)	2.00e-01	2.00e-01	7.95e+00	7.10e+01
Aldicarb	116-06-3	3.00e-03 (9)	3.00e-01	3.00e-01	5.49e+01	4.09e+02
Aldicarb Sulfone	1646-88-4	2.00e-03 (9)	2.00e-01	2.00e-01	8.23e+01	6.13e+02
Aldicarb Sulfoxide	1646-88-3	4.00e-03 (9)	4.00e-01	4.00e-01	5.49e+01	4.09e+02
Aldrin	309-00-2	5.01e-06	5.01e-04	1.68e-03	3.77e-02	3.36e-01
Aluminum Phosphide	20859-73-8	1.46e-02	1.46e+00	4.09e+00	1.10e+02	8.18e+02
Aniline	62-53-3	1.49e-02	1.49e+00	5.02e+00	4.18e-02 (13)	4.80e-02 (13)
Anthracene	120-12-7	1.10e+01	1.10e+03	3.07e+03	5.91e+04 (13)	1.51e+05 (13)

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Antimony	7440-36-0	6.00e-03 (9)	6.00e-01	6.00e-01	1.10e+02	8.18e+02
Arsenic	7440-38-2	5.00e-02 (9)	5.00e+00	5.00e+00	3.66e-01	3.27e+00
Atrazine	1912-24-9	3.00e-03 (9)	3.00e-01	3.00e-01	2.88e+01	2.58e+02
Barium (ionic)	7440-39-3	2.00e+00 (9)	2.00e+02	2.00e+02	1.91e+04	1.37e+05
Benzene	71-43-2	5.00e-03 (9)	5.00e-01	5.00e-01	1.33e+00 (13)	1.62e+00 (13)
Benzidine	92-87-5	3.70e-07	3.70e-05	1.24e-04	2.78e-03	2.49e-02
Beryllium	7440-41-7	4.00e-03 (9)	4.00e-01	4.00e-01	1.49e-01	1.33e+00
Biphenyl	92-52-4	1.83e+00	1.83e+02	5.11e+02	6.68e+03 (13)	1.11e+04 (13)
Bis (2-chloro-ethyl) ether	111-44-4	7.74e-05	7.74e-03	2.60e-02	2.20e-01 (13)	3.77e-01 (13)
Bis (2-chloroisopropyl) ether	39638-32-9	1.22e-02	1.22e+00	4.09e+00	4.50e+01 (13)	9.05e+01 (13)
Bis (2-ethyl-hexyl) phthalate	117-81-7	6.08e-03	6.08e-01	2.04e+00	4.57e+01	4.09e+02
Bromodichloromethane	75-27-4	1.00e-01 (9)	1.00e+01	1.00e+01	7.19e-01 (13)	9.46e-01 (13)
Bromoform	75-25-2	1.00e-01 (9)	1.00e+01	1.00e+01	8.11e+01	7.24e+02
Bromomethane	74-83-9	5.11e-02	5.11e+00	1.43e+01	2.46e+01 (13)	2.47e+01 (13)
Butyl-4,6-dinitrophenol, 2-sec-	88-85-7	3.65e-02	3.65e+00	1.02e+01	2.74e+02	2.04e+03
Cadmium	7440-43-9	5.00e-03 (9)	5.00e-01	5.00e-01	1.37e+02	1.02e+03

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Carbofuran	1563-66-2	4.00e-02 (9)	4.00e+00	4.00e+00	1.37e+03	1.02e+04
Carbon Disulfide	75-15-0	3.65e+00	3.65e+02	1.02e+03	2.45e+01 (13)	2.34e+01 (13)
Carbontetrachloride	56-23-5	5.00e-03 (9)	5.00e-01	5.00e-01	4.14e-01 (13)	5.13e-01 (13)
Chlordane	57-74-9	2.00e-03 (9)	2.00e-01	2.00e-01	4.93e-01	4.40e+00
Chloroaniline, p-	106-47-8	1.46e-01	1.46e+01	4.09e+01	1.10e+03	8.18e+03
Chlorobenzene	108-90-7	1.00e-01 (9)	1.00e+01	1.00e+01	2.56e+02 (13)	2.56e+02 (13)
Chlorobenzilate	510-15-6	7.30e-01	7.30e+01	2.04e+02	5.49e+03	4.09e+04
Chloroethane (Ethylchloride)	75-00-3	7.30e-01	7.30e+01	2.04e+02	4.99e+03 (13)	2.30e+04 (13)
Chloroform	67-66-3	1.00e-01 (9)	1.00e+01	1.00e+01	4.37e-[illegible] (13)	5.04e-01 (13)
Chloronaphthalene, 2-	91-58-7	2.92e+00	2.92e+02	8.18e+02	2.20e+04	1.64e+05
2-chlorophenol	95-57-8	1.83e-01	1.83e+01	5.11e+01	1.37e+03	1.02e+04
Chromium (total)	7440-47-3	1.00e-01 (9)	1.00e+01	1.00e+01	3.91e+02 (12)	5.11e+03 (12)
Chromium (VI)	7440-47-3	1.00e-01 (9)	1.00e+01	1.00e+01	3.91e+02 (12)	5.11e+03 (12)
Cresol, m-	108-39-4	1.83e+00 (12)	1.83e+02	5.11e+02	3.91e+03 (12)	5.11e+04 (12)
Cresol, o-	95-48-7	1.83e+00 (12)	1.83e+02	5.11e+02	3.91e+03 (12)	5.11e+04 (12)
Cresol, p-	106-44-5	1.83e+00 (12)	1.83e+02	5.11e+02	3.91e+03 (12)	5.11e+04 (12)

CONSTITUENT	CAS #	GV (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Cyanide	57-12-5	2.00e-01 (9)	2.00e+01	2.00e+01	5.49e+03	4.09e+04
DDD	72-54-8	3.55e-04	3.55e-02	1.19e-01	2.67e+00	2.38e+01
DDE	72-55-9	2.50e-04	2.50e-02	8.41e-02	1.88e+00	1.68e+01
DDT	50-29-3	2.50e-04	2.50e-02	8.41e-02	1.88e+00	1.68e+01
Di-n-butyl phthalate	84-74-2	3.65e+00	3.65e+02	1.02e+03	2.74e+04	2.04e+05
Di-n-octyl phthalate	117-81-7	7.30e-01	7.30e+01	2.04e+02	5.49e+03	4.09e+04
Dibromo-3-chloropropane, 1,2-	96-12-8	2.00e-04 (9)	2.00e-02	2.00e-02	4.57e-01	4.09e+00
Dibromochloromethane	124-48-1	1.00e-01 (9)	1.00e+01	1.00e+01	7.62e+01	6.81e+02
Dichlorobenzene (1,2)	95-50-1	6.00e-01 (9)	6.00e+01	6.00e+01	6.69e+03 (13)	8.39e+03 (13)
Dichlorobenzene (1,3)	541-73-1	6.00e-01 (9)	6.00e+01	6.00e+01	7.61e+03 (13)	9.99e+03 (13)
Dichlorobenzene (1,4)	106-46-7	7.50e-02 (9)	7.50e+00	7.50e+00	8.64e+01 (13)	1.38e+02 (13)
Dichlorodifluoromethane	75-71-8	7.30e+00	7.30e+02	2.04e+03	5.00e+01 (13)	4.79e+01 (13)
Dichloroethane (1,1)	75-34-3	3.65e+00	3.65e+02	1.02e+03	7.30e+03 (13)	2.04e+04 (13)
Dichloroethane (1,2)	107-06-2	5.00e-03 (9)	5.00e-01	5.00e-01	4.17e-01 (13)	5.05e-01 (13)
Dichloroethylene (1,1)	75-35-4	7.00e-03 (9)	7.00e-01	7.00e-01	7.15e-01 (13)	8.72e-01 (13)
Dichloroethylene, cis-(1,2)	156-59-2	7.00e-02 (9)	7.00e+00	7.00e+00	1.08e+02 (13)	1.08e+02 (13)

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Dichloroethylene, trans-(1,2)	156-60-5	1.00e-01 (9)	1.00e+01	1.00e+01	2.56e+02 (13)	2.56e+02 (13)
Dichlorophenol, 2,4-	120-83-2	1.10e-01	1.10e+01	3.07e+01	8.23e+02	6.13e+03
Dichlorophenoxyacetic acid, 2,4-	94-75-7	7.00e-02 (9)	7.00e+00	7.00e+00	2.74e+03	2.04e+04
Dichloropropane (1,2)	78-87-5	5.00e-03 (9)	5.00e-01	5.00e-01	6.88e-01 (13)	8.43e-01 (13)
Dieldrin	60-57-1	5.32e-06	5.32e-04	1.79e-03	4.00e-02	3.57e-01
Diethyl phthalate	84-66-2	2.92e+01	2.92e+03	8.18e+03	2.20e+05	NNNB (16)
Diethylhexyl adipate	103-23-1	5.00e-01 (9)	5.00e+01	5.00e+01	5.34e+03	4.77e+04
Dimethoate	60-51-5	7.30e-03	7.30e-01	2.04e+00	5.49e+01	4.09e+02
Dimethyl phenol, 2,4-	105-67-9	7.30e-01	7.30e+01	2.04e+02	5.49e+03	4.09e+04
Dinitrobenzene, 1,3-	99-65-0	3.65e-03	3.65e-01	1.02e+00	2.74e+01	2.04e+02
Dinitrophenol, 2,4-	51-28-5	7.30e-02	7.30e+00	2.04e+01	5.49e+02	4.09e+03
Dioxane (1,4)	123-91-1	7.74e-03	7.74e-01	2.60e+00	1.55e+01 (13)	2.31e+01 (13)
Diphenylamine	122-39-4	9.13e-01	9.13e+01	2.56e+02	6.86e+03	5.11e+04
Diphenylhydrizine, 1,2-	122-66-7	1.06e-04	1.06e-02	3.58e-02	8.00e-01	7.15e+00
Disulfoton	298-04-4	1.46e-03	1.46e-01	4.09e-01	1.10e+01	8.18e+01
Endosulfan	115-29-7	1.83e-03	1.83e-01	5.11e-01	1.37e+01	1.02e+02

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Endothall	145-73-3	1.00e-01 (9)	1.00e+01	1.00e+01	5.49e+03	4.09e+04
Endrin	72-20-8	2.00e-03 (9)	2.00e-01	2.00e-01	8.23e+01	6.13e+02
Ethoxy ethanol, 2-	110-80-5	1.46e+01	1.46e+03	4.09e+03	1.10e+05	8.17e+05
Ethoxyethanol acetate, 2-	111-15-9	1.10e+01	1.10e+03	3.07e+03	8.23e+04	6.13e+05
Ethyl benzene	100-41-4	7.00e-01 (9)	7.00e+01	7.00e+01	1.14e+04 (13)	1.70e+04 (13)
Ethylene dibromide	106-93-4	5.00e-05 (9)	5.00e-03	5.00e-03	7.09e-03 (13)	4.53e-02 (13)
Ethylene glycol	107-21-1	7.30e+01	7.30e+03	2.04e+04	5.49e+05	NNHB (16)
Ethylene oxide	75-21-8	8.35e-05	8.35e-03	2.80e-02	1.11e-01 (13)	1.51e-01 (13)
Fluoranthene	206-44-0	1.46e+00	1.46e+02	4.09e+02	1.10e+04	8.18e+04
Fluorene	86-73-7	1.46e+00	1.46e+02	4.09e+02	9.60e+03 (13)	3.87e+04 (13)
Fluorides	7782-41-4	4.00e+00 (9)	4.00e+02	4.00e+02	1.65e+04	1.23e+05
Formaldehyde	50-00-0	7.30e+00 (12)	7.30e+02	2.04e+03	1.56e+04 (12)	2.04e+05 (12)
Heptachlor	76-44-8	4.00e-04 (9)	4.00e-02	4.00e-02	1.42e-01	1.27e+00
Heptachlor epoxide	1024-57-3	2.00e-04 (9)	2.00e-02	2.00e-02	7.04e-02	6.29e-01
Hexachlorobenzene	118-74-1	1.00e-03 (9)	1.00e-01	1.00e-01	4.00e-01	3.57e+00
Hexachlorobutadiene	87-68-3	1.09e-02	1.09e+00	3.67e+00	8.21e+01	7.33e+02

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Hexachlorocyclohexane, alpha	319-84-6	1.35e-05	1.35e-03	4.54e-03	1.02e-01	9.08e-01
Hexachlorocyclohexane, beta	319-85-7	4.73e-04	4.73e-02	1.59e-01	3.56e+00	3.18e+01
Hexachlorocyclohexane, gama	58-89-9	2.00e-04 (9)	2.00e-02	2.00e-02	8.23e+01	6.13e+02
Hexachloroethane	67-72-1	6.08e-02	6.08e+00	2.04e+01	4.57e+02	4.09e+03
Isobutyl alcohol	78-83-13	1.10e+01	1.10e+03	3.07e+03	8.23e+04	6.13e+05
Lead (inorganic)	7439-92-1	1.50e-02 (9)	1.50e+00	1.50e+00	5.00e+02 (14)	1.00e+03 (14)
Mercury	7439-97-6	2.00e-03 (9)	2.00e-01	2.00e-01	8.23e+01	6.13e+02
Methomyl	16752-77-5	9.13e-01	9.13e+01	2.56e+02	6.86e+03	5.11e+04
Methoxy ethanol	109-86-4	1.46e-01	1.46e+01	4.09e+01	1.10e+03	8.18e+03
Methoxychlor	72-43-5	4.00e-02 (9)	4.00e+00	4.00e+00	1.37e+03	1.02e+04
Methoxyethanol acetate	110-49-6	7.30e-02	7.30e+00	2.04e+01	5.49e+02	4.09e+03
Methyl Ethyl Ketone	78-93-3	1.83e+00	1.83e+02	5.11e+02	7.58e+03 (13)	1.40e+04 (13)
Methyl isobutyl ketone	108-10-1	1.83e+00	1.83e+02	5.11e+02	1.37e+04	1.02e+05
Methyl methacrylate	80-62-6	2.92e+00	2.92e+02	8.18e+02	6.74e+02 (13)	6.63e+02 (13)
Methylene Chloride	75-09-2	5.00e-03 (9)	5.00e-01	5.00e-01	1.07e+01 (13)	1.38e+01 (13)
Naphthalene	91-20-3	1.46e+00	1.46e+02	4.09e+02	4.91e+03 (13)	7.72e+03 (13)

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Nickel	7440-02-0	1.00e-01 (9)	1.00e+01	1.00e+01	1.56e+03 (12)	2.04e+04 (12)
Nitrate	14797-55-8	1.00e+01 (9)	1.00e+03	1.00e+03	4.39e+05	NNNB (16)
Nitrite	14797-65-0	1.00e+00 (9)	1.00e+02	1.00e+02	2.74e+04	2.04e+05
Nitrobenzene	98-95-3	1.83e-02	1.83e+00	5.11e+00	6.48e+01 (13)	1.06e+02 (13)
Nitroso-methyl-ethyl-amine, n-	10595-95-6	3.87e-06	3.87e-04	1.30e-03	2.91e-02	2.60e-01
Nitrosodi-n-propylamine, n-	621-64-7	1.22e-05	1.22e-03	4.09e-03	9.15e-02	8.17e-01
Nitrosodiethylamine, n-	55-18-5	5.68e-07	5.68e-05	1.91e-04	4.27e-03	3.81e-02
Nitrosodimethylamine, n-	62-75-9	1.67e-06	1.67e-04	5.61e-04	1.26e-02	1.12e-01
Nitrosopryyolidine, n-	930-55-2	4.06e-05	4.06e-03	1.36e-02	3.05e-01	2.72e+00
Pentachloronitrobenzene	82-68-8	3.28e-03	3.28e-01	1.10e+00	2.46e+01	2.20e+02
Pentachlorophenol	87-86-5	1.00e-03 (9)	1.00e-01	1.00e-01	5.34e+00	4.77e+01
Phenol	108-95-2	2.19e+01	2.19e+03	6.13e+03	1.65e+05	NNNB (16)
Phthalic anhydride	85-44-9	7.30e+01	7.30e+03	2.04e+04	5.49e+05	NNNB (16)
Polychlorinated biphenyls	1336-36-3	5.00e-04 (9)	5.00e-02	5.00e-02	1.00e+01 (15)	2.50e+01 (15)
Pronamide	23950-58-5	2.74e+00	2.74e+02	7.67e+02	2.06e+04	1.53e+05
Pyrene	129-00-0	1.10e+00	1.10e+02	3.10e+02	8.20e+03	6.10e+04

0013-9211/94/$0+$1.00

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Pyridine	110-86-1	3.65e-02	3.65e+00	1.02e+01	2.74e+02	2.04e+03
Selenium	7782-49-2	5.00e-02 (9)	5.00e+00	5.00e+00	1.37e+03	1.02e+04
Silver	7440-22-4	1.83e-01	1.83e+01	5.11e+01	1.37e+03	1.02e+04
Strychnine	57-24-9	1.10e-02	1.10e+00	3.07e+00	8.23e+01	6.13e+02
Styrene	100-42-5	1.00e-01 (9)	1.00e+01	1.00e+01	2.13e+01	1.91e+02
Tetrachlorobenzene, 1,2,4,5-	95-94-3	1.10e-02	1.10e+00	3.07e+00	8.23e+01	6.13e+02
Tetrachloroethane (1,1,1,2)	630-20-6	3.28e-02	3.28e+00	1.10e+01	4.59e+01 (13)	6.29e+01 (13)
Tetrachloroethane (1,1,2,2)	79-34-5	4.26e-03	4.26e-01	1.43e+00	8.00e+00 (13)	1.17e+01 (13)
Tetrachloroethylene	127-18-4	5.00e-03 (9)	5.00e-01	5.00e-01	7.93e+01 (13)	2.07e+02 (13)
Tetrachlorophenol, 2,3,4,6-	58-90-2	1.10e+00	1.10e+02	3.07e+02	8.23e+03	6.13e+04
Tetraethyl dithiopyrophosphate	3689-24-5	1.83e-02	1.83e+00	5.11e+00	1.37e+02	1.02e+03
Toluene	108-88-3	1.00e+00 (9)	1.00e+02	1.00e+02	3.58e+03 (13)	3.63e+03 (13)
Toxaphene	8001-35-2	3.00e-03 (9)	3.00e-01	3.00e-01	5.82e-01	5.20e+00
TP Silvex, 2,4,5-	93-72-1	5.00e-02 (9)	5.00e+00	5.00e+00	2.20e+03	1.64e+04
Trichlorobenzene (1,2,4)	120-82-1	7.00e-02 (9)	7.00e+00	7.00e+00	6.78e+02 (13)	8.28e+02 (13)
Trichloroethane (1,1,1)	71-55-6	2.00e-01 (9)	2.00e+01	2.00e+01	9.63e+03 (13)	1.40e+04 (13)

CONSTITUENT	CAS #	GW (1-4)	GWP-Res (1,5)	GWP-Ind (1,6)	SAI-Res (1,7, 10,11)	SAI-Ind (1,8, 10,11)
Trichloroethane (1,1,2)	79-00-5	5.00e-03 (9)	5.00e-01	5.00e-01	1.27e+01 (13)	1.62e+01 (13)
Trichloroethylene	79-01-6	5.00e-03 (9)	5.00e-01	5.00e-01	2.40e+00 (13)	2.85e+00 (13)
Trichlorofluoromethane	75-69-4	1.10e+01	1.10e+03	3.07e+03	8.73e+00 (13)	8.36e+00 (13)
Trichlorophenol (2,4,5)	95-95-4	3.65e+00	3.65e+02	1.02e+03	8.08e+03 (13)	1.04e+04 (13)
Trichlorophenol, 2,4,6-	88-06-2	7.74e-03	7.74e-01	2.60e+00	5.82e+01	5.20e+02
Trichlorophenoxyacetic acid, 2,4,5-	93-76-5	3.65e-01	3.65e+01	1.02e+02	2.74e+03	2.04e+04
Trichloropropane, 1,1,2-	598-77-6	1.83e-01	1.83e+01	5.11e+01	1.37e+03	1.02e+04
Trichloropropane, 1,2,3-	96-18-4	2.19e-01	2.19e+01	6.13e+01	1.65e+03	1.23e+04
Trinitrobenzene, 1,3,5-	99-35-4	1.83e-03	1.83e-01	5.11e-01	1.37e+01	1.02e+02
Vinyl acetate	108-05-4	3.65e+01	3.65e+03	1.02e+04	2.74e+05	2.04e+06
Vinyl Chloride	75-01-4	2.00e-03 (9)	2.00e-01	2.00e-01	1.99e-02 (13)	2.41e-02 (13)
Xylene	1330-20-7	1.00e+01 (9)	1.00e+03	1.00e+03	5.47e+03 (13)	5.80e+03 (13)

(1) Concentrations for constituents are expressed in scientific notation. Examples 2.20E-00 = 2.2; 2.20E+02 = 220; and 2.20E-01 = 0.22.

(2) The development of final cleanup levels may involve other factors as described in this subchapter, such as cumulative health effects, that are not considered in this table.

(3) Groundwater concentrations are based on Maximum Contaminant Levels (MCLs) or the formula and parameters for residential use of groundwater which are contained in §335.567 of this title (relating to Appendix I). For non-residential exposure conditions, the groundwater concentrations are calculated using the procedures of §335.559(d)(2) or (3).

(4) For some constituents, the Practical Quantitation Limit (PQL) may be the appropriate Groundwater MSC as described in §335.555(d)(1) of this title. See 40 Code of Federal Regulations, Part 264 (Appendix IX) for a list of groundwater PQLs.

(5) Residential soil groundwater protection concentrations are based on a multiplication factor of 100 times the groundwater MSC.

(6) Industrial soil groundwater protection concentrations are based on a multiplication factor of 100 times the MCL or, when an MCL is not available, a factor of 100 times the groundwater concentration calculated using the formula and parameters which are contained in §335.559(d)(2) or (3) of this title.

(7) Residential soil concentrations (maximum) are calculated using the formula and parameters for residential land use which are contained in §335.567 of this title (relating to Appendix I). The person must also demonstrate that groundwater is protected and that no nuisance conditions exist (§335.559(a)-(h) of this title).

(8) Industrial soil concentrations (maximum) are calculated using the formula and parameters for industrial land use which are contained in §335.567 of this title (relating to Appendix I). The person must also demonstrate that groundwater is protected and that no nuisance conditions exist (§335.559(a)-(h) of this title).

(9) The final, proposed on listed Maximum Contaminant Level (MCL), from Section 141 of the Federal Safe Drinking Water Act. For lead, the Action Level for lead in drinking water is used as the MSC.

(10) All concentrations were calculated using data from the Integrated Risk Information System (IRIS) Chemical Files, or data from the Health Effects Assessment Summary Tables (HEAST), developed by the United States Environmental Protection Agency, Office of Research and Development and Office of Health and Environmental Assessment, Washington, D.C. 20460. The toxicity information, and the MSCs, will be updated as new information becomes available.

(11) In some cases, an oral Reference Dose (RFD) or an oral Slope Factor (SF) was substituted for the inhalation RFD or inhalation SF in calculating MSC. This MSC will be updated when this information becomes available.

(12) The MSCs calculated for this compound are based on noncarcinogenic effects. The following formula was used for calculating the soil MSCs: MSC = [(oral RFD)(Body Weight)(ED)(365 days/yr)]/[(EF)(ED)(IR)(CF)]. For residential soils, the following exposure factors were used: BW = 15 Kg; ED = five years; EF = 350 days/year; IR = 200 mg/day. For industrial soils, the following exposure factors were used; BW = 70 Kg; ED = 25 years; EF = 250 days/year; IR = 100 mg/day. In both cases, the CF is 0.000001 kg/mg. When oral slope factors become available, these MSCs will be revised.

(13) As described in §335.559(e) of this title, the sum of concentrations of the volatile organic compounds in vapor phase in soil shall not exceed 1,000 ppm by weight or volume.

(14) The MSC for lead in soil is based on values calculated by the United States EPA using the Lead Uptake/Biokinetic Model, Version 0.4, which has been developed by the United States EPA Office of Health and Environmental Assessment.

(15) Soil MSCs for polychlorinated biphenyls are based upon the April 2, 1987 TSCA regulations, 40 Code of Federal Regulation, §761.125 (see 52 FR 10688).

(16) NHHB = Not Human Health Based. The SAI-Ind MSC for this compound exceeds 10e+6 ppm, which means it is not toxic to humans when exposed to soils under these assumptions. Persons must consider other criteria of §335.559 of this title (relating to Medium Specific Requirements and Adjustments for Risk Reduction Standards Number 2) to develop numeric cleanup values.

§335.569. Appendix III

MODEL DEED CERTIFICATION LANGUAGE

STATE OF TEXAS (_____) COUNTY

INDUSTRIAL SOLID WASTE

CERTIFICATION OF REMEDIATION

KNOW ALL MEN BY THESE PRESENTS THAT: Pursuant to the Rules of the Texas Water Commission pertaining to Industrial Solid Waste Management, this document is hereby filed in the Deed Records of _____County, Texas in compliance with the recordation requirements of said rules:

I

(Company Name) has performed a remediation of the land described herein. A copy of the Notice of Registration (No.), including a description of the facility, is attached hereto and is made part of this filing. A list of the known waste constituents, including known concentrations (i.e., soil and ground water, if applicable), which have been left in place is attached hereto and is made part of this filing. Further information concerning this matter may be found by an examination of company records or in the Notice of Registration (No.) files. which are available for inspection upon request at the central office of the Texas Water Commission in Austin. The Texas Water Commission derives its authority to review the remediation of this tract of land from the Texas Solid Waste Disposal Act, §361.002, Texas Health and Safety Code, Chapter 361, which enables the Texas Water Commission to promulgate closure and remediation standards to safeguard the health, welfare and physical property of the people of the State and to protect the environment by controlling the management of solid waste. In addition, pursuant to the Texas Water Code, §5.012 and §5.013, Texas Water Code, Annotated, Chapter 5, the Texas Water Commission is given primary responsibility for implementing the laws of the State of Texas relating to water and shall adopt any rules necessary to carry out its powers and duties under the Texas Water Code. In accordance with this authority, the Texas Water Commission requires certain persons to provide certification and/or recordation in the real property records to notify the public of the conditions of the land and/or the occurrance of remediation. This deed certification is not a representation or warranty by

the Texas Water Commission of the suitability of this land for any purpose, nor does it constitute any guarantee by the Texas Water Commission that the remediation standards specified in this certification have been met by (Company name).

II

Being a _____ acre tract, more or less, out of the (Company Name)'s _____ acre tract in the (Name) League (No.), Abstract (No.), recorded in Volume (No.), Page (No.) of the Deed of Records _____ County, Texas, said _____ acre tract being more particularly described as follows: (Insert metes and bounds description here) For Standard 2 cleanups: (Contaminants/contaminants and waste) deposited hereon have been remediated (to meet residential soil criteria/to meet non-residental (i.e., industrial/commercial) soil criteria)), in accordance with a plan designed to meet the Texas Water Commission's requirements in 31 Texas Administrative Code, §335.555), which mandates that the remedy be designed to eliminate substantial present and future risk such that no post-closure care or engineering or institutional control measures are required to protect human health and the environment. Future land use is considered suitable for (residential, non-residential (i.e., industrial/commercial)) purposes in accordance with risk reduction standards applicable at the time of this filing. Future land use is intended to be (residential, non-residential).

For Standard 3 cleanups: (Contaminants/contaminants and waste) deposited hereon have been remediated (to meet residential soil critiera/to meet non-residential (i.e., industrial/commercial) soil criteria) in accordance with a plan designed to meet the requirements of 31 Texas Administrative Code §335.561 (Risk Reduction Standard Number 3), which mandates that the remedy be designed to eliminate or reduce to the maximum extent practicable, substantial present or future risk. The remediation plan (does/does not) require continued post-closure care or engineering or institutional control measures. Future use of the property is considered appropriate for (describe) in accordance with risk reduction standards applicable at the time of this filing. Institutional or legal controls placed on the property to ensure appropriate future use include (describe).

For both Standard 2 and 3 cleanups where the remedy is based upon non-residential soil criteria: The current or future owner must undertake actions as necessary to protect human health or the environment in accordance with the rules of the Texas Water Commission.

III

The owner of the site is (Company Name), a Texas corporation, and its address is (P.O. Box or Street), (City), Texas (Zip Code), where more specific information may be obtained from the (plant manager, owner).

EXECUTED this the _____ day of _____, 19__.

(Company name)

a Texas corporation

_____

(Name)

Plant Manager

STATE OF TEXAS

(_____) COUNTY

BEFORE ME, on this the _____ day of _____, personally appeared (Name, (Plant Manager, Owner) of (company Name), a Texas corporation, known to me to be the person and agent of said corporation whose name is subscribed to the foregoing instrument, and he acknowledged to me that he executed the same for the purposes and in the capacity therein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the _____ day of _____, 19__.

_____

Notary Public in and for the State of Texas, County of

_____

My Commission Expires

_____

269285

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

269289

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE