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**NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
TEXAS**

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INSTALLATION RESTORATION PROGRAM (IRP)
BASEWIDE QUARTERLY GROUND-WATER MONITORING
SECOND SEMIANNUAL REPORT

VOLUME 1: REPORT

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

June 1996

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

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FINAL

**INSTALLATION RESTORATION PROGRAM (IRP)
BASEWIDE QUARTERLY GROUND-WATER MONITORING
DRAFT SECOND SEMIANNUAL REPORT**

FOR

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

JUNE 1996

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center for Environmental Excellence
ARAR	applicable or relevant and appropriate requirement
BTEX	benzene, toluene, ethylbenzene, xylenes
CAD	computer aided drafting
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cis-1,2-DCE	cis-1,2-dichloroethene
DNAPL	dense, nonaqueous phase liquid
EDD	electronic data deliverable
gpd/ft	gallons per day per foot
gpm	gallons per minute
IDW	investigation derived waste
IRP	Installation Restoration Program
LAW	Law Environmental, Inc.
LCS	Laboratory Control Sample
LENL-P	Law Environmental, Inc., National Laboratories - Pensacola
LIMS	laboratory information management system
LNAPL	light, nonaqueous phase liquid
MCL	maximum contaminant level
MDL	method detection limit
MS/MSD	matrix spike/matrix spike duplicate
MSC	medium-specific concentration
msl	mean sea level
NAS	Naval Air Station
NCP	National Contingency Plan
PID	Photoionization Detector

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

POL	petroleum, oils, and lubricants
PVC	polyvinyl chloride
PQL	Practical Quantitation Limit
QA/QC	quality assurance/quality control
RPD	relative percent difference
SARA	Superfund Amendments and Reauthorization Act of 1986
SOP	standard operating procedures
SWMU	Solid Waste Management Unit
TCE	trichloroethene
TNRCC	Texas Natural Resource Conservation Commission
TOC	top of casing
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
WBV	well bore volumes
µg/L	micrograms per liter

EXECUTIVE SUMMARY

Quarterly ground-water sampling was conducted at NAS Fort Worth in April, July, and October of 1995 and January of 1996. Seventy monitoring wells were included in the investigation. The objective of the program was to determine the configuration of the ground-water potentiometric surface, to assess variations of the ground-water flow directions, and to assess the extent of previously identified constituents of concern in the ground water on a basewide scale.

As part of the field sampling procedures, water level measurements were collected each quarter over a three-day period in an effort to provide representative ground-water elevations. Ground-water samples were collected and shipped to an off-site laboratory for analysis. The analytical data were evaluated and compared to quality control criteria. Overall, the data quality was sufficient to identify the nature of contamination at the monitoring wells sampled. The samples collected were considered to be representative of the ground water at the sampling locations. The ground-water elevation data were used in development of maps as a means of depicting the ground-water surface during each of the four quarterly sampling events.

Based on the distribution of the monitoring wells, the ground-water flow was determined for four zones present on the base. The direction of ground-water flow is from southwest to northeast in the southwestern corner of the study area; from west to east in the north-central, south-central, and eastern portions of the study area; and from northwest to southeast in the southeastern portion of the study area. There is insufficient information to determine the ground-water flow direction in the northern portion of the study area.

In general, ground-water elevations dropped steadily between the first quarter (April 1995) and the fourth quarter (January 1996) sampling episodes. The greatest fluctuations were measured in the wells located along the eastern boundary of the site (along the West Fork Trinity River) and in the area of Landfills 4 and 5 in the southwest quadrant of the base. Fluctuations in these areas were generally 3 to 5 feet from the first to the fourth quarter, with the maximum fluctuation of 5.97 feet in well MW-12.

Ground-water samples were analyzed for volatile organic compounds, semi-volatile organic compounds, total metals, and pesticides/PCBs. A single sample required pesticide/PCB analysis. The concentrations of constituents detected were compared to the USEPA Maximum Contaminant Levels and the TNRCC Medium-Specific Concentrations. The extent of contamination of volatile and semi-volatile organic constituents was evaluated based on the presence of these constituents above the quantitation limit. Metals results were only compared to MSC values pending the results of the basewide background study.

Constituents of concern detected on the base consisted primarily of metals and the volatile organic compounds trichloroethene, cis-1,2-dichloroethene, and BTEX. Basewide trends were not apparent due to the lack of monitoring well data for some areas of the base.

The highest concentration of trichloroethene and cis-1,2-dichloroethene were reported from monitoring wells in the vicinity of Landfills 4 and 5. BTEX constituents were detected in the vicinity of the POL Tank Farm, the Base Service Station, Building 1628, and Landfills 4 and 5. Other volatile organic compounds reported with concentrations exceeding MSC values include: tetrachloroethene, vinyl chloride, styrene, and methylene chloride. However, methylene chloride was not considered a constituent of concern because there was no further methylene chloride detections after the second quarter.

Total lead was detected primarily in monitoring wells located in the area of the POL Tank Farm and Building 1628. Other metals reported with concentrations exceeding MSC values include: arsenic, barium, beryllium, cadmium, chromium, nickel, and silver.

Although bis(2-ethylhexyl)phthalate was detected above its MSC value, the data reported may be the result of random phthalate contamination from the field or the laboratory. There were no detections of pesticides or PCBs in monitoring well OT15C, which was the only well sampled for pesticides/PCBs.

Data interpretation was limited by incomplete survey data, non-strategic location of existing monitoring wells, and the absence of comprehensive background data. Additional data will soon be available from a recently completed survey of all monitoring wells on the base. We recommend the substitution of additional existing monitoring wells and/or installation of new wells prior to subsequent sampling events. We also recommend evaluation of ground-water data using information from the background study which is planned for later this year.

1.0 INTRODUCTION

Law Environmental, Inc., (LAW) was contracted by the U.S. Air Force (USAF) Center for Environmental Excellence (AFCEE) to perform basewide quarterly ground-water monitoring at the Naval Air Station Fort Worth Joint Reserve Base, Carswell Field, Fort Worth, Texas (NAS Fort Worth). The work was conducted in conjunction with the Installation Restoration Program (IRP). This report summarizes the third and fourth of four scheduled quarterly characterization efforts and includes 70 existing monitoring well locations. The objective was to determine the configuration of the ground-water potentiometric surface, to assess variations of the ground-water flow directions, and to assess the extent of previously identified constituents of concern in the ground water on a basewide scale.

This report applies to sampling events conducted in October 1995 and January 1996. Well locations and analytical methods were selected by AFCEE based on the "Site-Specific Ground-Water Analyses Letter Report, Basewide Well Monitoring" (LAW, 1995b), dated March 10, 1995. Well locations were selectively modified by AFCEE based on results of earlier events.

The references used in this report are listed in Appendix A. The AFCEE Statement of Work for Basewide Well Monitoring at Carswell Air Force Base (AFB), Texas is included in Appendix B.

1.1 THE AIR FORCE INSTALLATION RESTORATION PROGRAM

The USAF IRP is designed to identify, confirm/quantify, and remediate problems caused by past management of hazardous wastes at Air Force facilities. The IRP serves as 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), as augmented and amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

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

1.2 INSTALLATION DESCRIPTION

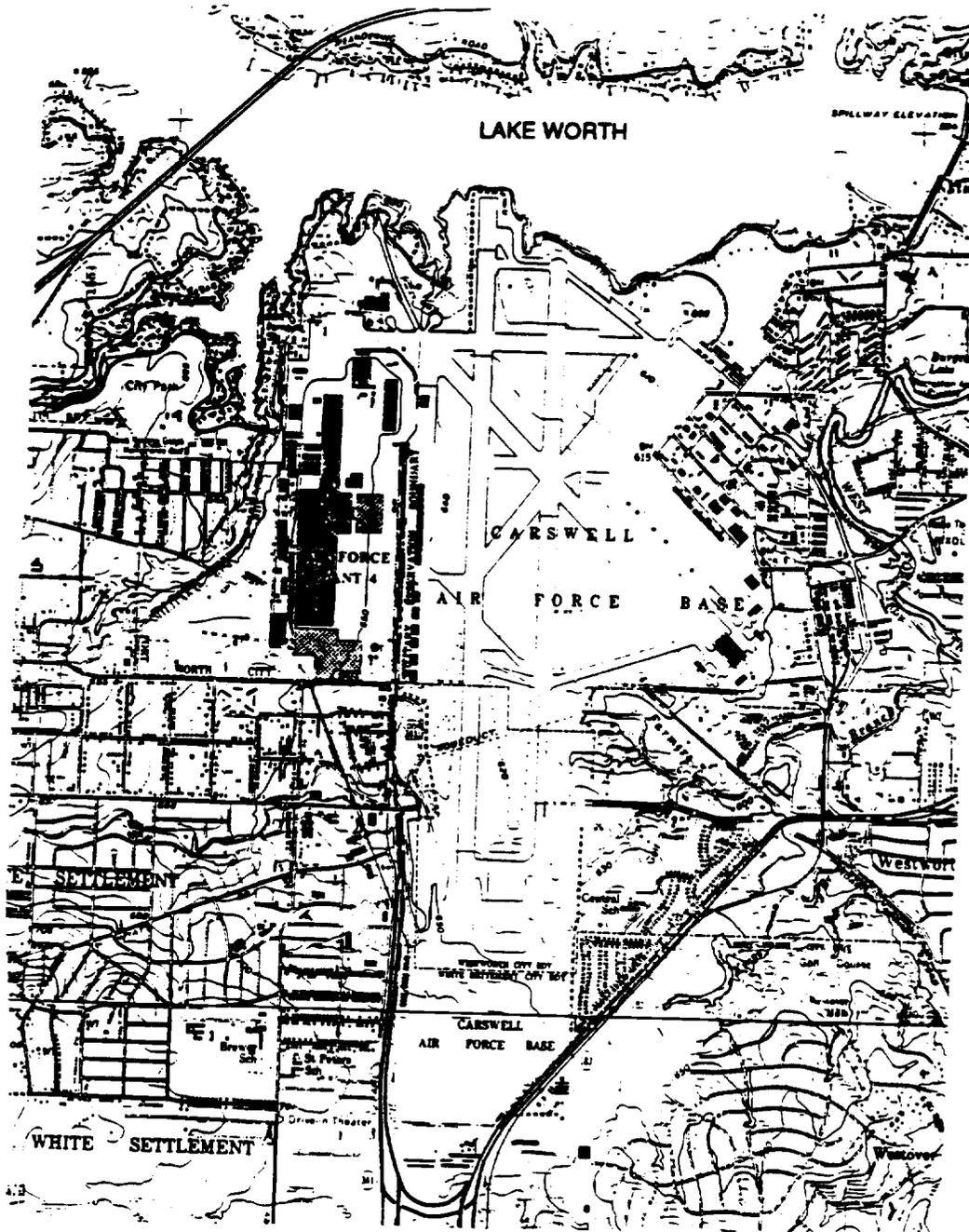
NAS Fort Worth is located in Tarrant County, Texas, approximately 6 miles west of Fort Worth, Texas (Figure 1-1). (Please note that all figures are included in Volume II of this report.) The base covers approximately 25,000 acres and includes a flightline area; operations buildings; warehouses; petroleum, 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 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.

Carswell AFB began operations in 1942 and was operated by the Air Force as a Strategic Air Command Base. The base is currently undergoing realignment to become a joint reserve base.

The following discussion of the NAS Fort Worth environmental setting is derived primarily from the Installation Restoration Program 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) (USACE, 1991) and Radian Corporation (Radian, 1986; 1991a).

1.2.1 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



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

SITE
VICINITY MAP

PREPARED/DATE: TM 8 NOV 94
CHECKED/DATE: JFD
APPROVED BY: EFS

FIGURE
NUMBER:
1-1

FILE DATE: N/A
PLOT DATE: N/A
FILE NAME: CP

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

Worth is within the Western Cross Timbers Physiographic Province which is characterized by rolling topography and a heavy growth of post and blackjack oaks. 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.

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

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.

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 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.

1.2.4 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-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.

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.

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.

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.

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/ft² (based on an approximate thickness for the aquifer of 100 ft). Well yields from the Paluxy aquifer range from 10 to 480 gallons per minute (gpm) averaging approximately 100 gpm.

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.

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.

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 and 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.

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/ft², with an average of 68 gpd/ft².

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.

1.2.5 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.

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.

1.2.6 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.

The average annual temperature for NAS Fort Worth during calendar year 1995 was 66 degrees Fahrenheit and monthly mean temperatures varied from 48 degrees Fahrenheit in January to 86 degrees Fahrenheit in July (Table 1-1). The average daily minimum temperature in January was 38 degrees Fahrenheit and the lowest recorded temperature was 18 degrees Fahrenheit. The average daily maximum temperature was 97 degrees Fahrenheit in July and the highest temperature recorded at the base was 107 degrees on July 28. Freezing temperatures occurred at NAS Fort Worth on 34 days during the year.

The annual precipitation recorded at NAS Fort Worth during 1995 was 31.4 inches. The wettest month was May, with a secondary maximum in July. The period from October to February was generally dry with a secondary minimum in August. Snowfall accounted for a very small percentage of the total precipitation between January and March, with only a trace of snowfall in the months of January, February, March, and November. Lake evaporation at NAS Fort Worth is estimated to be approximately 57 inches per year. Evapotranspiration over land areas may be greater or less than lake evaporation depending on vegetative cover type and moisture availability. Average net precipitation is expected to be equal to the difference between average total precipitation and average lake evaporation, or approximately minus 26 inches during 1995.

Thunderstorm activity occurred at NAS Fort Worth on 61 days during 1995. The greatest number of these storms occurred between March and July. The maximum precipitation recorded in a 24-hour period was 2.14 inches on May 5.

TABLE 1-1

METEOROLOGICAL DATA SUMMARY - 1995
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
TEMPERATURE (°F)													
Mean	48	52	55	64	72	78	86	85	79	69	56	49	66
Average Daily Maximum	58	64	66	75	83	89	97	96	87	82	69	59	77
Average Daily Minimum	38	41	46	53	64	68	75	75	68	57	43	39	56
Highest Recorded	80	84	96	87	91	96	107	104	103	90	85	81	107
Lowest Recorded	25	28	23	39	49	57	63	72	48	46	30	18	18
PRECIPITATION (inches)													
Total Monthly	1.92	0.51	4.36	3.10	6.43	2.30	4.80	1.96	3.08	1.29	0.40	1.26	31.41
Maximum in 24 Hours	0.79	0.22	1.57	1.04	2.14	1.51	2.13	0.91	1.44	1.02	0.27	0.7	2.14
Minimum in 24 Hours	0	0	0	0	0	0	0	0	0	0	0	0	0
Days with Thunderstorms	4	2	7	6	10	7	8	6	6	2	1	2	61
SNOWFALL (inches)													
Mean	(a)	(a)	(a)	0	0	0	0	0	0	0	(a)	0	(a)
Maximum Monthly	(a)	(a)	(a)	0	0	0	0	0	0	0	(a)	0	(a)
Maximum in 24 hours	(a)	(a)	(a)	0	0	0	0	0	0	0	(a)	0	(a)
SURFACE WINDS (knots)													
Mean	9	9	9	10	10	8	8	6	7	8	8	8	8
Maximum	30	30	38	36	38	32	34	26	29	38	44	27	44

Source: United States Air Force, Carswell AFB, Texas. Period of Record: January 1 - December 31, 1995.
(a) = Less than 1/10 inch.

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Mean cloud cover averages 50 percent at NAS Fort Worth with clear weather occurring frequently during all months. Some fog is present on an average of 83 days per year. Wind speed averaged 8 knots during 1995, with a maximum of 44 knots recorded on November 10. Wind direction is predominantly from the south during all months.

1.3 REMEDIAL ACTIONS

A Phase I Records Search study was conducted to identify past waste disposal activities at NAS Fort Worth which may have caused environmental contamination and the migration of contaminants off of the base (CH2M Hill, 1984). After ranking each site for potential adverse environmental effects, further investigation was recommended for 11 sites on the base and the Weapons Storage Area west of the base.

The 12 sites were investigated in the Phase II Stage 1 confirmation and quantification study (Radian, 1986). These sites include landfills, fire department training areas, industrial areas, and spills. The on-base sites were concentrated in two areas, the Flightline Area and the East Area (Figure 1-2). The Phase II Stage 1 investigation was intended to determine the effect of past waste disposal activities at NAS Fort Worth including the magnitude and extent of contamination and its potential for further migration.

A Phase II Stage 2 Remedial Investigation was conducted to further detail the extent of existing contamination in the East Area (Radian, 1991a). This study focused on the hydrogeology and ground-water quality at Landfill 1, Unnamed Stream, POL Tank Farm, and the Base Service Station.

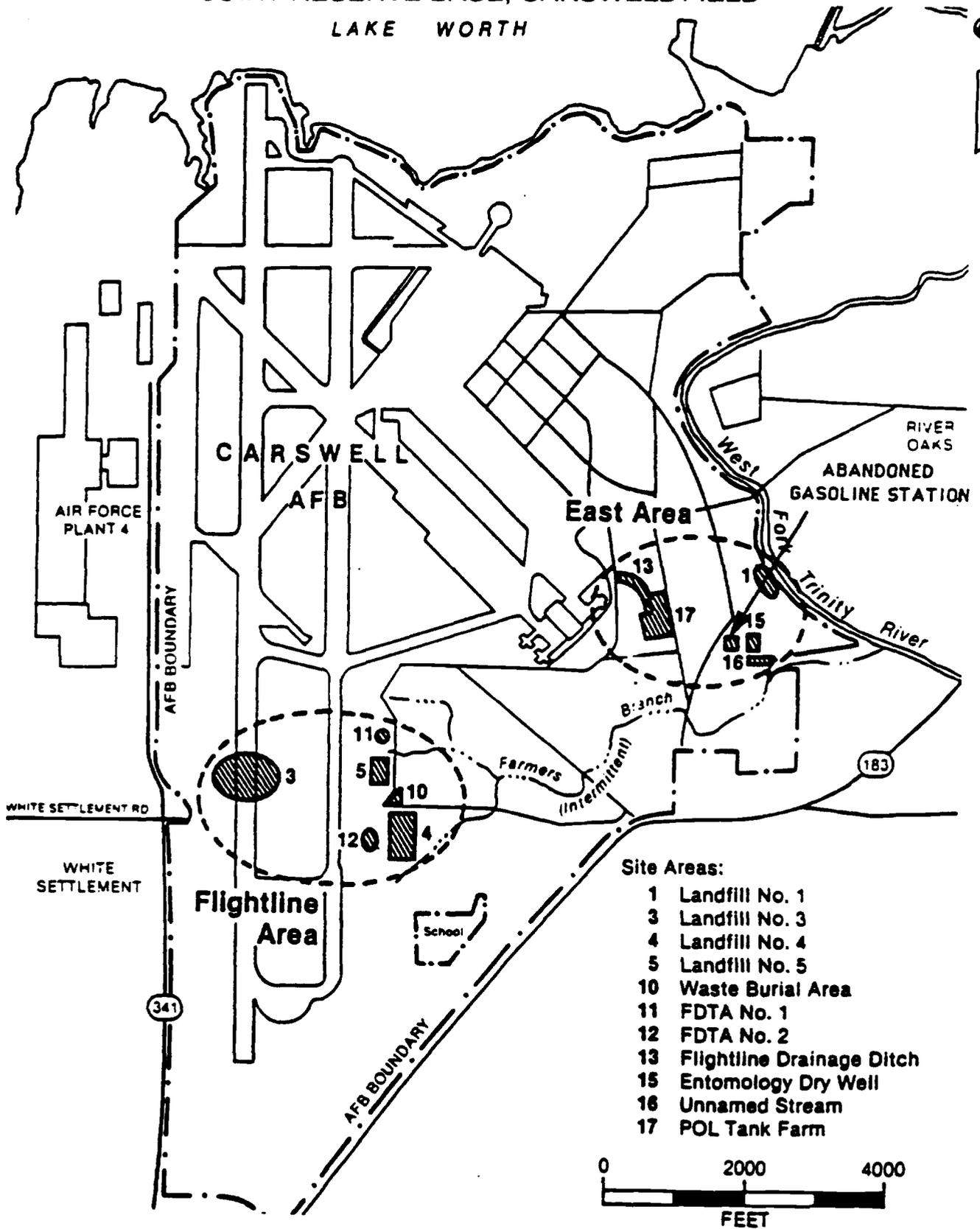
Data from Radian's 1991 Remedial Investigation were used in the selection of alternatives in a Feasibility Study conducted for 22 sites suspected of containing hazardous waste. Sites classed in Category II (requiring additional monitoring or work to assess the extent of current or future contamination) included the POL Tank Farm and the Unnamed Stream (Radian, 1991b).

LOCATION OF PHASE II, STAGE 1 SITES

(AFTER RADIAN, 1986)

NAVAL AIR STATION FORT WORTH
JOINT RESERVE BASE, CARSWELL FIELD

LAKE WORTH



- Site Areas:**
- 1 Landfill No. 1
 - 3 Landfill No. 3
 - 4 Landfill No. 4
 - 5 Landfill No. 5
 - 10 Waste Burial Area
 - 11 FDTA No. 1
 - 12 FDTA No. 2
 - 13 Flightline Drainage Ditch
 - 15 Entomology Dry Well
 - 16 Unnamed Stream
 - 17 POL Tank Farm

A non-IRP investigation was conducted prior to construction at Building 1337-White House Communication, to determine if pesticide contamination posed an environmental concern (Maxim, 1991). No significant pesticide contamination was detected in the soil or ground water at that time; however, evidence of fuel-related contamination was detected in soil samples from two soil borings at this location.

A pilot test/treatability study has been recently completed by Engineering-Science, Inc., (ES, 1993) at the POL Tank Farm site to test the effectiveness of bioventing on the petroleum impacted soil.

Engineering-Science is in the process of modeling ground-water contamination at the POL Tank Farm area to evaluate if soil contamination is entering the ground water and to evaluate the risk of exposure from ground water in the area (ES, 1994).

International Technology Corporation is currently remediating trichloroethylene (TCE) contamination in the Landfill 4 and Landfill 5 area. The ground-water extraction and treatment system (i.e., recovery well) is designed for the removal of TCE in the uppermost aquifer in the Terrace Alluvium Deposits (IT, 1994).

2.0 PROJECT ACTIVITIES

The following sections describe the project activities conducted as part of the basewide quarterly ground-water monitoring program. The activities include procedures associated with the selection of the monitoring wells located at NAS Fort Worth, and the sampling and analysis of selected monitoring wells as part of the third and fourth quarter sampling events. Field activities, laboratory analysis, and data evaluation for the third and fourth quarter sampling events are described in this section. Project activities carried out during the first and second quarter sampling events were presented in "Basewide Quarterly Ground-Water Monitoring, First Semiannual Report" (LAW, 1996). The work was performed in accordance with the "Final Sampling and Analysis Plan for Basewide Quarterly Ground-Water Monitoring at NAS Fort Worth" (LAW, 1995a).

2.1 PROJECT OBJECTIVES

The objective of the quarterly ground-water sampling and analysis program is to determine the configuration of the ground-water potentiometric surface, to assess variations in the ground-water flow directions, and to assess the extent of previously identified constituents of concern in the ground water on a basewide scale.

2.1.1 Monitoring Well Selection

Monitoring wells were chosen for inclusion in this study based on information gathered from reconnaissance of existing monitoring wells and review of available records to determine the number, location, and likely contaminants present in the wells. The results of the reconnaissance and records search of 82 existing wells were submitted under separate cover as the "Site-Specific Ground-Water Analyses Letter Report, Basewide Well Monitoring" (LAW, 1995b). This information was presented during the March 2 and 3, 1995, On-Board Review Meeting, held at NAS Fort Worth. The final list of 70 monitoring wells and the analytical

parameters to be reported were agreed to by LAW, AFCEE, and the Air Force Base Conversion Agency (AFBCA).

Summary of Well Reconnaissance and Records Search - A reconnaissance of the existing monitoring wells at NAS Fort Worth, was performed between October 26 and 29, 1994. During this survey, 82 monitoring wells were located, observed for visible damage, and a sampling bailer was inserted into each well to verify that ground water could be collected. Monitoring well descriptions are summarized in Appendix C.

LAW's objectives for the monitoring well field reconnaissance were to:

- Locate and identify the monitoring wells.
- Observe and record the visible condition of each monitoring well.
- Measure the depth to ground water and total depth of each well, measure vapors emanating from the wellhead using a photoionization detector (PID) organic vapor analyzer, and check for sediment accumulation at the bottom of the well.
- Obtain a ground-water sample from each well using a bailer and observe any phase separation, difficulty of sample retrieval and turbidity, and measure/record the pH.

The well number on each monitoring well was identified and recorded along with the date and time of the reconnaissance. Accessibility to the well was noted, including overgrowth/vegetation, insect infestation, and the need for flightline clearance.

Information relating to the physical characteristics of each well was recorded, including flush mount/stick up type, amount of stick up, if any, and casing diameter. The visible condition of the grout collar and its ability to block the migration of surface water into the well was noted. Notes were made to indicate the presence of guard posts, an operable lock, vented cap, and dedicated sampling equipment.

An HNu hand-held organic vapor analyzer equipped with a PID was used to detect organic vapors inside the well casing. This measurement was taken immediately after the well cap was removed and prior to the water level measurement. The static water level and total depth of the well was measured using an oil/water interface probe. The probe was also used to determine if the bottom of the well was "soft" or "hard," which indicated whether sediment had collected in the bottom of the well.

Each monitoring well was checked for sampler accessibility using a Teflon bailer. The bailer was 1.66 inches in diameter by 36 inches long with a one-way ball valve. Only one bailer volume of water was removed from each well. Observations recorded included the degree of turbidity in the sample, any phase separation, the general color, and the presence of odors. A pH reading was taken using pH indicator paper.

Types of Data Collected in the Records Search

Information and details concerning well installation and construction procedure were reviewed in documents provided by NAS Fort Worth. Data obtained from the documents are summarized as follows:

- **Well Locations and Groupings** - Maps, tables, and text were reviewed for information on well locations and groupings, whether by IRP Site, Solid Waste Management Unit (SWMU), or facility.
- **Borehole Summary** - Well boring records were reviewed to obtain depth to top of rock, zone of termination (terrace deposits, shallow bedrock or Paluxy Aquifer), and total boring depth.
- **Casing Details (Size, Material, Construction, and Fittings)** - Monitoring well installation diagrams were reviewed for data on well casing materials and construction. Information collected includes casing material, diameter, grade, assembly method (whether glued or threaded joints) and stickup (the distance from ground surface to the top of casing).

- **Screened Interval** - Monitoring well installation diagrams and text summary tables were reviewed to determine screened intervals, referenced to the top of casing.
- **Filter Pack** - Monitoring well installation diagrams were reviewed for the depth of filter pack intervals, referenced to ground surface.
- **Bentonite Seal** - Monitoring well installation diagrams were consulted for bentonite seal intervals, referenced to ground surface.
- **Survey** - Survey information was obtained from text summary tables and monitoring well installation diagrams, and consists of ground surface and reference point elevations. Information was also gathered to verify that each well's reference point was the top of casing (TOC).

The following additional criteria were used in selection of monitoring wells to be included in the basewide ground-water monitoring program:

- **Well Locations and Groupings** - This study does not include wells located on Air Force Plant 4, or within the runway area west of Taxiway 197. Therefore, any wells located in this flightline area were not considered for quarterly sampling. Also, several wells in close proximity to other selected wells were not chosen for the program.
- **Well Protection** - Wells exhibiting evidence of, or susceptibility to, the entry of surface water into the production zone, tampering, and structural damage were not considered for quarterly sampling.
- **Access to Well** - Some wells located in areas of difficult access (due to security or operational constraints) were not evaluated during the field reconnaissance.
- **Product** - The current or past occurrence of measurable free phase product (whether light, nonaqueous phase liquid [LNAPL] or dense, nonaqueous phase liquid [DNAPL]) disqualified a well from quarterly sampling, unless the well was deemed critical to the investigation based on other criteria.
- **Location** - Four monitoring wells were added to the sampling program during the fourth quarter in order to better define the extent of trichloroethene in ground water at Landfill No. 4 and 5. These wells replace four monitoring wells which were not sampled due to unexpected field conditions encountered during the fourth quarter sampling event.

2.2 FIELD ACTIVITIES

The Sampling and Analysis Plan (LAW, 1995a) describes the field activities and procedures which were used during the quarterly ground-water monitoring events. The following activities were performed during each field event:

- Collection of water level measurements to determine ground-water flow direction
- Collection of ground-water samples and transport to laboratory
- Disposal of investigation derived wastes

All field activities were performed by LAW personnel. The chemical analyses were performed by Law Environmental National Laboratories, located in Pensacola, Florida. The following sections describe the chronology and methodology of the field activities, Quality Assurance/Quality Control (QA/QC) procedures, and investigation derived waste (IDW) management for the third and fourth quarter sampling events at NAS Fort Worth.

2.2.1 Field Program for the Third Quarter Sampling Event

The objectives of the field activities were to perform quarterly monitoring of 70 basewide monitoring wells at NAS Fort Worth in order to achieve the following:

- Establish ground-water flow directions by collecting ground-water level measurements
- Assess the extent of previously identified constituents of concern in the ground water on a basewide scale through ground-water sampling and analysis

At the completion of each field event, documentation was evaluated to assess the success of the sampling effort. Lessons learned and corrective actions for subsequent field efforts are discussed in the following sections.

2.2.1.1 Water Level Measurements - Water level measurements were recorded for each monitoring well using an electronic interface probe. The measurements were taken during the first three days of the sampling event, prior to purging and sampling the wells, in order to obtain representative ground-water elevations at a point in time. Water level measurements were not recorded at this time for WP07-10C due to an obstruction in the well. During the field effort, a bailer was retrieved from the well and the well was sampled as planned. Monitoring well GMI22-01M could not be located due to construction activities at that location. Table 2-1 presents the water level measurements and ground-water elevations for the third quarter sampling event.

2.2.1.2 Ground-Water Sampling - The following sampling protocol was followed:

1. **Floating Hydrocarbon and Static Water Level Measurement** - An electronic interface probe was used to test for the presence of floating product and to measure the static water level. The probe was decontaminated before and after each measurement to minimize the potential for cross-contamination between wells.
2. **Monitoring Well Purging** - The wells were purged using a stainless steel Grundfos pump until the water quality parameters (pH, specific conductance, and temperature) were stabilized and a minimum of three well bore volumes (WBV) had been removed. Stabilization of the parameters was defined as: pH within plus or minus 0.1 pH units, specific conductance within 5 percent, and temperature within plus or minus 1 degree Celsius over consecutive readings. The pH, temperature and specific conductance were measured and recorded at the initiation of purging, after each WBV, and after collection of the samples. If the well was purged to dryness before the removal of 3 WBVs, the volume removed was recorded and the well was allowed to recharge before collection of the sample.

TABLE 2-1

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SUMMARY OF GROUND-WATER LEVELS AND ELEVATIONS FOR THIRD QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

Monitoring Well	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft. msl)	Quarter 3 (October 1995)	
				Ground-Water Level (ft)	Ground-Water Elevation (ft)
LF01-1A	6964379.79	2301262.30	570.27	16.63	553.64
LF01-1C	6964570.37	2301174.14	560	19.4	540.6
LF01-1D	6964260.11	2301399.35	563.93	20.67	543.26
LF01-1E	6964710.02	2301098.23	562.25	18.91	543.34
LF04-4A	6960309.58	2295843.39	625.76	14.13	611.63
LF04-4B	6960344.86	2296285.37	619.9	21.34	598.56
LF04-4D	6960738.32	2296412.03	615.35	20.49	594.86
LF04-4E	6961012.29	2296410.62	618.54	23.72	594.82
LF04-4F	6961077.24	2296017.27	625.36	29.33	596.03
LF05-5C	6961716.52	2295987.93	608.68	11.35	597.33
LF05-5D	6961728.69	2295786.58	611.71	12.87	598.84
LF05-5G	6961607.55	2296622.04	615.39	21.1	594.29
WP07-10B	6961320.67	2296039.46	624.46	27.82	596.64
WP07-10C	6961551.78	2296048.17	617.24	NA	--
FT08-11A	6962330.04	2295898.98	608.22	12.66	595.56
FT08-11B	6962046.37	2295940.03	608.14	9.88	598.26
FT09-12A	6960568.13	2295413.09	635.66	17.87	617.79
FT09-12B	6960750.89	2295646.43	627.55	30.72	596.83
FT09-12C	6960642.28	2295709.68	628.05	31.65	596.4
SD13-01	6963365.39	2300590.43	573.24	13.21	560.03
SD13-02	6963471.4	2300634.34	573.39	15.23	558.16
SD13-03	6963353.03	2300673.84	571.54	12.08	559.46
SD13-05	6963890.4	2300754.46	571.4	9.73	561.67
SD13-06	6963183.34	2300951.06	557.66	12.21	545.45
SD13-07	6963200.73	2301022.29	556.3	18.23	538.07
ST14-01	6963286.05	2300092.59	575.89	14.43	561.46
ST14-02	6963520.58	2300063.60	575.64	12.73	562.91
ST14-03	6963830.32	2300017.03	576.6	10.56	566.04
ST14-04	6963661.85	2300334.72	575.74	13.24	562.5
ST14-W05 *	6963734.09	2299085.40	593.75	8.67	585.08
ST14-W06 *	6963806.74	2299323.48	581.33	11.53	569.8
ST14-W07 *	6963600.96	2299371.50	579.98	12.96	567.02
ST14-W08 *	6964290.1	2299504.71	580.43	11.56	568.87
ST14-W09 *	6963444.97	2299531.70	575.51	9.46	566.05
ST14-W11 *	6964102.84	2299619.94	576.21	8.8	567.41
ST14-W13 *	6963827.31	2299719.71	574.35	9.44	564.91
ST14-W15 *	6963292.25	2299899.35	573.35	10.95	562.4
ST14-W16 *	6964189.71	2300093.65	573.46	8.91	564.55

SUMMARY OF GROUND-WATER LEVELS AND ELEVATIONS FOR THIRD QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

Monitoring Well	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft. msl)	Quarter 3 (October 1995)	
				Ground-Water Level (ft)	Ground-Water Elevation (ft)
ST14-W19 *	6963724.05	2300183.16	573.11	10.25	562.86
ST14-W20 *	6963983.62	2300288.82	573.44	9.55	563.89
ST14-W21 *	6963323.75	2300221.00	572.76	10.97	561.79
ST14-W22 *	6963743.94	2300972.45	571.16	10.63	560.53
ST14-W23 *	6962939.39	2300316.91	564.97	7.27	557.7
OT15C	6963421.07	2300982.78	567.87	8.77	559.1
P3A	6970359.08	2297661.10	604.77	11.91	592.86
P6A	6960114.88	2295214.14	632.45	11.78	620.67
T3	6968697.5	2300582.55	575.11	4.28	570.83
T4A	6963623.58	2297567.60	606.49	18.2	588.29
T7	6968757.3	2299167.55	604.88	18.46	586.42
MW-5	6965793.95	2300138.54	563.9	5.08	558.82
MW-7	6966018.4	2300064.16	567.88	8.59	559.29
MW-8	6965549.32	2300407.23	556.91	8.76	548.15
MW-9	6965991.2	2300348.98	560.3	10.75	549.55
MW-10	6965908.63	2300460.96	559.53	14.5	545.03
MW-11	6965699.44	2300762.94	558.9	26.74	532.16
MW-12	6966165.08	2300102.06	560.38	9.97	550.41
LSA1628-1	6967935	2297798.40	601.67	9.85	591.82
LSA1628-2	6967957.56	2297868.90	601.93	10.31	591.62
LSA1628-3	6968007.63	2297794.00	601.71	9.92	591.79
BSSA	6965477.12	2300110.37	566.38	5.04	561.34
BSSB	6965775.79	2300068.92	569.73	9.88	559.85
GMI04-01M	6960881.81	2296711.57	NA	19.78	--
GMI22-01M	6965193.71	2297689.70	606.62	NR	--
GMI22-02M	6966618.4	2296162.42	619.19	8.88	610.31
GMI22-03M	6966253.93	2298516.95	607.99	20.52	587.47
GMI22-04M	6967242.46	2297342.02	610.71	19.44	591.27
GMI22-05M	6966966.77	2299409.80	584.36	11.72	572.64
GMI22-06M	6966990.33	2298185.83	606.77	18.27	588.5
GMI22-07M	6969003.09	2298306.26	605.63	15.65	589.98
GMI22-08M	6970349.65	2299013.95	606.92	16.95	589.97

NR = Not recorded

NA = Not available

* Top of casing elevations are based on information provided in September 1995. Other top of casing elevations were submitted in the Basewide Quarterly Ground-Water Monitoring Final Scoping Documents dated March 1995.

Locations are not surveyed and are considered approximate.

PREPARED/DATE: TW 03/26/96

CHECKED/DATE: HAL 03/26/96

Several wells were purged using a dedicated polyvinyl chloride (PVC) bailer. Many of these wells had been previously identified as having slow recoveries or had been purged to dryness in prior sampling episodes. During the third quarter sampling event, the following wells were purged to dryness before three well bore volumes could be removed: FT08-11A, ST14-W21, ST14-W15, SD13-06, MW-5, MW-10, MW-12, GMI22-07M, P6A, LSA1628-1, and LSA1628-2.

In the event free product was detected in the well, pH indicator paper was used to estimate the pH, and specific conductance and temperature were not measured. This precaution was taken to prevent contamination of the testing equipment. The presence of free product was determined based on the presence of strong petroleum odor and a sheen on the purge water.

3. **Sample Collection** - Wells were allowed to recharge to at least 80 percent of the original static water level and sampled using dedicated PVC bailers. Sample containers were filled in decreasing order of sample volatility. Vials collected for analysis of volatile organics were completely filled, leaving no headspace.
4. **Sample Handling** - Samples were collected in pre-labeled, pre-preserved containers. Sample preservation was confirmed in the field. Samples were iced immediately upon collection and remained on ice until receipt by the laboratory. Documentation of sample custody was maintained from the time of collection. A copy of the chain-of-custody records is presented in Appendix D. Samples were shipped by overnight courier on the day of collection.

Field information and measurements were recorded in hard bound field notebooks. Copies of the ground-water sampling reports, included in Appendix E, provide the calculated purge volume and results of the field measurements for each well sampled.

2.2.1.3 **Chronology of Field Work** - The field activities for the third quarter ground-water sampling were performed from October 16 to October 25, 1995. Samples were not collected at GMI22-01M because the well was not accessible due to recent site construction. As a result, this monitoring well was dropped from the sampling program for the third and fourth quarters. No information was available to determine whether the well had been abandoned.

Free product was detected at LSA1628-1 (0.19 ft.) and LSA1628-2 (0.11 ft.). A trace of product was also observed at SD13-07, however the thickness was not measurable using an electronic interface probe. Wells containing free product were purged and samples were collected for chemistry analysis.

Table 2-2 summarizes the monitoring wells sampled during the third quarter field event.

2.2.1.4 Field Quality Assurance/Quality Control - Quality control parameters are monitored through the assessment of data collected for the evaluation of precision, accuracy, representativeness, and completeness. Field quality control activities consisted of the following:

- Calibration of field equipment
- Collection of field duplicate samples and equipment blanks
- Decontamination of field equipment
- Recording of field measurements and duplicate measurements
- Documentation of field information and measurements in hard bound field notebooks
- Review of field documentation, chain of custody records, ground-water sampling reports, and other field records

Daily meetings were conducted by the site manager for the purpose of reviewing the field procedures and quality control activities with the field team. Any corrective actions necessary were discussed, documented, and implemented immediately. Changes to procedures described in the Sampling and Analysis Plan were then discussed with the AFCEE team chief.

2.2.1.5 Lessons Learned - Following this sampling event, the equipment decontamination procedure was evaluated due to the detection of low concentrations of trichloroethene (TCE) at locations where there had been no previous detections (P3A, T3, and T7). No procedural deviations were found. However, it was decided by the site manager that the order in which monitoring wells are sampled would be modified in future sampling events, so that all wells with

TABLE 2-2

THIRD QUARTER SAMPLING DETAIL
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

SAMPLE ID	COMMENT	LOGDATE	LOGTIME	PARAMETER:				NUMBER OR SAMPLES PER PARAMETER
				Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury	
LF01-1A		10/20/95	1405	1	1	0	1	
LF01-1C		10/20/95	1750	1	1	0	1	
LF01-1D		10/17/95	1510	1	1	0	1	
LF01-1E	FDUP-5	10/20/95	1440	1	1	0	1	
LF04-4A		10/17/95	1521	1	1	0	1	
LF04-4B		10/17/95	1750	1	1	0	1	
LF04-4D		10/18/95	1718	1	1	0	1	
LF04-4E	MS/MSD	10/18/95	1556	1	1	0	1	
LF04-4F		10/21/95	1525	1	1	0	1	
LF05-5C		10/19/95	0852	1	1	0	1	
LF05-5D		10/19/95	0945	1	1	0	1	
LF05-5G		10/21/95	1435	1	1	0	1	
FT08-11A		10/19/95	1510	1	1	0	1	
FT08-11B		10/19/95	1130	1	1	0	1	
FT09-12A	FDUP-7	10/18/95	1100	1	1	0	1	
FT09-12B	MS/MSD	10/18/95	1730	1	1	0	1	
FT09-12C		10/18/95	1550	1	1	0	1	
ST14-01		10/18/95	1415	1	1	0	1	
ST14-02		10/21/95	1550	1	1	0	1	
ST14-03		10/18/95	1925	1	1	0	1	
ST14-04		10/21/95	0950	1	1	0	1	

Method:
Container:
Preservative 1:
Preservative 2:

SW 8250
40 mL VOA vials
HCl to pH<2
Cool to 4C

SW8270
1 L amber glass
Cool to 4C
None

SW 8090
1 L amber glass
Cool to 4C
None

ICP, GFAA
and Mercury
SW 6010/7000
1 L polyethylene
HNO₃ to pH<2
Cool to 4C

TABLE 2-2

THIRD QUARTER SAMPLING DETAIL
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

PROJECT: CARSWELL
NUMBER: 11-3517-3201
Matrix: Groundwater

PARAMETER:	Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
Method:	SW 8250	SW 8270	SW 8060	SW 6010/7000
Container:	40 mL VOA vials	1 L amber glass	1 L amber glass	1 L polyethylene
Preservative 1:	HCl to pH<2	Cool to 4C	Cool to 4C	HNO ₃ to pH<2
Preservative 2:	Cool to 4C	None	None	Cool to 4C

NUMBER OF SAMPLES PER PARAMETER

SAMPLING INFORMATION

LOGDATE LOGTIME

SAMPLE ID	COMMENT	LOGDATE	LOGTIME	Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
ST14-W05		10/19/95	1355	1	1	0	1
ST14-W06		10/19/95	1015	1	1	0	1
ST14-W07		10/19/95	0855	1	1	0	1
ST14-W08		10/19/95	1210	1	1	0	1
ST14-W09	MS/MSD	10/18/95	1645	1	1	0	1
ST14-W11		10/20/95	1412	1	1	0	1
ST14-W13		10/20/95	1518	1	1	0	1
ST14-W15		10/20/95	0910	1	1	0	1
ST14-W16	FDUP-6	10/20/95	1010	1	1	0	1
ST14-W19	MS/MSD	10/19/95	1500	1	1	0	1
ST14-W20	FDUP-3	10/20/95	1140	1	1	0	1
ST14-W21		10/21/95	1020	1	1	0	1
ST14-W22		10/21/95	1230	1	1	0	1
ST14-W23		10/17/95	1050	1	1	0	1
BSSA	FDUP-2	10/19/95	1145	1	1	0	1
BSSB		10/17/95	1420	1	1	0	1
MW-5		10/17/95	1605	1	1	0	1
MW-7		10/17/95	1530	1	1	0	1
MW-8	FREE PRODUCT	10/19/95	0900	1	1	0	1
MW-9	FREE PRODUCT	10/19/95	1030	1	1	0	1
MW-10	MS/MSD; FREE PRODUCT	10/19/95	1530	1	1	0	1
MW-11		10/18/95	1410	1	1	0	1
MW-12		10/19/95	1405	1	1	0	1

TABLE 2-2

THIRD QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: CARSWELL
 NUMBER: 11-3517-3201
 Matrix: Groundwater

PARAMETER:	Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
Method:	SW 8250	SW8270	SW 8080	SW 6010/7000
Container:	40 mL VOA vials	1 L amber glass	1 L amber glass	1 L polyethylene
Preservative 1:	HCl to pH<2	Cool to 4C	Cool to 4C	HNO ₃ to pH<2
Preservative 2:	Cool to 4C	None	None	Cool to 4C

SAMPLE ID	COMMENT	NUMBER OF SAMPLES PER PARAMETER			
		LOGDATE	LOGTIME		

GMI04-01M	FDUP-1	10/21/95	1155	1	1	0	1	1
GMI22-01M		No Access to well		1	1	0	1	1
GMI22-02M		10/20/95	1200	1	1	0	1	1
GMI22-03M		10/20/95	0945	1	1	0	1	1
GMI22-04M		10/20/95	1350	1	1	0	1	1
GMI22-05M		10/17/95	1616	1	1	0	1	1
GMI22-06M		10/20/95	0845	1	1	0	1	1
GMI22-07M		10/21/95	1220	1	1	0	1	1
GMI22-08M	MS/MSD	10/20/95	1100	1	1	0	1	1
WP07-10B		10/19/95	1800	1	1	0	1	1
WP07-10C		10/18/95	1150	1	1	0	1	1
OT15C	MS/MSD FDUP-8	10/21/95	1120	1	1	1	1	1

(FDup collected for pesticides)

SD13-01		10/21/95	0938	1	1	0	1	1
SD13-02		10/17/95	1205	1	1	0	1	1
SD13-03	MS/MSD	10/21/95	0850	1	1	0	1	1
SD13-05	FDUP-4	10/23/95	0918	1	1	0	1	1
SD13-06		10/18/95	0915	1	1	0	1	1
SD13-07	FREE PRODUCT	10/17/95	1535	1	1	0	1	1

TABLE 2-2

THIRD QUARTER SAMPLING DETAIL
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

PROJECT: CARSWELL
 NUMBER: 11-3517-3201
 Matrix: Groundwater

SAMPLE ID	COMMENT	PARAMETER:		Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
		Method:	Container:				
		SW 8250	40 mL VOA vials	SW 8250	SW 8080	ICP, GFAA and Mercury	
		Preservative 1:	HCl to pH<2	40 mL VOA vials	1 L amber glass	SW 6010/7000	1 L polyethylene
		Preservative 2:	Cool to 4C	HCl to pH<2	Cool to 4C	HNO ₃ to pH<2	Cool to 4C
				Cool to 4C	None		

SAMPLE INFORMATION
 LOGDATE LOGTIME

SAMPLE ID	COMMENT	PARAMETER:		Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
		Method:	Container:				
P3A		10/21/95	1025	1	1	0	1
T3		10/20/95	0920	1	1	0	1
T4A		10/19/95	1450	1	1	0	1
T7		10/21/95	1210	1	1	0	1
P6A		10/18/95	0900	1	1	0	1
LSA1628-1	Free Product	10/20/95	1520	1	1	0	1
LSA1628-2	Free Product	10/21/95	1600	1	1	0	1
LSA1628-3		10/20/95	1710	1	1	0	1
TB-101795		10/17/95	1615	1	1	0	1
TB-101895		10/18/95	1530	1	1	0	1
TB-101995		10/19/95	1415	1	1	0	1
TB-102095		10/20/95	1620	1	1	0	1
TB-102195		10/21/95	1215	1	1	0	1
FDUP-1	GMI04-01M	10/21/95	0730	1	1	0	1
FDUP-2	BSAA	10/19/95	0730	1	1	0	1
FDUP-3	ST14-W20	10/20/95	0730	1	1	0	1

TABLE 2-2

THIRD QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: CARSWELL
 NUMBER: 11-3517-3201
 Matrix: Groundwater

PARAMETER:	Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
Method:	SW 8230	SW 8270	SW 8060	SW 6010/7000
Container:	40 mL VOA vials	1 L amber glass	1 L amber glass	1 L polyethylene
Preservative 1:	HCl to pH<2	Cool to 4C	Cool to 4C	HNO ₃ to pH<2
Preservative 2:	Cool to 4C	None	None	Cool to 4C

NUMBER OR SAMPLES PER PARAMETER

SAMPLING INFORMATION

SAMPLE ID	COMMENT	SAMPLING INFORMATION		Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
		LOGDATE	LOGTIME				
FDUP-4	SD13-05	10/23/95	0730	1	1	0	1
FDUP-5	LF01-1E	10/20/95	0730	1	1	0	1
FDUP-6	ST14-W16	10/20/95	0730	1	1	0	1
FDUP-7	FT09-12A	10/18/95	0730	1	1	0	1
FDUP-8	OTC15C	10/21/95	0730	1	1	0	1

FDUP = Field duplicate sample

MS/MSD = Matrix spike samples

TB = Trip blank

PREPARED/DATE: SDP 4-2-96

CHECKED/DATE: SDM 4-2-96

non-detect or low concentration TCE would be sampled prior to higher concentration wells. In addition, equipment blanks were planned for the fourth quarter event to monitor the decontamination procedures used to clean the Grundfos pumps used for well purging. Dedicated bailers used for sample collection did not require decontamination.

2.2.2 Field Program for the Fourth Quarter Sampling Event

The field program was carried out following procedures consistent with the third quarter sampling activities, with the following exception:

- The order in which monitoring wells were sampled was based on third quarter TCE concentrations. Monitoring wells with previously non-detect or low concentration TCE were sampled first.

2.2.2.1 Chronology of Field Work - The field activities for the fourth quarter ground-water sampling event were performed from January 8 through January 16, 1996. Table 2-3 presents the fourth quarter water level measurements and ground-water elevations.

Based on recommendations made during the December 1995 Air Force Base Conversion Agency (AFBCA) Base Realignment and Closure (BRAC) Cleanup Team (BCT) meeting, additional wells were substituted in the fourth quarter sampling event in order to better define the TCE plume in the Landfill No. 4 and 5 Areas of the base. Four monitoring wells were added to the sampling program: LF04-04, LF04-10, LF05-2, and LF05-18. Four monitoring wells located in the Unnamed Stream Area were planned for deletion from the monitoring program. However, four other wells (GMI22-01M, GMI04-01M, SD13-07, and LSA1628-1) were identified for deletion from the fourth quarter sampling event based on the following field conditions:

- GMI22-01M was not accessible due to site construction
- GMI04-01M was determined to be dry
- SD13-07 and LSA1628-1 contained free product

SUMMARY OF GROUND-WATER LEVELS AND ELEVATIONS FOR FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

Monitoring Well	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft. msl)	Quarter 4 (January 1996)	
				Ground-Water Level (ft)	Ground-Water Elevation (ft)
LF01-1A	6964379.79	2301262.30	570.27	17.43	552.84
LF01-1C	6964570.37	2301174.14	560	20.24	539.76
LF01-1D	6964260.11	2301399.35	563.93	21.46	542.47
LF01-1E	6964710.02	2301098.23	562.25	19.63	542.62
LF04-4A	6960309.58	2295843.39	625.76	15.34	610.42
LF04-4B	6960344.86	2296285.37	619.9	21.82	598.08
LF04-4D	6960738.32	2296412.03	615.35	20.98	594.37
LF04-4E	6961012.29	2296410.62	618.54	24.25	594.29
LF04-4F	6961077.24	2296017.27	625.36	29.98	595.38
LF04-04	6960945.68	2297131.42	612.07	19.22	592.85
LF04-10	6960463.04	2296995.32	626.54	33.42	593.12
LF05-5C	6961716.52	2295987.93	608.68	11.85	596.83
LF05-5D	6961728.69	2295786.58	611.71	13.81	597.9
LF05-5G	6961607.55	2296622.04	615.39	21.38	594.01
LF05-02	6962758.47	2295369.17	622.69	26.32	596.37
LF05-18	6961648.84	2297058.56	611.84	19.36	592.48
WP07-10B	6961320.67	2296039.46	624.46	28.48	595.98
WP07-10C	6961551.78	2296048.17	617.24	21.08	596.16
FT08-11A	6962330.04	2295898.98	608.22	13.15	595.07
FT08-11B	6962046.37	2295940.03	608.14	10.51	597.63
FT09-12A	6960568.13	2295413.09	635.66	18.64	617.02
FT09-12B	6960750.89	2295646.43	627.55	31.43	596.12
FT09-12C	6960642.28	2295709.68	628.05	32.35	595.7
SD13-01	6963365.39	2300590.43	573.24	13.07	560.17
SD13-02	6963471.4	2300634.34	573.39	15.22	558.17
SD13-03	6963353.03	2300673.84	571.54	11.96	559.58
SD13-05	6963890.4	2300754.46	571.4	9.75	561.65
SD13-06	6963183.34	2300951.06	557.66	10.78	546.88
SD13-07	6963200.73	2301022.29	556.3	17.6	538.7
ST14-01	6963286.05	2300092.59	575.89	14.36	561.53
ST14-02	6963520.58	2300063.60	575.64	12.73	562.91
ST14-03	6963830.32	2300017.03	576.6	10.87	565.73
ST14-04	6963661.85	2300334.72	575.74	13.19	562.55
ST14-W05 *	6963734.09	2299085.40	593.75	9.05	584.7
ST14-W06 *	6963806.74	2299323.48	581.33	13.55	567.78
ST14-W07 *	6963600.96	2299371.50	579.98	13.64	566.34
ST14-W08 *	6964290.1	2299504.71	580.43	11.99	568.44
ST14-W09 *	6963444.97	2299531.70	575.51	9.94	565.57
ST14-W11 *	6964102.84	2299619.94	576.21	8.88	567.33
ST14-W13 *	6963827.31	2299719.71	574.35	9.63	564.72
ST14-W15 *	6963292.25	2299899.35	573.35	10.98	562.37
ST14-W16 *	6964189.71	2300093.65	573.46	9.03	564.43
ST14-W19 *	6963724.05	2300183.16	573.11	10.33	562.78

TABLE 2-3

SUMMARY OF GROUND-WATER LEVELS AND ELEVATIONS FOR FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

Monitoring Well	Northing (ft)	Easting (ft)	Top of Casing Elevation (ft. msl)	Quarter 4 (January 1996)	
				Ground-Water Level (ft)	Ground-Water Elevation (ft)
ST14-W20 *	6963983.62	2300288.82	573.44	9.63	563.81
ST14-W21 *	6963323.75	2300221.00	572.76	10.86	561.9
ST14-W22 *	6963743.94	2300972.45	571.16	10.76	560.4
ST14-W23 *	6962939.39	2300316.91	564.97	6.65	558.32
OT15C	6963421.07	2300982.78	567.87	8.81	559.06
P3A	6970359.08	2297661.10	604.77	11.94	592.83
P6A	6960114.88	2295214.14	632.45	12.57	619.88
T3	6968697.5	2300582.55	575.11	4.36	570.75
T4A	6963623.58	2297567.60	606.49	18.63	587.86
T7	6968757.3	2299167.55	604.88	18.35	586.53
MW-5	6965793.95	2300138.54	563.9	5.05	558.85
MW-7	6966018.4	2300064.16	567.88	8.67	559.21
MW-8	6965549.32	2300407.23	556.91	9.02	547.89
MW-9	6965991.2	2300348.98	560.3	12.02	548.28
MW-10	6965908.63	2300460.96	559.53	15.08	544.45
MW-11	6965699.44	2300762.94	558.9	26.68	532.22
MW-12	6966165.08	2300102.06	560.38	11.4	548.98
LSA1628-1	6967935	2297798.40	601.67	10.36	591.31
LSA1628-2	6967957.56	2297868.90	601.93	10.72	591.21
LSA1628-3	6968007.63	2297794.00	601.71	10.25	591.46
BSSA	6965477.12	2300110.37	566.38	5.29	561.09
BSSB	6965775.79	2300068.92	569.73	9.93	559.8
GMI04-01M	6960881.81	2296711.57	NA	DRY	-
GMI22-01M	6965193.71	2297689.70	606.62	NR	-
GMI22-02M	6966618.4	2296162.42	619.19	9.44	609.75
GMI22-03M	6966253.93	2298516.95	607.99	20.77	587.22
GMI22-04M	6967242.46	2297342.02	610.71	19.84	590.87
GMI22-05M	6966966.77	2299409.80	584.36	11.94	572.42
GMI22-06M	6966990.33	2298185.83	606.77	18.6	588.17
GMI22-07M	6969003.09	2298306.26	605.63	16	589.63
GMI22-08M	6970349.65	2299013.95	606.92	16.9	590.02

NR = Not recorded

NA = Not available

* Top of casing elevations are based on information provided in September 1995. Other top of casing elevations were submitted in the Basewide Quarterly Ground-Water Monitoring Final Scoping Documents dated March 1995.

Locations are not surveyed and are considered approximate.

PREPARED/DATE: TW 03/26/96
 CHECKED/DATE: HAL 03/26/96

Product recovery measurements were taken from the two monitoring wells found to contain free product, based on recommendations made by TNRCC representatives at the January 1996 BCT meeting. In addition, these monitoring wells were sampled for hydrocarbon fingerprint analysis. Because of difficulties in obtaining representative ground-water data when free product is present, no other chemical analyses were performed.

The following separate phase measurements were recorded over a four-day period during the fourth quarter sampling event for the wells containing free product:

<u>Well ID</u>	<u>Date</u>	<u>Time</u>	<u>Separate Phase</u>
SD13-07	01/09/96	1042	0.02 ft.
	01/12/96	1350	Purged
	01/13/96	1510	0.01 ft.
	01/14/96	1510	0.01 ft.
	01/15/96	1500	0.01 ft.
LSA1628-1	01/09/96	1703	0.11 ft.
	01/12/96	1558	Purged
	01/13/96	1516	0.04 ft.
	01/14/96	1500	0.05 ft.
	01/15/96	1515	0.07 ft.

During water level measurements on January 9, 1996, water collected from monitoring well, ST14-W19, was observed to have a sheen, however separate phase was not detected using the electronic interface probe. On January 12, 1996, during sample collection, 0.1 foot of free product was visually observed. Based on the timing of this observation, the well was not included in the product recovery study described above.

Several wells were purged using a dedicated polyvinyl chloride (PVC) bailer. Many of these wells had been previously identified as having slow recoveries or had been purged to dryness in prior sampling episodes. During the fourth quarter sampling event, the following wells were purged to dryness before three well bore volumes could be removed: LF01-1D, LF04-4A,

LF04-4B, FT08-11A, ST14-W21, ST14-W23, SD13-06, BSSB, MW-5, MW-7, MW-11, MW-12, GMI22-05M, GMI22-07M, GMI22-08M, OT-15C, T3, and P6A.

Table 2-4 presents a summary of the sampling activities conducted at each monitoring well during the fourth quarter sampling event. Copies of the fourth quarter chain-of-custody forms are provided in Appendix D and copies of the ground-water sampling reports are provided in Appendix E.

2.2.2.2 Field Quality Assurance/Quality Control - Quality control parameters were consistent with the third quarter quality control program, with the exception of the following:

- Equipment blanks were collected daily from the submersible Grundfos pumps used to purge the wells in order to monitor the effectiveness of decontamination procedures.

2.2.2.3 Lessons Learned - Because of slow ground-water recharge of several wells during the fourth quarter sampling event, it is recommended that micro-purging techniques be implemented for subsequent sampling events. Through the use of a dedicated low-flow bladder pump, smaller volumes of water can be removed from the screened zone of the well without disturbing the water in the water column, thus reducing turbidity in the samples. In addition, this technique minimizes the loss of volatiles in the sample, and reduces the volume of purge water generated and the time spent purging the well.

2.2.3 Investigation Derived Waste Management

Investigation derived waste (IDW) consisted of purge water from the monitoring wells. The purge water from each sampling event was stored in a 3,000-gallon polyethylene tank until the end of the sampling episode. A sample from the tank was collected and analyzed for volatiles, semi-volatiles, and metals. Based on the analytical results, LAW disposed of the purge water through a ground-water treatment system located on the base.

TABLE 2-4
 FOURTH QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: NUMBER: Matrix:	PROJECT: CARSWELL 11-3517-3201 Groundwater	SAMPLE ID	COMMENT	SAMPLING INFORMATION		PARAMETER:				ICP, GFAA and Mercury SW 6010/7000 1 L polyethylene HNO ₃ to pH<2 Cool to 4C	
				LOGDATE	LOGTIME	Volatiles	Semi-Volatile Organics	Pesticides	Number of Samples per Parameter		
		LF01-1A		1/12/96	1550	SW 8260 40 mL VOA vials HCl to pH<2 Cool to 4C	SW6270 1 L amber glass Cool to 4C None	SW 8080 1 L amber glass Cool to 4C None	1	0	1
		LF01-1C		1/12/96	0905				1	0	1
		LF01-1D		1/12/96	1430				1	0	1
		LF01-1E	FDUP-5	1/12/96	0955				1	0	1
		LF04-4A		1/13/96	1500				1	0	1
		LF04-4B		1/13/96	1640				1	0	1
		LF04-4D		1/15/96	1245				1	0	1
		LF04-4E	MS/MSD	1/14/96	0915				1	0	1
		LF04-4F		1/14/96	1100				1	0	1
		*LF04-10		1/13/96	0930				1	0	1
		*LF04-04		1/13/96	0905				1	0	1
		*LF05-02		1/13/96	1100				1	0	1
		LF05-5C	FDUP-1	1/15/96	0900				1	0	1
		LF05-5D		1/14/96	1440				1	0	1
		LF05-5G		1/15/96	0915				1	0	1
		*LF05-18		1/13/96	1050				1	0	1
		FT08-11A		1/14/96	0845				1	0	1
		FT08-11B		1/14/96	0955				1	0	1
		FT09-12A	FDUP-7	1/13/96	1330				1	0	1
		FT09-12B	MS/MSD	1/14/96	1125				1	0	1
		FT09-12C		1/13/96	1440				1	0	1

TABLE 2-4

FOURTH QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: NUMBER: Matrix:	PROJECT: CARSWELL 11-3517-3201 Groundwater	PARAMETER:	NUMBER OF SAMPLES PER PARAMETER			
			Volatiles	Semi-Volatile Organics	Pesticides	ICP, GFAA and Mercury
SAMPLE ID	COMMENT	SAMPLING INFORMATION LOGDATE LOGTIME	Method: SW 8260 40 mL VOA vials HCl to pH<2 Preservative 2: Cool to 4C	SW 8270 1 L amber glass Cool to 4C None	SW 8080 1 L amber glass Cool to 4C None	SW 6010/7000 1 L polyethylene HNO ₃ to pH<2 Cool to 4C
ST14-01		1/11/96 1540	1	1	0	1
ST14-02		1/13/96 1600	1	1	0	1
ST14-03	FDUP-6	1/12/96 0850	1	1	0	1
ST14-04		1/13/96 1035	1	1	0	1
ST14-W05		1/11/96 0930	1	1	0	1
ST14-W06		1/11/96 1130	1	1	0	1
ST14-W07		1/12/96 1750	1	1	0	1
ST14-W08	MS/MSD	1/12/96 1530	1	1	0	1
ST14-W09	MS/MSD	1/13/96 1240	1	1	0	1
ST14-W11		1/11/96 1630	1	1	0	1
ST14-W13		1/11/96 1515	1	1	0	1
ST14-W15		1/13/96 1205	1	1	0	1
ST14-W16	FDUP-8	1/12/96 0915	1	1	0	1
ST14-W19		1/12/96 1315	1	1	0	1
ST14-W20	FDUP-3	1/12/96 1015	1	1	0	1
ST14-W21		1/12/96 1520	1	1	0	1
ST14-W22		1/12/96 1235	1	1	0	1
ST14-W23		1/11/96 1055	1	1	0	1
BSSA	FDUP-2	1/10/96 1150	1	1	0	1
BSSB		1/15/96 1308	1	1	0	1
MW-5		1/15/96 1250	1	1	0	1
MW-7		1/10/96 1700	1	1	0	1
MW-8		1/10/96 1450	1	1	0	1
MW-9		1/10/96 1205	1	1	0	1
MW-10	MS/MSD	1/15/96 1430	1	1	0	1
MW-11		1/10/96 1520	1	1	0	1
MW-12		1/10/96 1515	1	1	0	1

TABLE 2-4

FOURTH QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: CARSWELL
 NUMBER: 11-3517-3201
 Matrix: Groundwater

PARAMETER: Volatiles
 Method: SW 8260
 Container: 40 mL VOA vials
 Preservative 1: HCl to pH < 2
 Preservative 2: Cool to 4C

PARAMETER: Semi-Volatile
 Organics
 SW 8270
 1 L amber glass
 Cool to 4C
 None

PARAMETER: Pesticides
 SW 8080
 1 L amber glass
 Cool to 4C
 None

PARAMETER: KCP, GFAA
 and Mercury
 SW 6010/7000
 1 L polyethylene
 HNO₃ to pH < 2
 Cool to 4C

SAMPLE ID COMMENT

SAMPLING INFORMATION
 LOGDATE LOGTIME NUMBER OF SAMPLES PER PARAMETER

SAMPLE ID	COMMENT	LOGDATE	LOGTIME	Volatiles	Semi-Volatile Organics	Pesticides	KCP, GFAA and Mercury
GMI04-01M		DRY		1	1	1	0
GMI22-02M		1/13/96	1410	1	1	1	0
GMI22-03M		1/14/96	1020	1	1	1	0
GMI22-04M		1/14/96	1420	1	1	1	0
GMI22-05M		1/12/96	1640	1	1	1	0
GMI22-06M		1/15/96	1030	1	1	1	0
GMI22-07M		1/11/96	1200	1	1	1	0
GMI22-08M	MS/MSD	1/11/96	1655	1	1	1	0

WP07-10B		1/15/96	1135	1	1	1	0
WP07-10C		1/15/96	1045	1	1	1	0

OT15C	MS/MSD	1/12/96	1045	1	1	1	0
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(Equipment blank and FDup collected for pesticides)

SD13-01		1/15/96	1045	1	1	1	0
SD13-02		1/11/96	1355	1	1	1	0
SD13-03	MS/MSD	1/11/96	1015	1	1	1	0
SD13-05	FDUP-4	1/12/96	0915	1	1	1	0
SD13-06		1/12/96	1335	1	1	1	0
SD13-07	Free Product	1/12/96	1347	0	0	0	0

P3A		1/11/96	1625	1	1	1	0
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TABLE 2-4

FOURTH QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: CARSWELL
 NUMBER: 11-3517-3201
 Matrix: Groundwater

SAMPLE ID	COMMENT	SAMPLING INFORMATION		PARAMETER: Volatiles				Semi-Volatile Organics		Pesticides		ICP, GFAA and Mercury	
		LOGDATE	LOGTIME	Method:	Container:	Preservative 1:	Preservative 2:	SW 8260	SW 8270	SW 8080	SW 6010/7000	ICP, GFAA	and Mercury
T3		1/10/96	1540	SW 8260	40 mL VOA vials	HCl to pH < 2	Cool to 4C	SW 8270	SW 8080	SW 6010/7000	ICP, GFAA	and Mercury	
T4A		1/14/96	1335	40 mL VOA vials	HCl to pH < 2	Cool to 4C	None	1 L amber glass	1 L amber glass	1 L polyethylene	SW 6010/7000	ICP, GFAA	
T7		1/11/96	0900	HCl to pH < 2	Cool to 4C	None	None	Cool to 4C	Cool to 4C	Cool to 4C	SW 6010/7000	ICP, GFAA	
P6A		1/13/96	1640	Cool to 4C	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
LSA1628-1	Free Product	1/12/96	1605	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
LSA1628-2		1/15/96	0948	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
LSA1628-3		1/14/96	1230	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
TB-11096		1/10/96	1730	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
TB-11196		1/11/96	1700	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
TB-11296		1/12/96	1815	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
TB-11396		1/13/96	1800	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	
TB-11596		1/15/96	1600	None	None	None	None	None	None	None	SW 6010/7000	ICP, GFAA	

TABLE 2-4

FOURTH QUARTER SAMPLING DETAIL
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PROJECT: CARSWELL
 NUMBER: 11-3517-3201
 Matrix: Groundwater

SAMPLE ID	COMMENT	SAMPLING INFORMATION		PARAMETER: Volatiles				Semi-Volatile		Pesticides		KCP, GFAA and Mercury
		LOC DATE	LOC TIME	Method:	Container:	Preservative 1:	Preservative 2:	Organics	SW 8080	SW 8080	SW 8080	
EB-3	LF05-18	1/13/96	1115	SW 8260	40 mL VOA vials	HCl to pH<2	Cool to 4C	SW8270	1 L amber glass	Cool to 4C	None	SW 6010/7000
EB-2	GM122-03	1/14/96	0840					1 L amber glass	Cool to 4C	None		1 L polyethylene
EB-1	WP07-10B	1/15/96	1530					None	None	None		HNO ₃ to pH<2
FDUP-1	GM104-01M	1/15/96	0730									Cool to 4C
FDUP-2	BSAA	1/10/96	1420									
FDUP-3	ST14-W20	1/12/96	0930									
FDUP-4	SD13-05	1/12/96	1200									
FDUP-5	LF01-1E	1/12/96	0730									
FDUP-6	ST14-03	1/12/96	1200									
FDUP-7	FT09-12A	1/13/96	0730									
FDUP-8	ST14-W16	1/12/96	1100									

NUMBER OF SAMPLES PER PARAMETER

EB = Equipment blank
 FDUP = Field duplicate sample
 MS/MSD = Matrix spike samples
 TB = Trip blank

PREPARED/DATE: SDP 4-2-96
 CHECKED/DATE: SDM 4-2-96

2.3 LABORATORY ANALYSIS

The following sections describe the analytical program, chronology of laboratory analyses, and the quality assurance/quality control program.

2.3.1 Analytical Program

The Law Environmental, Inc., National Laboratories facility in Pensacola, Florida (LENL-P), a LAW chemical testing laboratory established in 1989, provided sample shipping containers, chain-of-custody documents, chemical analysis, and laboratory quality assurance/quality control (QA/QC).

All ground-water samples were analyzed for volatile organic compounds, semi-volatile organic compounds, and total metals. One monitoring well, OT15C, was also analyzed for pesticides because it is located in the vicinity of an abandoned pesticide disposal well. Ground-water samples were analyzed by the U.S. Environmental Protection Agency (USEPA) SW-846 methodologies listed in Table 2-5.

Volatile compounds were analyzed by the laboratory following Method SW8260. This method utilizes a 25-milliliter sample aliquot to achieve the required detection limits. However, when the laboratory encountered high concentrations of volatile constituents, a dilution was performed and a 5-milliliter aliquot of the diluted sample was analyzed on a second instrument set up for Method SW8240. Because all SW8260 quality control protocols were followed regardless of the instrumentation used for analysis, the data reported for volatiles analyses were considered comparable and the methodology used satisfied the data quality objectives of the project.

Quantitation limits were based on the method detection limits (MDLs) established by the laboratory using the required USEPA procedure specified in 40 CFR Part 136 Appendix B. The 1995 laboratory established detection and quantitation limits are presented in Appendix A of the Final Sampling and Analysis Plan (LAW, 1995a). For Methods SW-8240, SW-8260, and

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

Matrix: Equipment Rinsate/Ground Water

Parameter	Method	Holding Time	
		Extraction	Analysis
Volatile Organics	SW8240/8260	--	14 days
Semi-Volatile Organics	SW3520/8270	7 days	40 days
Total Metals Screen	SW3005/6010	--	6 months
Arsenic	SW3020/7060	--	6 months
Lead	SW3020/7421	--	6 months
Selenium	SW3020/7740	--	6 months
Thallium	SW3020/7841	--	6 months
Mercury	SW7470	--	28 days
Pesticides	SW3520/8080	7 days	40 days

If the volatile organics concentration detected by Method 8260 exceeded the calibration curve, the sample was analyzed and reported by Method 8240.

PREPARED/DATE: JLP 9-25-95
 CHECKED/DATE: SDM 10/2/95

SW-8270, sample results detected below the practical quantitation limit (PQL) but above the MDL were reported and the data were flagged as estimated values using the qualifier "JQ." Samples requiring dilution were reported with elevated quantitation limits; however, detections below the PQL were reported in order to achieve project reporting requirements.

Quality control limits are generated annually by the laboratory based on statistical analysis of historic data. The QC limits for laboratory control samples (LCS) recovery, surrogate recovery, and matrix spike/matrix spike duplicate (MS/MSD) recovery and precision were presented in Appendix A of the Final Sampling and Analysis Plan (LAW, 1995a).

2.3.2 Chronology of Laboratory Analyses

The laboratory analyses for the third quarter of ground-water sampling were performed from October 18 to November 28, 1995. The fourth quarter ground-water samples were analyzed between January 11 and January 25, 1996. Appendix F provides the date of sampling, extraction/preparation, and analysis for each sample collected during the third and fourth quarter field events.

2.3.3 Quality Assurance/Quality Control Program

The quality of the chemical data is assessed through the evaluation of both field and laboratory QC data. The QC parameters that were evaluated include: sample preservation and holding time requirements, batch method blank analysis, LCS analysis, internal standard recovery, MS/MSD analysis, surrogate analysis, field duplicate analysis, trip blank analysis, and equipment blank analysis.

2.3.3.1 Sample Handling - Samples were transported to the laboratory daily by overnight express shipment. Upon receipt of the shipment, the laboratory recorded the temperature of each cooler and checked the preservation of samples. Adjustment of sample pH was performed as needed and recorded. Samples were maintained at the laboratory at a temperature of 2 to 8

degrees Celsius until analysis. Holding times for extraction and analysis were strictly adhered to following the requirements of the Sampling and Analysis Plan.

2.3.3.2 Method Blanks - Method blanks consist of organic-free or deionized water that is carried through the analytical scheme like a sample. Positive method blank results indicate the presence of contamination associated with sample preparation or analysis. For most analyses, a method blank is analyzed for each extraction or analysis batch at a frequency of 1 per 20 or fewer samples. If an analyte of interest is detected above the quantitation limit in a method blank, the corrective action consists of reprocessing and reanalyzing the entire sample batch. For the common organic contaminants such as methylene chloride, acetone, toluene, 2-butanone, and phthalates, and the inorganic contaminants, aluminum, calcium, iron, magnesium, sodium and potassium, reanalyses were performed only if contaminants exceeded three times the quantitation limit.

2.3.3.3 Laboratory Control Samples - Laboratory control samples were analyzed with every batch of 20 or fewer samples. LCS samples were prepared for each method by the addition of known concentrations of all method analytes. LCS samples were carried through the complete sample preparation and analysis procedure, and recoveries of the spiked analytes were determined and compared to QC criteria. Batch acceptance was based on the successful recovery of all analytes of interest as specified in the Sampling and Analysis Plan, and acceptable recovery of at least 80 percent of the total analyte list for each method. Failure to meet these criteria resulted in reprocessing and reanalyzing the entire sample batch.

2.3.3.4 Internal Standards - Internal standard results were evaluated for Methods SW-8240/8260 and SW-8270 according to method requirements. Failure to meet the internal standard recovery or retention time criteria resulted in reanalysis of the affected samples.

2.3.3.5 Matrix Spikes - The MS/MSD samples were designated prior to sampling to allow for the collection of additional aliquots of the sample in the field. At the laboratory, the sample aliquots were spiked with known concentrations of the analytes of interest (Table 2-6), and the

TABLE 2-6

MATRIX SPIKE COMPOUND LIST
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

Method SW-8260	1,1-Dichloroethene Trichloroethene Benzene Toluene Chlorobenzene
Method SW-8270	Phenol 2-Chlorophenol 1,4-Dichlorobenzene N-Nitroso-di-n-propylamine 1,2,4-Trichlorobenzene 4-Chloro-3-methylphenol Acenaphthene 4-Nitrophenol 2,4-Dinitrotoluene Pentachlorophenol Pyrene bis(2-Chloroethoxy)methane Butylbenzylphthalate Hexachlorobenzene Benzo(a)pyrene Benzo(a)anthracene Naphthalene
Method SW-8080	gamma-BHC (Lindane) Heptachlor Aldrin Dieldrin Endrin 4,4'-DDT PCB 1016/1260

samples were prepared and analyzed with a batch of 20 or fewer samples. The spike recoveries and the precision between duplicate spikes were calculated and evaluated compared to QC criteria. This technique allows for the assessment of any effect of the matrix on the precision and accuracy of the sample data. MS/MSD samples were collected from eight monitoring wells during the third and fourth quarter sampling activities. No corrective action was required for MS/MSD recoveries that failed QC criteria as long as the associated LCS results were within control.

2.3.3.6 Surrogates - Surrogates are known amounts of selected compounds added to all field and QC samples prior to preparation and analysis. Surrogate recoveries were evaluated for Methods SW-8240/8260, SW-8270, and SW-8080. The recovery of surrogates may be used to determine the effect of the matrix on the accuracy of the sample data. Surrogate recovery failure required reanalysis of the affected sample.

2.3.3.7 Field Precision - Field duplicate samples were collected from eight monitoring well locations during the third and fourth quarter sampling activities. The results of field duplicates were used to evaluate sampling precision. A relative percent difference (RPD) was calculated from the positive results of the sample and its duplicate, and the RPD values were compared to a precision goal of 30 percent. For sample values less than five times the quantitation limit, the precision is determined by calculating the difference between the concentrations reported in the sample and its duplicate. The criteria used to evaluate this result is the concentration equivalent to two times the PQL. Sample results for those parameters with field precision greater than the criteria of 30 percent RPD or two times the PQL, as applicable, are qualified as estimated values.

2.3.3.8 Trip Blanks - Trip blanks were shipped with each cooler containing samples collected for analysis of volatile compounds. Trip blanks were prepared by the laboratory from organic-free water, and were handled, packaged, preserved, and shipped in a manner similar to actual field samples. Trip blanks were analyzed for volatile organics to detect contamination that may

have resulted from cross-contamination or ambient sources of contamination during shipment and handling.

2.3.3.9 **Equipment Blanks** - Equipment blanks were collected during the fourth quarter sampling activities to evaluate the effectiveness of equipment decontamination procedures. One equipment blank was collected each day during the fourth quarter sampling event. Equipment blanks were analyzed for the same parameters as those requested on environmental samples.

2.3.3.10 **Completeness** - Completeness measures the amount of usable data resulting from a data collection activity. Completeness for the purpose of this project was defined as the amount of sample data points actually acquired and accepted as valid, divided by the number of sample data points planned to be acquired, expressed as a percentage. Valid data is defined as all data which was not rejected as a result of data quality evaluation. A completeness goal of 90 percent was expected to be achieved for this project.

2.4 DATA EVALUATION

The parameters of precision, accuracy, representativeness, completeness, and comparability are indicators of data quality (USEPA, 1987). The field QC data and laboratory QC data were evaluated to ascertain the quality of the chemical data. The QC data were compared to the criteria presented in the Final Sampling and Analysis Plan (LAW, 1995a). If QC problems were encountered during the performance of sampling and analysis procedures, corrective action was immediately initiated, and the problem and its resolution are reported in the following section. If QC problems affected the data reported for a field sample and corrective action did not resolve the problem, the data for that sample has been qualified. The following sections present the procedures used for evaluation of the field and laboratory data, and the results of the data quality evaluation.

2.4.1 Methodology for Data Quality Assessment

The following sections discuss the evaluation criteria used to review the field and laboratory results, the formulas used to calculate quality control data, and the qualifiers applied to the sample results based on data evaluation.

2.4.1.1 Review of Field Records - Field records were evaluated for the following:

- Completeness of field records
- Identification of valid samples
- Correlation of field testing data
- Identification of anomalous field testing data
- Assessment of accuracy and precision of field testing data
- Completeness of the sampling effort
- Sample preservation, handling, and shipping procedures
- Effectiveness of sampling procedures in preserving sample precision and accuracy

Field records were assessed for completeness and to determine whether field activities were carried out as planned. Samples were evaluated to determine their representativeness through the review of field test results. Anomalous data are discussed in Section 3.1.

2.4.1.2 Review of Laboratory Data - Laboratory data were evaluated for the following:

- Chain of custody forms
- Sample integrity
- Applicability of the instruments/methods used
- Holding times
- Method calibration criteria

- Method blanks
- Verification of quantitation limits
- Laboratory sample preparation records
- Quality control results
- Corrective action for out-of-control QC results
- Calculations used for analyte quantitation and reporting
- Completeness of data

Chemical data evaluation was performed according to LAW's standard operating procedures (SOPs) which were developed following the USEPA "National Functional Guidelines for Organic Data Review" (USEPA, 1990) and "Laboratory Data Validation: Functional Guidelines for Evaluating Inorganic Analyses" (USEPA, 1988). A standard format for the documentation of the results of data evaluation is included in the SOP. This documentation is maintained in the project file at LAW.

2.4.1.3 Formulas - The following formulas were used to calculate quality control data.

Accuracy - Accuracy is defined as the degree of agreement of a measurement with an accepted reference or true value. To determine the accuracy of an analytical method, a sample spiking program was conducted. The results of sample spiking were used to calculate the percent recovery (%R). The percent recovery is defined as follows:

$$\%R = \frac{X - T}{K} \times 100$$

where:

%R = percent recovery

X = analytical result of the spiked sample

T = analytical result of the unspiked sample

K = known amount of the spike in the sample

Surrogates, matrix spike and matrix spike duplicates (MS/MSD), and internal standards were analyzed to determine accuracy. The control limits were based on the mean percent recovery plus or minus 3 standard deviations of the mean using a population of 20 or more recovery values.

Precision - Precision is the measure of mutual agreement among individual measurements of the same property, under similar conditions. Precision between duplicate measurements is best expressed in terms of relative percent difference (RPD). Precision was assessed through the use of field duplicate samples and MS/MSD samples. An RPD for each sample pair was calculated using the following equation:

$$\text{RPD} = \frac{A - B}{(A + B)/2} \times 100$$

where:

A = replicate value 1

B = replicate value 2

RPD = relative percent difference

The laboratory established control limits were based on a population of ten or more RPD values. They were calculated by determining the mean RPD plus three times the standard deviation for the upper limit and zero as the lower limit.

Completeness - Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. The result is expressed as a percentage determined by analyte, by method.

$$\text{Percent completeness} = \frac{\text{Number of valid measurements}}{\text{Total number of measurements}} \times 100$$

For this project, a completeness goal of 90 percent was established.

2.4.1.4 Data Qualifiers - Data qualifiers are used to flag sample results if accuracy or precision criteria have not met the QC requirements presented in Appendix A in the Final Sampling and Analysis Plan (LAW, 1995a). Data qualification flags used for this project are presented in Table 2-7. Each data point reported is graded as usable as reported, usable with qualifications, or rejected. All data determined to be usable as reported or usable with qualifications are considered valid data for the purpose of calculating the data completeness for the project.

2.4.2 Data Analysis and Interpretation

Monitoring well locations were placed on a base map that was provided to LAW. The locations of the wells presented on each map generated for this report are not surveyed locations and are considered approximate. The location for each well was developed based on available surveyed locations for one well and using the relative locations of additional wells to establish a location grid for the entire map. This method was necessary because no comprehensive survey information was available for the base (i.e., wells, buildings, etc.). The well locations generated from this location grid are presented in Table 2-1 and Table 2-3.

The ground-water potentiometric surface contour lines were generated with the Surfer[®] computer program, Version 4.15, using the Kriging gridding (all search) method for measured water levels. The ground-water levels measured for Quarter 3 and Quarter 4, the top of casing (TOC) elevations, and ground-water elevations are listed in Tables 2-1 and 2-3, respectively.

Laboratory reports containing sample results and QC information were reviewed by the laboratory QA coordinator and submitted to LAW. A case narrative was included in each data report to provide an assessment of the laboratory's QA activities. The data presented in the laboratory report was generated from the laboratory's information management system (LIMS) and was reviewed by the LAW project chemist during the data evaluation process. An electronic data deliverable (EDD) was also produced by the laboratory from the LIMS and submitted to LAW. The chemical data tables presented in this report were produced from the EDD files

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

FLAG	POSITIVE RESULTS	NEGATIVE RESULTS
FLAGS FOR DATA WITHIN ACCEPTANCE LIMITS (Usable as Reported)		
(no flag)	{Use datum without qualification}	{Use datum without qualification}
FLAGS FOR DATA WITHIN ACTION LIMITS (Usable With Qualification)		
J	Estimated quantitation based upon QC data	Estimated quantitation based upon QC data
JB	Estimated quantitation: possible biased high or false positive based upon blank data	(Not applicable)
JH	Estimated quantitation - possibly biased high based upon QC data	(Not applicable)
JL	Estimated quantitation - possibly biased low based upon QC data	Possible false negative based upon QC data
JQ	Estimated quantitation; result below the PQL	(Not applicable)
FLAGS FOR DATA OUTSIDE OF ACTION LIMITS (Unusable)		
R	Datum rejected based upon QC data: do not use	Datum rejected based upon QC data: do not use
MISCELLANEOUS FLAGS		
t	Tentatively identified compound; identity not confirmed with standard and quantitation estimated (applicable to GC/MS data only)	(Not applicable)

Note that if the QC results suggest contradictory flags, the following hierarchy should be used to select the appropriate flag to assign:

R > J, JH, JL, JB, JQ
 JH + JL = J
 JB > J
 JH or JL > J

reported by the laboratory. Additional processing of the information contained in the EDD files resulted in the generation of the positive results tables presented in Section 3. Data comparison was achieved through visual review of the positive results and the Regulatory Standards Table. Electronic files of the positive results in ASCII format were created to transfer the data onto CAD drawings. All data entry results were checked by a reviewer, and approved by the project principal. The following sections present the results of the laboratory data quality evaluation.

2.4.2.1 Laboratory Methods and Detection Limit Requirements - The laboratory followed the analytical methods presented in the Final Sampling and Analysis Plan (LAW, 1995a). All method detection limits provided in Appendix A of the plan were met. Sample results quantitated below the Practical Quantitation Limit (PQL) in order to meet project required detection limits, were qualified as estimated (JQ.)

2.4.2.2 Calibration - Initial calibrations and continuing calibrations were evaluated according to method-specific calibration criteria. All calibrations met the required criteria with the exception of the following:

Third Quarter Volatiles Analyses

- Continuing calibrations exhibited high percent difference for acetone and 2-chloroethyl vinyl ether. Associated samples were qualified as estimated (J). Low continuing calibration response factors were also reported for 2-chloroethyl vinyl ether. Associated samples were rejected (R).

Third Quarter Semi-Volatiles Analyses

- Initial calibrations resulted in percent difference values greater than the method criteria. The following compounds were affected: 4-chloroaniline and 2,4-dinitrophenol. The sample results associated with an analytical batch for which a compound failed the criteria were qualified as estimated (J).

- Several continuing calibrations resulted in percent difference values greater than the method criteria. The following compounds were affected: benzoic acid, benzyl alcohol, 4-chloroaniline, 3,3'-dichlorobenzidine, 2,4-dinitrophenol, hexachlorocyclopentadiene, 4-nitroaniline and 4-nitrophenol. The sample results associated with an analytical batch for which a compound failed the criteria were qualified as estimated (J).

Fourth Quarter Volatiles Analyses

- Continuing calibrations resulted in percent difference values greater than the method criteria. The following compounds were affected: acetone, 2-butanone, 2-hexanone and 4-methyl-2-pentanone. The sample results associated with an analytical batch for which a compound failed the criteria, were qualified as estimated (J).
- Several continuing calibrations resulted in response factors below the method criteria for 2-chloroethyl vinyl ether. 2-chloroethyl vinyl ether results were non-detect, therefore associated sample results were rejected (R).

Fourth Quarter Semi-Volatiles Analyses

- Several initial calibrations resulted in percent difference values greater than the method criteria. The following compounds were affected: 4-chloroaniline and 2,4-dinitrophenol. The sample results associated with an analytical batch for which a compound failed the criteria, were qualified as estimated (J).
- Several continuing calibrations resulted in percent difference values greater than the method criteria. The following compounds were affected: 4-chloroaniline, 3,3'-dichlorobenzidine, hexachlorocyclopentadiene, and 4-nitrophenol. The sample results associated with an analytical batch for which a compound failed the criteria, were qualified as estimated (J).

2.4.2.3 Method Blanks - Method blanks were analyzed to determine the effect of laboratory contamination on sample results. Method blank results were non-detect with the exception of the following:

Third Quarter Metals Analyses

- ICPWB3107 contained 251 $\mu\text{g/L}$ of sodium. Associated sample results were greater than 5 times the blank concentration; therefore, no data were qualified.

Fourth Quarter Semi-Volatiles Analyses

- SWB7787 contained 6.13 $\mu\text{g/L}$ of diethylphthalate. Associated sample results were non-detect; therefore, no data were qualified.

2.4.2.4 Laboratory Control Sample Results - Laboratory control samples (LCSs) were used to demonstrate method accuracy. The LCS analytes which were outside of control limits resulted in the qualification of the associated sample results. The LCS results were within control limits with the exception of the following:

Third Quarter Metals Analyses

- ICPWL3092 had high recovery of potassium. Associated positive sample results were qualified (JH) for potassium.

Third Quarter Semi-Volatiles Analyses

- SWL7376 had no recovery of benzyl alcohol and hexachlorocyclopentadiene, and low recovery of bis(2-chloroisopropyl)ether and 2,4-dimethylphenol. Associated sample results for benzyl alcohol and hexachlorocyclopentadiene were non-detect; therefore, results were rejected (R). Associated sample results were qualified (JL) for bis(2-chloroisopropyl)ether and 2,4-dimethylphenol.
- SWL7391 had no recovery of hexachlorocyclopentadiene and high recovery of benzo(b)fluoranthene. Associated sample results were qualified (R) for hexachlorocyclopentadiene. Sample results were non-detect for benzo(b)fluoranthene; therefore, no results were qualified.

- SWL7390 had no recovery of hexachlorocyclopentadiene and low recovery of 2,4-dimethylphenol. Associated sample results were qualified (R) for hexachlorocyclopentadiene and (JL) for 2,4-dimethylphenol.
- SWL7414 had no recovery of hexachlorocyclopentadiene, extremely low recovery of pentachlorophenol, and low recovery of 2,4-dimethylphenol and 3&4-methylphenol. Associated sample results were rejected (R) for hexachlorocyclopentadiene and pentachlorophenol. Associated sample results were qualified (JL) for 2,4-dimethylphenol and 3&4-methylphenol.
- SWL7406 had no recovery of 2,4-dichlorophenol, 4,6-dinitro-2-methylphenol, 2,4-dinitrophenol, 4-nitrophenol, and hexachlorocyclopentadiene; extremely low recovery of pentachlorophenol and phenol; and low recovery of hexachloroethane. Associated sample results were rejected (R) for 2,4-dichlorophenol, 4,6-dinitro-2-methylphenol, 2,4-dinitrophenol, 4-nitrophenol, hexachlorocyclopentadiene, pentachlorophenol, and phenol. Associated sample results were qualified (JL) for hexachloroethane.
- SWL7407 had no recovery of hexachlorocyclopentadiene and low recovery of bis(2-chloroisopropyl)ether. Associated sample results were qualified (R) for hexachlorocyclopentadiene and (JL) for bis(2-chloroisopropyl)ether.
- SWL7416 had no recovery of 2,4-dinitrophenol, hexachlorocyclopentadiene, and pentachlorophenol, and low recovery of 2,4-dimethylphenol and hexachloroethane. Associated sample results were rejected (R) for 2,4-dinitrophenol, hexachlorocyclopentadiene, and pentachlorophenol. Associated sample results were qualified (JL) for hexachloroethane and 2,4-dimethylphenol.
- SWL7421 had no recovery of hexachlorocyclopentadiene, and low recovery of bis(2-chloroisopropyl)ether. Associated sample results were rejected (R) for hexachlorocyclopentadiene and (JL) for bis(2-chloroisopropyl)ether.
- SWL7425 had no recovery of hexachlorocyclopentadiene, and high recoveries for 3,3'-dichlorobenzidine and pyrene. Associated sample results were rejected (R) for hexachlorocyclopentadiene. Associated sample results for 3,3'-dichlorobenzidine and pyrene were non-detect; therefore, no data were qualified.

Fourth Quarter Volatiles Analyses

- V25WL0227 had a low recovery for vinyl chloride. Associated sample results were qualified (JL).
- VWL0777 had a low recovery for methylene chloride. Associated sample results were qualified (JL).

Fourth Quarter Semi-Volatiles Analyses

- SWL7773 had no recovery for hexachlorocyclopentadiene and a high recovery for 4-chloroaniline. Associated sample results were rejected (R) for hexachlorocyclopentadiene. Associated sample results were non-detect for 4-chloroaniline; therefore, no data were qualified.
- SWL7778 had no recovery for hexachlorocyclopentadiene. Associated sample results were rejected (R).
- SWL7781 had no recovery of hexachlorocyclopentadiene and low recoveries for 2,4-dimethylphenol, hexachloroethane and phenanthrene. Associated sample results were rejected (R) for hexachlorocyclopentadiene, and qualified (JL) for 2,4-dimethylphenol, hexachloroethane and phenanthrene.
- SWL7782 had no recovery for hexachlorocyclopentadiene and a high recovery for 4-chloroaniline. Associated sample results were rejected (R) for hexachlorocyclopentadiene. Sample results were non-detect for 4-chloroaniline; therefore, no data were qualified.
- SWL7783 had a high recovery for 4-chloroaniline. Associated sample results were non-detect for 4-chloroaniline; therefore, no data were qualified.
- SWL7787 had no recovery for hexachlorocyclopentadiene. Associated sample results were rejected (R).
- SWL7788 had no recovery for hexachlorocyclopentadiene. Associated sample results were rejected (R).

2.4.2.5 MS/MSD Results - MS/MSD samples were analyzed to assess method accuracy and precision. The results of the analysis of MS/MSD samples are provided in Appendix G. MS/MSD results were within QC ranges with the exception of the following:

Third Quarter Metals Analyses

- Sample LF04-4E was analyzed as an MS/MSD sample. Iron had low MS and high MSD recoveries; however, because the sample concentration was greater than four times the spike amount, the results were not qualified. Arsenic, selenium, and thallium had low MS and MSD recoveries. Associated sample results were qualified (JL) for arsenic, selenium, and thallium.
- Sample MW-10 was analyzed as an MS/MSD sample. Iron and manganese had MS and/or MSD recoveries outside the QC range, and RPD results greater than the control limit; however, because the sample concentration for both metals was greater than four times the spike amount, the results were not qualified. Selenium and thallium had low MS and MSD recoveries. Associated sample results were qualified (JL) for selenium and thallium.
- Sample ST14-W09 was analyzed as an MS/MSD sample. Aluminum and iron had high MS and/or MSD recoveries, and iron had RPD results greater than the control limit. The sample concentration for both metals was greater than four times the spike amount; therefore, the sample results were not qualified. Selenium and thallium had low MS and MSD recoveries. The sample was qualified (JL) for selenium and thallium.
- Sample ST14-W19 was analyzed as an MS/MSD sample. Iron had low MS and MSD recoveries; however, because the sample concentration was greater than four times the spike amount, the results were not qualified. Arsenic and selenium had low MS and MSD recoveries. Associated sample results were qualified (JL) for arsenic and selenium.
- Sample GMI22-08M was analyzed as an MS/MSD sample. Aluminum and iron had high MS recoveries, and the RPD was greater than 20 percent for iron. The sample result was qualified (JH) for aluminum. The sample concentration for iron was greater than four times the spike amount; therefore, the results were not qualified for iron. Arsenic had low MS and MSD recoveries. The associated sample result was qualified (JL) for arsenic.

- Sample SD13-03 was analyzed as an MS/MSD sample. Iron had an RPD greater than 20 percent; however, the sample concentration was greater than four times the spike amount and the results were not qualified.
- Sample OT15C was analyzed as an MS/MSD sample. Aluminum and iron had low MS and/or MSD recoveries, and the RPDs were greater than 20 percent. The sample result was qualified (JL) for aluminum. The sample concentration for iron was greater than four times the spike amount; therefore, the results were not qualified for iron. Thallium had low MS and MSD recoveries. The associated sample result was qualified (JL) for thallium.

Third Quarter Volatiles Analyses

- Sample ST14-W09 was analyzed as an MS/MSD sample. Trichloroethene had low MS and MSD recoveries for sample ST14-W09, and results were qualified as estimated biased low (JL) for this compound.
- Sample FT09-12B was analyzed as an MS/MSD sample. 1,1-Dichloroethene and tetrachloroethene had high MS recoveries for sample FT09-12B. The sample result for 1,1-dichloroethene was non-detect; therefore, the sample data were not qualified. The sample result was qualified as estimated biased high (JH) for tetrachloroethene.
- Sample MW-10 was analyzed as an MS/MSD sample. Toluene had a high MSD recovery. The associated sample was qualified (JH) for toluene.
- Sample ST14-W19 was analyzed as an MS/MSD sample. Benzene and ethylbenzene had high MS and MSD recoveries. The associated positive sample results were qualified (JH) for these compounds.

Third Quarter Semi-Volatiles Analyses

- Sample MW-10 was analyzed as an MS/MSD sample. Acenaphthene, benzo(a)anthracene, butyl benzyl phthalate, 4-chloro-3-methylphenol, 2-chlorophenol, 2,4-dinitrotoluene, pyrene, and 1,2,4-trichlorobenzene had low MS and/or MSD recoveries. Associated sample results were qualified as estimated biased low (JL) for the above compounds. Naphthalene had low MS and high MSD recoveries; therefore, this compound was qualified

(J) as estimated. Benzo(a)pyrene, 4-nitrophenol, and pentachlorophenol had an RPD greater than QC limits. The associated sample was qualified (J) for benzo(a)pyrene. 4-nitrophenol and pentachlorophenol were qualified based on LCS failure.

- Sample ST14-W19 was analyzed as an MS/MSD sample. Naphthalene had low MS and MSD recoveries. Associated sample results were qualified as estimated biased low (JL) for naphthalene.
- Sample GMI22-08M was analyzed as an MS/MSD sample. 4-Nitrophenol had an RPD greater than QC limits. The associated sample result was qualified (J) for 4-nitrophenol.
- Sample SD13-03 was analyzed as an MS/MSD sample. 4-Nitrophenol had high MS and MSD recoveries. The associated sample result was non-detect; therefore, no data were qualified.

Fourth Quarter Metals Analyses

- Sample GMI22-08M was analyzed as an MS/MSD sample. Arsenic and iron had low MS recoveries. The associated arsenic result was qualified (JL). The iron concentration in the sample was greater than four times the spike amount, therefore the results were not qualified. The RPD was high for aluminum. The associated sample result was qualified as estimated (J).
- Sample LF04-4E was analyzed as an MS/MSD sample. Selenium had a low MS recovery. The associated sample result was qualified (JL) for selenium.
- Sample MW-10 was analyzed as an MS/MSD sample. Selenium and thallium had low MS and MSD recoveries. The associated sample results for selenium and thallium were qualified (JL).
- Sample OT15-C was analyzed as an MS/MSD sample. Aluminum had low MS/MSD recoveries, and barium and iron had high MS/MSD recoveries. Because the sample concentration was greater than four time the spike amount, the results were not qualified. Antimony, arsenic, cadmium, selenium and thallium had low MS and MSD recoveries. The associated sample results for these compounds were qualified (JL).

- Sample SD13-03 was analyzed as an MS/MSD sample. Aluminum, molybdenum, and vanadium had high MS and/or MSD recoveries. Iron had a high MS recovery and a low MSD recovery. Because the sample concentrations were greater than four times the spike amount, the results for iron and molybdenum were not qualified. Aluminum and vanadium were non-detect; therefore, no data were qualified. Antimony, arsenic, cadmium, thallium, and selenium had low MS and/or MSD recoveries. Associated sample results were qualified (JL).
- Sample ST14-W08 was analyzed as an MS/MSD sample. Iron had a high MSD recovery and aluminum had a high RPD. Because the sample concentration was greater than four times the spike amount, the results were not qualified.
- Sample ST14-W09 was analyzed as an MS/MSD sample. Aluminum and iron had high MS and MSD recoveries; however, because the sample concentration was greater than four times the spike amount, the results were not qualified. Selenium had a low MS recovery. The associated sample result was qualified (JL) for selenium.

Fourth Quarter Volatiles Analyses

- Sample GMI22-08M was analyzed as an MS/MSD sample. Chloroform had a high MS recovery. The associated sample result was non-detect, therefore no data were qualified.
- Sample MW-10 was analyzed as an MS/MSD sample. Benzene had a high MSD recovery. The associated sample was qualified (JH) for benzene.

Fourth Quarter Semi-Volatiles Analyses

- Sample FT09-12B was analyzed as an MS/MSD sample. MS and MSD recoveries were high for 4-nitrophenol; however, since the associated sample result was non-detect, no data were qualified.
- Sample GMI22-08M was analyzed as an MS/MSD sample. The MS and/or MSD recovery was low for acenaphthene; benz(a)anthracene; 1,2,4-trichlorobenzene; 2,4-dinitrotoluene; 4-chloro-3-methylphenol;

naphthalene; and pyrene. The associated sample results were qualified (JL).

- Sample MW-10 was analyzed as an MS/MSD sample. Naphthalene had high MS and high MSD recoveries; however, because the sample concentration was greater than four times the spike amount, the results were not qualified. The MS and MSD recoveries were low for 2,4-dinitrotoluene, 4-nitrophenol and pentachlorophenol, and the MS recovery was low for butyl benzyl phthalate. Butyl benzyl phthalate and pentachlorophenol had high RPD. No data were qualified, since a 1:10 dilution was required.
- Sample ST14-W09 was analyzed as an MS/MSD sample. The MSD recovery was high for 4-nitrophenol, and the RPD was high for 4-nitrophenol and pentachlorophenol. The associated sample results were qualified as estimated (J) for 4-nitrophenol and pentachlorophenol.

2.4.2.6 Holding Times and Preservation - The holding times were met for all parameters for both third and fourth quarter samples. Appendix F presents the dates of sampling, preparation/extraction, and analysis for each sample collected during the third and fourth quarter sampling events.

2.4.2.7 Surrogate and Internal Standard Analysis Results - Internal and surrogate standard recoveries were used to indicate acceptable extraction and analytical performance for each sample. Corrective actions initiated included re-extraction/reanalysis of samples exhibiting poor surrogate recovery and internal standard recovery, unless failure was due to dilution. All surrogate and internal standards were within control limits with the exception of the following:

Third Quarter Semi-Volatiles Analyses

- All surrogate recoveries were outside of control limits for sample SD13-07, due to a required 1:100 dilution; therefore, no results were qualified. 61.5

Fourth Quarter Semi-Volatiles Analyses

- Surrogate recoveries were outside of control limits for samples LSA1628-2 and MW-10 due to required 1:10 dilutions; therefore, no results were qualified.

2.4.2.8 Field Duplicates - Field duplicate samples were analyzed to assess sampling precision for the analytes detected. The results of the field duplicate analyses and the corresponding RPDs are presented in Tables 2-8 and 2-9. The RPDs calculated were less than 30 percent with the exception of the following:

Third Quarter Metals Analyses

- Sample LF01-1E and its duplicate FDUP-5 had an RPD greater than 30 percent for barium. Both samples were qualified (J) for barium.
- Sample SD13-05 and its duplicate FDUP-4 had an RPD greater than 30 percent for iron. Both samples were qualified (J) for iron.

Third Quarter Semi-Volatiles Analyses

- Sample LF01-1E and its duplicate FDUP-5 had an RPD greater than 30 percent for butyl benzyl phthalate. Both samples were qualified (J) for butyl benzyl phthalate.

Fourth Quarter Metals Analyses

- Sample ST14-W20 and its duplicate FDUP-3 had an RPD greater than 30 percent for aluminum, manganese, and arsenic. Both samples were qualified (J) for these metals.
- Sample SD13-05 and its duplicate FDUP-4 had an RPD greater than 30 percent for iron. Both samples were qualified (J) for iron.

TABLE 2-8
 DUPLICATE POSITIVE RESULTS TABLE
 THIRD QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID : Sample Date : Notes :	BSSA 19-OCT-95	FDUP-2 19-OCT-95 Duplicate of BSSA	% RPD	FT09-12A 18-OCT-95	FDUP-7 18-OCT-95 Duplicate of FT09-12A	%RPD
METALS TOTAL BY ICP/SW 6010 (ug/L)								
Aluminum	500		1820	2410	27.9	4370	5410	21.3
Barium	20.0		187	192	2.6	110	113	2.7
Calcium	100		153000	162000	5.7	143000	150000	4.8
Iron	50.0		5220	6650	24.1	4160	5140	21.1
Magnesium	250		6720	6890	2.5	4520	4740	4.8
Manganese	10.0		598	637	6.3	127	137	7.6
Potassium	600		1320	1450	9.4	1650	1910	14.6
Sodium	250		56400	56800	0.7	14200	14200	0
Zinc	10.0		197	210	6.4	14.0	17.0	19.4
ARSENIC TOTAL BY GFAA/SW 7060 (ug/L)								
Arsenic	5.00		<5.00					
LEAD TOTAL BY GFAA/SW3905M/7421 (ug/L)								
Lead	5.00		<5.00	5.38				
VOLATILE ORGANIC COMPOUNDS/SW9260/NONE (ug/L)								
Benzene	0.500							
Bromodichloromethane	0.500							
Bromoform	1.00							
Chloroform	0.500							
Dibromochloromethane	0.500							
Ethylbenzene	0.500							
Trichloroethene	0.500		<0.500	1.04				
cis-1,2-Dichloroethene	0.500		<0.500	0.321	IQ			
SEMI-VOLATILE ORGANIC COMPOUNDS/SW9270/SW3520 (ug/L)								
2-Methylnaphthalene	10.0							
Butyl benzyl phthalate	10.0		7.53	IQ				
Di-n-butylphthalate	10.0			25.6				
Naphthalene	10.0							
Phenol	10.0							
bis(2-Ethylhexyl)phthalate	10.0					2.84	IQ	31

Data Qualifications Flags/Notes:
 J = Estimated quantitation based upon QC data
 JB = Estimated quantitation: possibly biased high or a false positive based upon blank data
 JH = Estimated quantitation: possibly biased high based upon QC data
 JL = Estimated quantitation: possibly biased low or a false negative based upon QC data
 IQ = Estimated quantitation: detected below the Practical Quantitation Limit
 R = Datum rejected based upon QC data: do not use.

*Note: Percent RPD values greater than 30% are shown in boxes unless the samples or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.

☐ Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (J)

TABLE 2-8

DUPLICATE POSITIVE RESULTS TABLE

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

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID Sample Date Notes	GMD04-01M 21-OCT-95 Duplicate of GMD04-01M	FDUP-1 21-OCT-95 Duplicate of GMD04-01M	% RPD	LF01-1E 20-OCT-95	FDUP-5 20-OCT-95 Duplicate of LF01-1E	% RPD
PARAMETER/METHOD(UNITS)								
METALS, TOTAL BY ICP/SW 6910 (pp/L)								
Aluminum	500		2540	2380	6.5	1710	1340	24.3
Barium	20.0		118	106	10.7	857 J	612 J	33.4
Calcium	100		208000	204000	1.9	137000	139000	1.4
Iron	50.0		5770	5410	6.4	4220	4190	0.7
Magnesium	250		7640	7400	3.2	9260	9080	2.0
Manganese	10.0		1150	869	27.8	19600	14600	29.2
Potassium	600		3090	2470	22.3	1040 JH	872 JH	17.6
Sodium	250		25400	24600	3.2	19500	19200	1.6
Zinc	10.0		14.0	14.0	0	23.0	30.0	26.4
ARSENIC, TOTAL BY GFAA/SW 7069 (pp/L)								
Arsenic	5.00					5.67	5.25	7.7
LEAD, TOTAL BY GFAA/SW3065M/7431 (pp/L)								
Lead	5.00							
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8240/NONE (pp/L)								
Trichloroethene	0.500		1270	1280	0.8			
Xylenes (total)	1.00		<50.0	17.2 JQ				
cis-1,2-Dichloroethene	0.500		337	330	2.1			
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8260/NONE (pp/L)								
Benzene	0.500					1.55	1.69	8.6
Bromodichloromethane	0.500					0.221 JQ	<1.00	
Bromoform	1.00					1.06	1.24	15.7
Chloroform	0.500					1.25	1.43	13.4
Dibromochloromethane	0.500							
Ethylbenzene	0.500							
Trichloroethene	0.500							
cis-1,2-Dichloroethene	0.500							
SEMI-VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8270/SW3520 (pp/L)								
2-Methylnaphthalene	10.0							
Butyl benzyl phthalate	10.0			13.8		69.9 J	21.5 J	105.9
Di-n-butylphthalate	10.0		7.97 JQ			1.29 JQ	<10.9	
Naphthalene	10.0					2.88 JQ	2.17 JQ	28.1
Phenol	10.0							
bis(2-Ethylhexyl)phthalate	10.0					9.41 JQ	<10.9	

Data Qualification Flags/Notes:

- J = Estimated quantitation based upon QC data
 - JB = Estimated quantitation; possibly biased high or a false positive based upon blank data
 - JH = Estimated quantitation; possibly biased high based upon QC data
 - JL = Estimated quantitation; possibly biased low or a false negative based upon QC data
 - IQ = Estimated quantitation; detected below the Practical Quantitation Limit
- Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (E)

* Note: Percent RPD values greater than 30% are shown in boxes unless the sample or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.

□ Re boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (E)

TABLE 2-8
DUPLICATE POSITIVE RESULTS TABLE
THIRD QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID Sample Date Notes	OT15C		FDUP-8		SD13-05		FDUP-4	
			21-OCT-95	21-OCT-95	21-OCT-95	Duplicate of OT15C	23-OCT-95	23-OCT-95	Duplicate of SD13-05	23-OCT-95
METALS, TOTAL BY ICPSW 6019 (ug/L)										
Aluminum	500		5310 JL	4240	22.4		189	202	6.6	
Berium	20.0		200	221	10		128000	133000	3.8	
Calcium	100		185000	184000	0.5		431 J	151 J	96.2	
Iron	50.0		4540	3820	17.2		4170	4400	5.4	
Magnesium	250		5210	5140	1.4		98.0	102	4	
Manganese	10.0		444	489	9.6		2420 JH	2550 JH	5.2	
Potassium	600		3160	3600	13		22900	23700	3.4	
Sodium	250		27100	28000	3.3		26.0	19.0	31.1	
Zinc	10.0		11.0	11.0	0					
ARSENIC, TOTAL BY GFAS/SW 7060 (ug/L)										
Arsenic	5.00									
LEAD, TOTAL BY GFAS/SW3905M/7421 (ug/L)										
Lead	5.00									
VOLATILE ORGANIC COMPOUNDS/SW8160/NONE (ug/L)										
Benzene	0.500									
Bromodichloromethane	0.500									
Bromoform	1.00									
Chloroform	0.500									
Dibromochloromethane	0.500									
Ethylbenzene	0.500									
Trichloroethene	0.500									
cis-1,2-Dichloroethene	0.500									
SEMI-VOLATILE ORGANIC COMPOUNDS/SW8170/SW3520 (ug/L)										
2-Methylnaphthalene	10.0									
Butyl benzyl phthalate	10.0									
Di-n-butylphthalate	10.0									
Naphthalene	10.0									
Phenol	10.0									
bis(2-Ethylhexyl)phthalate	10.0									
			<10.5	1.22 JQ			8.80 JQ	9.76 JQ	10.3	
							6.32 JQ	2.76 JQ	78.4	

Data Qualification Flags/Notes:
 J = Estimated quantitation based upon QC data
 JB = Estimated quantitation; possibly biased high or a false positive based upon blank data
 JH = Estimated quantitation; possibly biased high based upon QC data
 JL = Estimated quantitation; possibly biased low or a false negative based upon QC data
 JQ = Estimated quantitation; detected below the Practical Quantitation Limit
 R = Datum rejected based upon QC data; do not use.

* Note: Percent RPD values greater than 30% are shown in boxes unless the sample or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.
 Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (J).

TABLE 2-8

DUPLICATE POSITIVE RESULTS TABLE
 THIRD QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carrawell Field
 Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID : Sample Date :	ST14-W16 20-OCT-95	FDUP-6 20-OCT-95 Duplicate of ST14-W16	% RPD	ST14-W20 20-OCT-95	FDUP-3 20-OCT-95 Duplicate of ST14-W20	% RPD
METALS, TOTAL BY ICP/SW 6010 (ug/L)								
Aluminum	500		1770	1620	8.8	5780	4690	20.8
Barium	20.0		1.40	1.37	2.2	220	213	3.2
Calcium	100		164000	156000	5	214000	210000	1.9
Iron	50.0		35800	32500	9.7	20300	19700	3
Magnesium	250		6970	6820	2.2	7090	6840	3.6
Manganese	10.0		450	422	6.4	470	441	6.4
Potassium	600		2220 JH	2240 JH	0.9	2620 JH	2300 JH	13
Sodium	250		26200	25900	1.2	21600	21900	1.4
Zinc	10.0		50.0	45.0	10.5	49.0	47.0	4.2
ARSENIC, TOTAL BY GFAS/SW 7060 (ug/L)								
Arsenic	5.00		30.3	30.9	2	30.2	29.6	2
LEAD, TOTAL BY GFAS/SW3005M/7421 (ug/L)								
Lead	5.00		86.8	88.9	2.4	12.1	11.2	7.7
VOIATILE ORGANIC COMPOUNDS BY GC/MS - SW8260/NONE (ug/L)								
Benzene	0.500		80.3	61.9	25.9			
Bromodichloromethane	0.500							
Bromoform	1.00							
Chloroform	0.500							
Dibromodichloromethane	0.500							
Ethylbenzene	0.500		1.78 JQ	1.32 JQ	29.7			
Trichloroethene	0.500							
cis-1,2-Dichloroethene	0.500							
SEMI-VOIATILE ORGANIC COMPOUNDS BY GC/MS - SW8270/SW3510 (ug/L)								
2-Methylnaphthalene	10.0		3.03 JQ	3.80 JQ	22.5			
Ethyl benzy phthalate	10.0		4.07 JQ	6.32 JQ	43.3	5.28 JQ	7.40 JQ	33.4
Di-n-butylphthalate	10.0							
Naphthalene	10.0		9.76 JQ	11.4	15.5			
Phenol	10.0		2.10 JQ	3.26 JQ	43.3			
bis(2-Ethylhexyl)phthalate	10.0		5.36 JQ	9.18 JQ	52.5			

Prepared By: JLP 4/3/96
 Checked By: SDM 4/3/96

Data Qualification Flags/Notes:
 J = Estimated quantitation based upon QC data
 JB = Estimated quantitation: possibly biased high or a false positive based upon blank data
 JH = Estimated quantitation: possibly biased high based upon QC data
 JL = Estimated quantitation: possibly biased low or a false negative based upon QC data
 JQ = Estimated quantitation: detected below the Practical Quantitation Limit
 R = Datum rejected based upon QC data; do not use.

* Note: Percent RPD values greater than 30% are shown in boxes unless the sample or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.
 Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (J).

TABLE 2-9
 DUPLICATE POSITIVE RESULTS TABLE
 FOURTH QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carroll Field
 Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID : Sample Date : Notes :	BSSA 10-JAN-96	FDUP-2 10-JAN-96 Duplicate of BSSA	% RPD	FT09-12A 13-JAN-96	FDUP-7 13-JAN-96 Duplicate of FT09-12A	% RPD
METALS, TOTAL BY ICP/SW 6010 (ug/L)								
Aluminum	500		16200	14200	13.2	7540	6170	20.0
Barium	20.0		306	311	1.6	127	131	3.1
Beryllium	3.00							
Calcium	100		362000	391000	7.7	186000	179000	3.8
Chromium	50.0		<50.0	67.0				
Cobalt	50.0							
Copper	50.0		59.0	60.0	1.7			
Iron	50.0		45700	49400	7.8	8680	7920	9.2
Magnesium	250		10000	9980	0.2	5570	5300	5.0
Manganese	10.0		1760	1830	3.9	152	145	4.7
Nickel	50.0		<50.0	58.0				
Potassium	600		3920	3510	11.0	2630	2370	10.4
Sodium	250		57800	57700	0.2	15200	14800	2.7
Vanadium	50.0		113	119	5.2			
Zinc	10.0		1300	1280	1.6	15.0	16.0	6.5
ARSENIC, TOTAL BY GFAA/SW 7060 (ug/L)								
Arsenic	5.00		6.47	5.76	11.6			
LEAD, TOTAL BY GFAA/SW 065M/7421 (ug/L)								
Lead	5.00		36.8	33.5	9.4			
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SWE76/SW3510 (ug/L)								
Benzene	0.500							
Chloroform	0.500							
Toluene	0.500							
cis-1,2-Dichloroethene	0.500		0.436 JQ	0.460 JQ				
SEMI-VOLATILE ORGANIC COMPOUNDS BY GC/MS - SWE76/SW3510 (ug/L)								
2-Methylnaphthalene	10.0							
Acenaphthene	10.0							
Benzo(a)anthracene	10.0							
Butyl benzyl phthalate	10.0					1.19 JQ	2.56 JQ	
Naphthalene	10.0							
Pyrene	10.0							
but(2-Ethylhexyl)phthalate	10.0							

Data Qualification Flags/Notes:
 J = Estimated quantitation based upon QC data
 JB = Estimated quantitation based upon blank data
 JH = Estimated quantitation: possibly biased high or a false positive based upon QC data
 JI = Estimated quantitation: possibly biased low or a false negative based upon QC data
 JQ = Estimated quantitation: detected below the Practical Quantitation Limit
 R = Datum rejected based upon QC data: do not use.

*Note: Percent RPD values greater than 30% are shown in boxes unless the sample or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.
 □ Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (J)

TABLE 2-9

DUPLICATE POSITIVE RESULTS TABLE
FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID : Sample Date : Notes :	LF01-IE 12-JAN-96	FDUP-5 12-JAN-96 , Duplicate of LF01-IE	% RPD	LF05-5C 15-JAN-96	FDUP-1 15-JAN-96 Duplicate of LF05-5C	% RPD
METALS, TOTAL BY ICP/SPW 6918 (ug/L)								
Aluminum	500		2640	2640	0.0	<500	<500	
Berium	20.0		596	502	17.1	229	229	0.0
Beryllium	3.00							
Calcium	100		138000	140000	1.4	138000	139000	0.7
Chromium	50.0							
Cobalt	50.0							
Copper	50.0							
Iron	50.0		4210	4580	8.4	936	907	3.1
Magnesium	250		8980	8940	0.4	6870	6890	0.3
Manganese	10.0		12700	11200	12.6	893	879	1.6
Nickel	50.0							
Potassium	600		831	836	0.6	1610	1630	1.2
Sodium	250		19700	19800	0.5	22300	22300	0.0
Vanadium	50.0							
Zinc	10.0							
ARSENIC, TOTAL BY GFAS/SPW 7669 (ug/L)								
Arsenic	5.00							
LEAD, TOTAL BY GFAS/SPW3065M7421 (ug/L)								
Lead	5.00							
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW#246/NONE (ug/L)								
Trichloroethene	0.500					939	879	6.6
cis-1,2-Dichloroethene	0.500					244	228	6.8
trans-1,2-Dichloroethene	0.500					19.2 JQ	16.4 JQ	15.7
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW#246/NONE (ug/L)								
Benzene	0.500							
Chloroform	0.500							
Toluene	0.500							
cis-1,2-Dichloroethene	0.500							
SEMI-VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW#270/SW3528 (ug/L)								
2-Methylnaphthalene	10.0							
Acenaphthene	10.0							
Benz(a)anthracene	10.0							
Butyl benzyl phthalate	10.0							
Naphthalene	10.0							
Pyrene	10.0							
bis(2-Ethylhexyl)phthalate	10.0							
Data Qualification Flag/Notes:								
J	J = Estimated quantitation based upon QC data							
JB	JB = Estimated quantitation; possibly biased high or a false positive based upon blank data							
IH	IH = Estimated quantitation; possibly biased high based upon QC data							
JL	JL = Estimated quantitation; possibly biased low or a false negative based upon QC data							
JQ	JQ = Estimated quantitation; detected below the Practical Quantitation Limit							
R	R = Datum rejected based upon QC data; do not use							

*Note: Percent RPD values greater than 30% are shown in boxes unless the sample or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.
 Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (J).

TABLE 2-9

DUPLICATE POSITIVE RESULTS TABLE
FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carlisle Field
Fort Worth, Texas

PARAMETER/METHOD(S)	Quantitation Limits	Sample ID : Sample Date :	ST14-W16 12-JAN-96	FDUP-8 12-JAN-96 Duplicate of ST14-W16	% RPD	ST14-W20 12-JAN-96	FDUP-3 12-JAN-96 Duplicate of ST14-W20	% RPD
METALS, TOTAL BY ICPSW 6818 (ug/L)								
Aluminum	500		1460	1690	14.6	1220 J	3090 J	84.4
Barium	20.0		119	124	4.1	150	168	11.3
Beryllium	3.00							
Calcium	100		139000	160000	0.6	139000	165000	17.1
Chromium	50.0		72.0	74.0	2.7			
Cobalt	50.0							
Copper	50.0		43800	45800	4.5	13200	14200	7.3
Iron	50.0		6800	6810	0.1	5930	5930	10.1
Magnesium	250		395	424	7.1	219 J	299 J	30.9
Manganese	10.0		<50.0	63.0				
Nickel	50.0		1640	1680	2.4	1160	1470	23.6
Potassium	600		25700	24800	3.6	22300	20700	7.4
Sodium	250							
Vanadium	50.0		33.0	42.0	24.0	10.0	22.0	75.0
Zinc	10.0							
ARSENIC, TOTAL BY GFAS/SW 7069 (ug/L)								
Arsenic	5.00		38.8	43.3	11.0	52.8 J	37.2 J	34.7
LEAD, TOTAL BY GFAS/SW 3065M/7421 (ug/L)								
Lead	5.00		159	185	15.1	<5.00	7.25	
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8260/NONE (ug/L)								
Benzene	0.500		1.58	1.52	3.9			
Chloroform	0.500							
Toluene	0.500					0.275 JB	<0.500	
cis-1,2-Dichloroethene	0.500							
SEMI-VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8270/SW328 (ug/L)								
2-Methylnaphthalene	10.0		3.70 JQ	4.23 JQ	13.4			
Acenaphthene	10.0							
Benz(a)anthracene	10.0		4.93 JQ	5.63 JQ	13.3	5.08 JQ	11.4	76.7
Benyl benzy/ phthalate	10.0		12.2	14.1	14.4			
Naphthalene	10.0							
Pyrene	10.0							
bis(2-Ethylhexyl)phthalate	10.0		4.46 JQ	4.11 JQ	8.2			

Data Qualification Flags/Notes:

- J = Estimated quantitation based upon QC data
- JB = Estimated quantitation; possibly biased high or a false positive based upon blank data
- JH = Estimated quantitation; possibly biased high based upon QC data
- JL = Estimated quantitation; possibly biased low or a false negative based upon QC data
- JQ = Estimated quantitation; detected below the Practical Quantitation Limit
- R = Datum rejected based upon QC data; do not use

Prepared By: JLP 4/3/96

Checked By: SDM 4/3/96

*Note: Percent RPD values greater than 30% are shown in boxes unless the sample or its duplicate is less than five times the PQL and the difference between the concentrations is less than two times the PQL.
 [] Results in boxes exceeded RPD criteria. Associated sample results were qualified as estimated values (J)

- Sample ST14-03 and its duplicate FDUP-6 had an RPD greater than 30 percent for iron and zinc. Both samples were qualified (J) for these metals.

2.4.2.9 Field Blanks - Trip blanks were analyzed to assess sample contamination that may have occurred during shipping, and equipment blanks were analyzed to assess sample contamination that may have occurred during samples collection. Table 2-10 presents the results of trip blanks and Table 2-11 presents the results of the equipment blanks. Field blank results were acceptable with the exception of the following:

Fourth Quarter Trip Blanks

- The trip blank associated with samples collected January 12, 1996 contained toluene at 0.425 ug/L. Sample ST14-W20 was qualified (JB) due to blank contamination.

Fourth Quarter Equipment Blanks

- Equipment blanks, EB-1, EB-2, and EB-3 contained calcium at concentrations ranging from 113 ug/L to 326 ug/L. All associated sample results for calcium were greater than five times the blank concentrations, therefore the results were not qualified.
- Equipment blank EB-1, contained naphthalene at 5.58 ug/L. Samples SD13-01 and MW-5 were qualified (JB) due to blank contamination.

2.4.2.10 Completeness - Field completeness is defined as the number of field samples collected divided by the number of field samples planned. Field completeness was 99 percent for the third quarter sampling event because one monitoring well, GMI22-01M, was not accessible due to site construction activities. Field completeness was 100 percent for the fourth quarter sampling event.

TABLE 2-10

TRIP BLANK TABLE
THIRD AND FOURTH QUARTERS
Naval Air Station Fort Worth Joint Reserve Base, Currawell Field
Fort Worth, Texas

PARAMETER/METHOD(UNIT)	Quantitation Limit	Sample ID :		TB-101895 18-OCT-95 SW8260	TB-101995 19-OCT-95 SW8260	TB-102095 20-OCT-95 SW8260	TB-102195 21-OCT-95 SW8260	TB-11096 10-JAN-96 SW8260
		Sample Date :	Notes :					
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8240 or SW8260/NONE (ug/L)								
1,1,1-Trichloroethane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
1,1,2,2-Tetrachloroethane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
1,1,2-Trichloroethane	1.00	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
1,1-Dichloroethene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
1,2-Dichloroethane	1.00	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
2-Butanone	5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00 J
2-Chloroethyl vinyl ether	5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00 R
2-Hexanone	5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00 J
4-Methyl-2-pentanone	5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00 J
Acetone	5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00 J
Benzene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Bromodichloromethane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Bromoform	1.00	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00
Bromomethane	2.00	<2.00		<2.00	<2.00	<2.00	<2.00	<2.00
Carbon disulfide	1.00	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00
Carbon tetrachloride	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Chlorobenzene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Chloroethane	2.00	<2.00		<2.00	<2.00	<2.00	<2.00	<2.00
Chloroform	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Chloromethane	2.00	<2.00		<2.00	<2.00	<2.00	<2.00	<2.00
Dibromochloromethane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Dibromomethane	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Ethylbenzene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Methylene chloride	2.00	<2.00		<2.00	<2.00	<2.00	<2.00	<2.00
Styrene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Tetrachloroethene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Toluene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Trichloroethene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
Vinyl acetate	5.00	<5.00		<5.00	<5.00	<5.00	<5.00	<5.00
Vinyl chloride	2.00	<2.00		<2.00	<2.00	<2.00	<2.00	<2.00
Xylenes (total)	1.00	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00
cis-1,2-Dichloroethene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
cis-1,3-Dichloropropene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
trans-1,2-Dichloroethene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
trans-1,3-Dichloropropene	0.500	<0.500		<0.500	<0.500	<0.500	<0.500	<0.500
% surrogate recovery (Control Limit)								
sur-1,2-Dichloroethane-d4 R% (76 - 114)		96.0		97.0	98.0	95.0	93.0	93.0
sur-Bromofluorobenzene R% (86 - 115)		90.0		96.0	99.0	94.0	96.0	93.0
sur-Toluene-d8 R% (88 - 110)		100.0		98.0	101.0	99.0	100.0	102.0

Data Qualification Flags/Notes:

- J = Estimated quantitation based upon QC data
- JB = Estimated quantitation based upon blank data
- JL = Estimated quantitation: possibly biased high or a false positive based upon blank data
- JH = Estimated quantitation: possibly biased high based upon QC data
- JL = Estimated quantitation: possibly biased low or a false negative based upon QC data
- IQ = Estimated quantitation: detected below the Practical Quantitation Limit
- R = Datum rejected based upon QC data; do not use.
- ☐ Results in boxes are reported above PQL.

TABLE 2-11

EQUIPMENT BLANK SUMMARY TABLE
 FOURTH QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID :		
		EB-1 15-JAN-96	EB-2 14-JAN-96	EB-3 13-JAN-96
METALS, TOTAL BY ICP/SW 6910 (ug/L)				
Aluminum	500	<500	<500	<500
Antimony	250	<250	<250	<250
Barium	20.0	<20.0	<20.0	<20.0
Beryllium	3.00	<3.00	<3.00	<3.00
Cadmium	10.0	<10.0	<10.0	<10.0
Calcium	100	113	326	147
Chromium	50.0	<50.0	<50.0	<50.0
Cobalt	50.0	<50.0	<50.0	<50.0
Copper	50.0	<50.0	<50.0	<50.0
Iron	50.0	<50.0	<50.0	<50.0
Magnesium	250	<250	<250	<250
Manganese	10.0	<10.0	<10.0	<10.0
Molybdenum	50.0	<50.0	<50.0	<50.0
Nickel	50.0	<50.0	<50.0	<50.0
Potassium	600	<600	<600	<600
Silver	50.0	<50.0	<50.0	<50.0
Sodium	250	<250	<250	<250
Vanadium	50.0	<50.0	<50.0	<50.0
Zinc	10.0	<10.0	<10.0	<10.0
ARSENIC, TOTAL BY GFAA/SW 7068 (ug/L)				
Arsenic	5.00	<5.00	<5.00	<5.00
LEAD, TOTAL BY GFAA/SW 3065M/7421 (ug/L)				
Lead	5.00	<5.00	<5.00	<5.00
MERCURY, TOTAL BY CYAA/SW 7470 (ug/L)				
Mercury	0.500	<0.500	<0.500	<0.500
SELENIUM, TOTAL BY GFAA/SW 7740/METHOD (ug/L)				
Selenium	5.00	<5.00	<5.00	<5.00
THALIAM, TOTAL BY GFAA/SW 3020/7941 (ug/L)				
Thallium	2.00	<2.00	<2.00	<2.00
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SWF69/NONE (ug/L)				
1,1,1-Trichloroethane	0.500	<0.500	<0.500	<0.500
1,1,2,2-Tetrachloroethane	0.500	<0.500	<0.500	<0.500
1,1,2-Trichloroethane	1.00	<1.00	<1.00	<1.00
1,1-Dichloroethane	0.500	<0.500	<0.500	<0.500
1,1-Dichloroethane	0.500	<0.500	<0.500	<0.500
1,2-Dichloroethane	1.00	<1.00	<1.00	<1.00
1,2-Dichloropropane	0.500	<0.500	<0.500	<0.500
2-Butanone	5.00	<5.00	<5.00	<5.00
2-Chloroethyl vinyl ether	5.00	<5.00 R	<5.00	<5.00
2-Hexanone	5.00	<5.00	<5.00	<5.00
4-Methyl-2-pentanone	5.00	<5.00	<5.00	<5.00

TABLE 2-11

EQUIPMENT BLANK SUMMARY TABLE
FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carlwell Field
Fort Worth, Texas

PARAMETER/METHOD(UNITS)	Quantitation Limits	Sample ID :		
		Sample Date	Sample Date	Sample Date
	Notes :	EB-1	EB-2	EB-3
		15-JAN-96	14-JAN-96	13-JAN-96
VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW7616/NONE (ug/L cont'd)				
Acetone	5.00	<5.00	<5.00	<5.00
Benzene	0.500	<0.500	<0.500	<0.500
Bromochloromethane	0.500	<0.500	<0.500	<0.500
Bromoform	1.00	<1.00	<1.00	<1.00
Bromomethane	2.00	<2.00	<2.00	<2.00
Carbon disulfide	1.00	<1.00	<1.00	<1.00
Carbon tetrachloride	0.500	<0.500	<0.500	<0.500
Chlorobenzene	0.500	<0.500	<0.500	<0.500
Chloroethane	2.00	<2.00	<2.00	<2.00
Chloroform	0.500	<0.500	<0.500	<0.500
Chloromethane	2.00	<2.00	<2.00	<2.00
Dibromochloromethane	0.500	<0.500	<0.500	<0.500
Ethylbenzene	0.500	<0.500	<0.500	<0.500
Methylene chloride	2.00	<2.00	<2.00	<2.00
Styrene	0.500	<0.500	<0.500	<0.500
Tetrachloroethene	0.500	<0.500	<0.500	<0.500
Toluene	0.500	<0.500	<0.500	<0.500
Trichloroethene	0.500	<0.500	<0.500	<0.500
Vinyl acetate	5.00	<5.00	<5.00	<5.00
Vinyl chloride	2.00	<2.00	<2.00	<2.00
Xylenes (total)	1.00	<1.00	<1.00	<1.00
cis-1,2-Dichloroethene	0.500	<0.500	<0.500	<0.500
trans-1,2-Dichloroethene	0.500	<0.500	<0.500	<0.500
trans-1,3-Dichloropropene	0.500	<0.500	<0.500	<0.500
% SURrogate Recovery (Control Limit)				
m-1,2-Dichloroethane-d4 R% (76 - 114)	-	93.0	94.0	93.0
o-1,2-Dichloroethane R% (86 - 115)	-	92.0	100.0	98.0
m-Toluene-d8 R% (88 - 110)	-	98.0	97.0	99.0
SEMI-VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW7617/SW3526 (ug/L)				
1,2,4-Trichlorobenzene	10.0	<10.8	<11.0	<10.0
1,2-Dichlorobenzene	10.0	<10.8	<11.0	<10.0
1,3-Dichlorobenzene	10.0	<10.8	<11.0	<10.0
1,4-Dichlorobenzene	10.0	<10.8	<11.0	<10.0
2,4,5-Trichlorophenol	20.0	<21.5	<22.0	<20.0
2,4,6-Trichlorophenol	10.0	<10.8	<11.0	<10.0
2,4-Dichlorophenol	10.0	<10.8	<11.0	<10.0
2,4-Dimethylphenol	10.0	<10.8	<11.0	<10.0
2,4-Dinitrophenol	10.0	<10.8	<11.0	<10.0
2,4-Dinitrotoluene	50.0	<53.8	<55.0	<50.0
2,6-Dinitrotoluene	10.0	<10.8	<11.0	<10.0
2-Chloronaphthalene	10.0	<10.8	<11.0	<10.0
2-Chlorophenol	10.0	<10.8	<11.0	<10.0
2-Methylnaphthalene	10.0	<10.8	<11.0	<10.0
2-Methylphenol	10.0	<10.8	<11.0	<10.0

TABLE 2-11

EQUIPMENT BLANK SUMMARY TABLE
FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

PARAMETER/METHOD(UNIT)	Quantitation Limits	Sample ID : Sample Date : Notes :	EB-1 15-JAN-96	EB-2 14-JAN-96	EB-3 13-JAN-96
SEMI-VOLATILE ORGANIC COMPOUNDS BY GC/MS - SW8270SW3520 (us/L) cont'd.					
2-Nitroaniline	50.0		<3.8	<5.0	<50.0
2-Nitrophenol	10.0		<10.8	<11.0	<100
3,5-Dichlorobenzidine	20.0		<21.5	<22.0	<20.0
3-Nitroaniline	50.0		<3.8	<5.0	<50.0
4,6-Dinitro-2-methylphenol	50.0		<3.8	<5.0	<50.0
4-Bromophenyl phenyl ether	10.0		<10.8	<11.0	<100
4-Chloro-3-methylphenol	10.0		<10.8	<11.0	<100
4-Chloroaniline	20.0		<21.5 J	<22.0 J	<20.0
4-Chlorophenyl phenyl ether	10.0		<10.8	<11.0	<100
4-Methylphenol	10.0		<10.8	<11.0	<100
4-Nitroaniline	50.0		<3.8	<5.0	<50.0
4-Nitrophenol	50.0		<3.8	<5.0 J	<50.0
Acetophenone	10.0		<10.8	<11.0	<100
Acenaphthylene	10.0		<10.8	<11.0	<100
Anthracene	10.0		<10.8	<11.0	<100
Benzo(a)anthracene	10.0		<10.8	<11.0	<100
Benzo(a)pyrene	10.0		<10.8	<11.0	<100
Benzo(b)fluoranthene	10.0		<10.8	<11.0	<100
Benzo(g,h,i)perylene	10.0		<10.8	<11.0	<100
Benzo(k)fluoranthene	10.0		<10.8	<11.0	<100
Benzoic acid	50.0		<3.8	<5.0	<50.0
Benzyl alcohol	20.0		<21.5	<22.0	<20.0
Benzyl benzy l phthalate	10.0		<10.8	<11.0	<100
Chrysene	10.0		<10.8	<11.0	<100
Di-n-butylphthalate	10.0		<10.8	<11.0	<100
Di-n-octylphthalate	10.0		<10.8	<11.0	<100
Dibenz(a,h)anthracene	10.0		<10.8	<11.0	<100
Dibenzofuran	10.0		<10.8	<11.0	<100
Diethylphthalate	10.0		<10.8	<11.0	<100
Dimethylphthalate	10.0		<10.8	<11.0	<100
Fluoranthene	10.0		<10.8	<11.0	<100
Fluorene	10.0		<10.8	<11.0	<100
Hexachlorobenzene	10.0		<10.8	<11.0	<100
Hexachlorobutadiene	10.0		<10.8	<11.0	<100
Hexachlorocyclopentadiene	10.0		<10.8 R	<11.0 R	<100
Hexachloroethane	10.0		<10.8	<11.0	<100
Indeno(1,2,3-cd)pyrene	10.0		<10.8	<11.0	<100
Isophorone	10.0		<10.8	<11.0	<100
Naphthalene	10.0		5.98	<11.0	<100
Nitrobenzene	10.0		<10.8	<11.0	<100
Pentachlorophenol	30.0		<32.2	<33.0	<30.0
Phenanthrene	10.0		<10.8	<11.0	<100
Phenol	10.0		<10.8	<11.0	<100
Pyrene	10.0		<10.8	<11.0	<100
bis(2-Chloroethoxy) methane	10.0		<10.8	<11.0	<100
bis(2-Chloroethyl) ether	10.0		<10.8	<11.0	<100
bis(2-Chloroisopropyl) ether	10.0		<10.8	<11.0	<100
bis(2-Ethylhexyl) phthalate	10.0		<10.8	<11.0	<100

TABLE 2-11

EQUIPMENT BLANK SUMMARY TABLE
FOURTH QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carlswell Field
 Fort Worth, Texas

PARAMETER/METHOD(UNIT)	Quantitation Limits	Sample ID :		
		Sample Date :	EB-1	EB-2
n-Nitrosodipropylamine	10.0	15-JAN-96	14-JAN-96	13-JAN-96
n-Nitrosodiphenylamine	10.0			
% Extracts Recovered (Control Limit)				
ur-2,4,6-Trichlorophenol R% (10 - 173)	-	<10.8	<11.0	<10.0
ur-2-Fluorobiphenyl R% (43 - 116)	-	<10.8	<11.0	<10.0
ur-2-Fluorophenol R% (21 - 100)	-	58.1	78.8	52.0
ur-Nitrobenzene-d5 R% (35 - 114)	-	80.6	86.9	69.0
ur-Phenol-d6 R% (10 - 94)	-	63.4	75.8	58.0
ur-Terphenyl-d14 R% (38 - 141)	-	61.8	69.9	55.0
	-	61.1	70.9	55.0
	-	72.7	86.9	56.0

Data Qualification Flags/Notes:

- J - Estimated quantitation based upon QC data
- JB - Estimated quantitation: possibly biased high or a false positive based upon blank data
- JH - Estimated quantitation: possibly biased high based upon QC data
- JL - Estimated quantitation: possibly biased low or a false negative based upon QC data
- JQ - Estimated quantitation: detected below the Practical Quantitation Limit
- R - Data rejected based upon QC data: do not use

Results in boxes are reported above PQL

Prepared By: JLP 3/26/96

Checked By: SDM 3/26/96

The overall completeness of sampling and analysis activities is defined as the amount of acceptable data actually acquired divided by the total sample data planned. This calculation combines the field completeness and the analytical completeness. The goal for this project is 90 percent.

The overall completeness for third quarter was 99 percent for all analytes with the following exceptions:

- Volatile constituents: 2-chloroethyl vinyl ether 83 percent
- Semi-volatile constituents:

2,4-dinitrophenol	74 percent
benzyl alcohol	87 percent
hexachlorocyclopentadiene	0 percent
pentachlorophenol	61 percent
4,6-dinitro-2-methylphenol	86 percent
4-nitrophenol	86 percent
phenol	86 percent
2,4-dichlorophenol	86 percent

For third quarter, the constituents listed above failed the completeness goal of 90 percent due to laboratory calibration failure and poor LCS recoveries.

The overall completeness for fourth quarter was 100 percent for all analytes with the exception of 2-chloroethyl vinyl ether (50 percent) and hexachlorocyclopentadiene (16 percent). These analytes also failed the completeness goal due to laboratory calibration failure and poor LCS recoveries.

2.4.3 Methodology for Comparison to Regulatory Standards

The chemical data generated from the third and fourth quarter sampling events were compared to U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Levels (MCLs) and the Texas Natural Resource Conservation Commission (TNRCC) Risk Reduction Standards

(TNRCC, 1993). Comparison of metals to background concentrations under Risk Reduction Standard Number 1 was not possible because basewide background levels for metals have not as yet been established. Therefore, the ground-water data collected for this project were evaluated based on Risk Reduction Standard Number 2.

In accordance with Risk Reduction Standard Number 2, ground water was compared to existing USEPA MCLs, which are applicable for both residential and industrial land use categories. For constituents that do not have MCLs, Medium-Specific Concentrations (MSCs) have been established by TNRCC for residential and industrial land use conditions. Tables 2-12 through 2-15 present the MCLs and MSCs applicable to ground water in the industrial land use category. The positive results reported for the third and fourth quarter ground-water monitoring events are presented in Appendix H. Sample results exceeding MCL/MSc concentrations are indicated on the table.

TABLE 2-12

**TNRCC GROUND WATER
RISK REDUCTION RULES (CATEGORY #2)
METALS
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas**

	EPA MCL ^(a) (µg/L)	TNRCC ^(b) GW-Ind (µg/L)
<u>Metals, Total by ICP/SW6010</u>		
Aluminum	NA	NA
Antimony	6	6
Barium	2000	2000
Beryllium	4	4
Cadmium	5	5
Calcium	NA	NA
Chromium	100	100
Cobalt	NA	NA
Copper	NA	NA
Iron	NA	NA
Magnesium	NA	NA
Manganese	NA	NA
Molybdenum	NA	NA
Nickel	100	100
Potassium	NA	NA
Silver	NA	511
Sodium	NA	NA
Vanadium	NA	NA
Zinc	NA	NA
<u>Metals, Total by GFAA</u>		
Arsenic SW 7060	50	50
Lead SW 7421	15	15
Mercury SW 7470	2	2
Selenium SW 7740	50	50
Thallium SW 7841	NA	NA

NA : Not Available

(a) Primary Drinking Water Maximum Contaminant Levels (MCLs)
Specified under the Safe Drinking Water Act (40 CFR 141)

(b) TNRCC Final Risk Reduction Standards (TAC, Title 30, Chapter 335)

PREPARED/DATE: SDP 4/05/96

CHECKED/DATE: SDM 4/05/96

**TNRCC GROUND WATER
RISK REDUCTION RULES (CATEGORY #2)
VOLATILE ORGANIC COMPOUNDS**
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

	EPA MCL (a) (µg/L)	TNRCC (b) GW-Ind (µg/L)
<u>Volatile Organic Compounds</u>		
Acetone	NA	10200
Benzene	5	5
Bromodichloromethane	100	100
Bromoform	100	100
Bromomethane	NA	143
2-Butanone (MEK)	NA	5110
Carbon disulfide	NA	10200
Carbon tetrachloride	5	5
Chlorobenzene	100	100
Dibromochloromethane	100	100
Chloroethane	NA	2040
2-Chloroethyl vinyl ether	NA	NA
Chloroform	100	100
Chloromethane	NA	NA
1,1-Dichloroethane	NA	10200
1,2-Dichloroethane	5	5
1,1-Dichloroethene	7	7
cis-1,2-Dichloroethene	70	70
trans-1,2-Dichloroethene	100	100
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropene	NA	NA
trans-1,3-Dichloropropene	NA	NA
Ethylbenzene	700	700
2-Hexanone	NA	NA
Methylene chloride	5	5
4-Methyl-2-pentanone (MIBK)	NA	5110
Styrene	100	100
1,1,2,2-Tetrachloroethane	NA	14.3
Tetrachloroethene	5	5
Toluene	1000	1000
1,1,1-Trichloroethane	200	200
1,1,2-Trichloroethane	5	5
Trichloroethene	5	5
Vinyl acetate	NA	102000
Vinyl chloride	2	2
Xylenes (total)	10000	10000

NA: Not available

(a) Primary Drinking Water Maximum Contaminant Levels (MCLs)
Specified under the Safe Drinking Water Act (40 CFR 141)

(b) TNRCC Final Risk Reduction Standards (TAC, Title 30, Chapter 335)

PREPARED/DATE: JLP 09-27-95
CHECKED/DATE: SDM 10-2-95

TABLE 2-14

**TNRCC GROUND WATER
RISK REDUCTION RULES (CATEGORY #2)
PESTICIDES/PCBs
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas**

	EPA MCL ^(a) (µg/L)	TNRCC ^(b) GW-Ind. (µg/L)
<u>Pesticides/PCBs</u>		
Aldrin	NA	0.0168
alpha-BHC	NA	NA
beta-BHC	NA	NA
delta-BHC	NA	NA
gamma-BHC (Lindane)	0.2	0.2
Chlordane	2	2
4,4'-DDD	NA	1.19
4,4'-DDE	NA	0.842
4,4'-DDT	NA	0.842
Dieldrin	NA	0.0179
Endosulfan I	NA	5.11
Endosulfan II	NA	5.11
Endosulfan sulfate	NA	NA
Endrin	2	2
Endrin Aldehyde	NA	NA
Heptachlor	0.4	0.4
Heptachlor epoxide	0.2	0.2
Methoxychlor	40	40
Toxaphene	3	3
PCB-1016	0.5	0.5
PCB-1221	0.5	0.5
PCB-1232	0.5	0.5
PCB-1242	0.5	0.5
PCB-1248	0.5	0.5
PCB-1254	0.5	0.5
PCB-1260	0.5	0.5

NA: Not Available

(a) Primary Drinking Water Maximum Contaminant Levels (MCLs)
Specified under the Safe Drinking Water Act (40 CFR 141)

(b) TNRCC Final Risk Reduction Standards (TAC, Title 30, Chapter 335)

PREPARED/DATE: JLP 9/27/95
CHECKED/DATE: SDM 10/02/95

TABLE 2-15

**TNRCC GROUND WATER
RISK REDUCTION RULES (CATEGORY #2)
SEMI-VOLATILE ORGANIC COMPOUNDS**
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

	EPA MCL ^(a) (µg/L)	TNRCC ^(b) GW-Ind (µg/L)
<u>Semi-Volatile Organics:</u>		
<u>Base/Neutral Extractables</u>		
Acenaphthene	NA	6130
Acenaphthylene	NA	NA
Anthracene	NA	30700
Benz(a)anthracene	NA	NA
Benzo(b)fluoranthene	NA	NA
Benzo(ghi)perylene	NA	NA
Benzo(a)pyrene	NA	NA
Benzo(k)fluoranthene	NA	NA
Benzyl alcohol	NA	NA
bis(2-Chloroethoxy)methane	NA	NA
bis(2-Chloroethyl)ether	NA	0.26
bis(2-Chloroisopropyl)ether	NA	40.9
bis(2-ethylhexyl)phthalate	NA	20.4
4-Bromophenyl phenyl ether	NA	NA
Butyl benzyl phthalate	NA	NA
4-Chloroaniline	NA	409
2-Chloronaphthalene	NA	8180
4-Chlorophenyl phenyl ether	NA	NA
Chrysene	NA	NA
Dibenz(a,h)anthracene	NA	NA
Dibenzofuran	NA	NA
Di-n-butylphthalate	NA	10200
1,2-Dichlorobenzene	600	600
1,3-Dichlorobenzene	600	600
1,4-Dichlorobenzene	75	75
3,3'-Dichlorobenzidine	NA	NA
Diethylphthalate	NA	81800
Dimethylphthalate	NA	NA
2,4-Dinitrotoluene	NA	NA
2,6-Dinitrotoluene	NA	NA
Di-n-octyl phthalate	NA	2040
Fluoranthene	NA	4090
Fluorene	NA	4090
Hexachlorobenzene	1.0	1.0
Hexachlorobutadiene	NA	36.7
Hexachlorocyclopentadiene	NA	NA
Hexachloroethane	NA	204
Indeno(1,2,3-cd)pyrene	NA	NA
Isophorone	NA	NA
2-Methylnaphthalene	NA	NA
Naphthalene	NA	4090

TABLE 2-15

**TNRCC GROUND WATER
RISK REDUCTION RULES (CATEGORY #2)
SEMI-VOLATILE ORGANIC COMPOUNDS
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas**

	EPA MCL ^(a) (µg/L)	TNRCC ^(b)
		GW-Ind (µg/L)
<u>Base/Neutral Extractables (Cont'd)</u>		
2-Nitroaniline	NA	NA
3-Nitroaniline	NA	NA
4-Nitroaniline	NA	NA
Nitrobenzene	NA	51.1
n-Nitrosodiphenylamine	NA	NA
n-Nitrosodipropylamine	NA	0.0409
Phenanthrene	NA	NA
Pyrene	NA	3070
1,2,4-Trichlorobenzene	70	70
<u>Acid:</u>		
Benzoic acid	NA	NA
4-Chloro-3-methylphenol	NA	NA
2-Chlorophenol	NA	511
2,4-Dichlorophenol	NA	307
2,4-Dimethylphenol	NA	2040
4,6-Dinitro-2-methylphenol	NA	NA
2,4-Dinitrophenol	NA	204
2-Methylphenol	NA	NA
4-Methylphenol	NA	NA
2-Nitrophenol	NA	NA
4-Nitrophenol	NA	NA
Pentachlorophenol	1.0	1.0
Phenol	NA	61300
2,4,5-Trichlorophenol	NA	10200
2,4,6-Trichlorophenol	NA	26.0

NA : Not Available

(a) Primary Drinking Water Maximum Contaminant Levels (MCLs)
Specified under the Safe Drinking Water Act (40 CFR 141)

(b) TNRCC Final Risk Reduction Standards (TAC, Title 30, Chapter 335)

PREPARED/DATE: JLP 9/27/95

CHECKED/DATE: SDM 10/2/95

3.0 SAMPLING AND ANALYSIS RESULTS

The following sections present the hydrogeologic and analytical chemistry results. Water levels measured during the third and fourth quarterly sampling events are presented in Tables 2-1 and 2-3. Analytical data summary tables presented in Appendix I provide the analytical results of all samples collected from the four quarterly sampling events.

3.1 REVIEW OF FIELD DATA

Based on the ground-water levels measured in the monitoring wells sampled during the third and fourth quarters, the ground-water elevations ranged from 532.16 feet and 532.12 feet, in well MW-11, to 620.67 feet and 619.88 feet, in well P6A. The ground-water flow across the study area, as indicated from the ground-water levels measured in wells during October 1995 and January 1996, is toward the West Fork Trinity River. The direction of ground-water flow is from southwest to northeast in the southwestern corner of the study area; from west to east in north-central, south-central, and eastern portions of the study area; and from northwest to southeast in the southeastern portion of the study area. There is insufficient information to determine the ground-water flow direction in the northern portion of the study area. Figures 3-1 and 3-2 show the interpreted ground-water potentiometric surface for the third and fourth quarters, respectively.

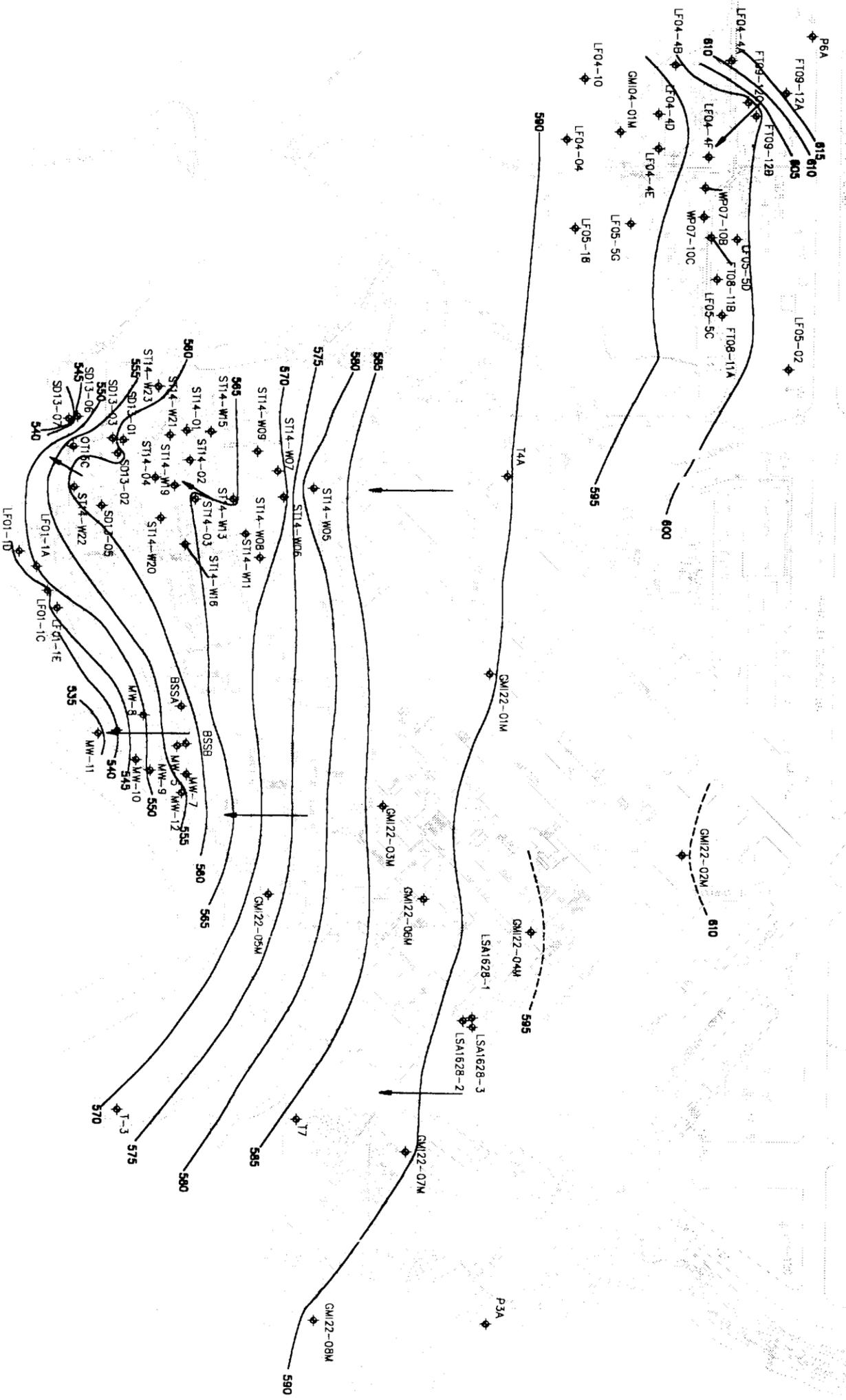
Based on the distribution of monitoring wells sampled for the quarterly monitoring program, there is adequate information to determine ground-water flow in the groups of wells in the northwest corner, east-central edge, and southeastern corner of the study area. Ground-water level information in the northern and central portions of the study area is insufficient to accurately determine ground-water flow direction in these areas.

3.2 REVIEW OF LABORATORY DATA

The following section discusses the chemical constituents detected in ground-water samples collected from the monitoring wells. Positive Results Tables for the third and fourth quarter



HM-127

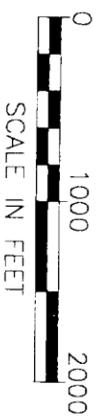


LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100' CONCENTRATION CONTOUR
- - - 100' ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN $\mu\text{g/L}$.



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

GROUND-WATER POTENTIOMETRIC SURFACE MAP - 4TH QUARTER (ALLUVIAL AQUIFER)

BASE-WIDE QUARTERLY GROUND-WATER MONITORING	
PREPARED BY: DSS	FILE DATE: 05 APRIL 96
CHECKED BY: JRF	PLT. DATE: 11 APRIL 96
PROJECT NO. 11-3517-3201	FIGURE NUMBER: 3-2
	FILE NAME: GWSM4POT.DWG

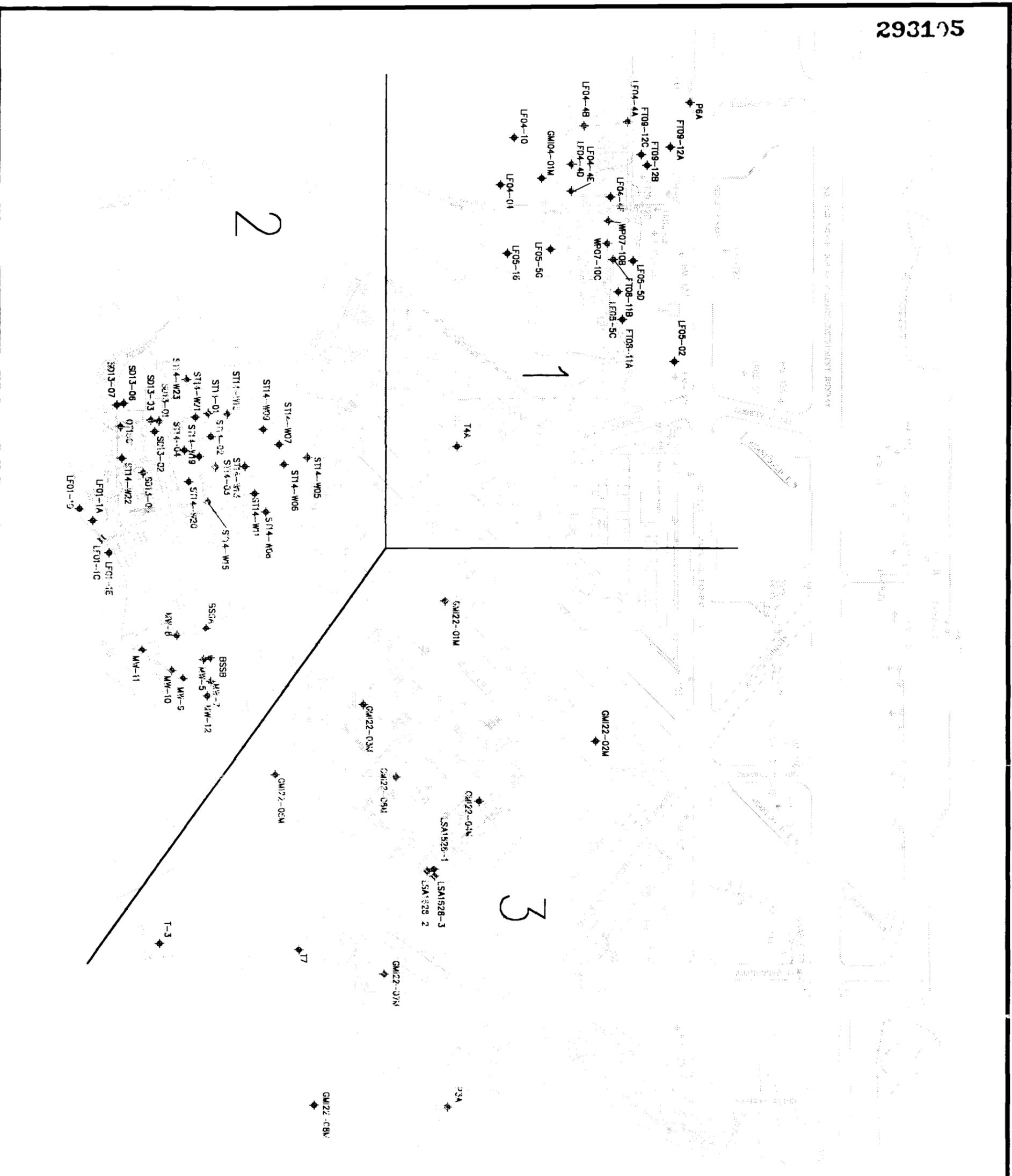
sampling events are presented in Appendix H. The tables also indicate the results exceeding regulatory standards (Section 2.4.3). Maps generated for the third and fourth quarter sampling events depict the concentrations of volatile and semi-volatile constituents detected in ground-water samples, and metals concentrations exceeding MSC values. Maps depicting concentration plumes for trichloroethene, cis-1,2-dichloroethene, total BTEX, and lead are discussed in Section 3.4.

For the purpose of data presentation, the base was divided into 3 areas as shown in Figure 3-3. Table 3-1 presents site designations associated with each area of the base and a list of the associated monitoring wells.

General Area 1 encompasses the southwest quadrant of the base including monitoring wells in the vicinity of Landfill 4, Landfill 5, and fire training areas 1 and 2. Area 2 encompasses the southeast-east portion of the base including monitoring wells in the vicinity of Landfill 1, POL Tank Farm, and the Base Service Station. Area 3 encompasses the northern portion of the base. Monitoring wells in Area 3 are dispersed throughout this area, with one monitoring well cluster near Building 1628.

Ground-water samples were analyzed for volatile organics, semi-volatile organics, total metals, and (for sample OT15C only) pesticides/PCBs. Figures 3-4 and 3-5 depict the results of volatile compounds detected from the third and fourth quarter sampling events, respectively. Figures 3-6 and 3-7 depict the results of semi-volatile compounds detected from the third and fourth quarter events, respectively. Figures 3-8 and 3-9 depict total metals results that exceed MSC concentrations for the third and fourth quarter events, respectively.

Volatile and semi-volatile constituents detected below the practical quantitation limits were qualified "JQ." Because these concentrations were below the calibrated range of the instrument, they should be considered estimated values.



- LEGEND**
- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
 - ◆ EXISTING MONITORING WELL
 - 1 ZONE AREA DESTINATION

NOTE
1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.



NAVAL AIR STATION		FORT WORTH JOINT RESERVE BASE	
FORT WORTH WORTH, TEXAS			
GENERAL AREA MAP			
BASE-WIDE QUARTERLY GROUND-WATER MONITORING			
DESIGNED BY: DSS	FILE DATE: 05 APRIL 96	PROJECT NO: 14 357 3200	FILE NAME: 9TEX-4T.DWG
CHECKED BY: JRF	PLOT DATE: 10 APRIL 96		
	3-3		

TABLE 3-1

293106

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

<u>Area 1</u>	<u>Area 2</u>	<u>Area 2 (cont.)</u>
Landfill 04, SWMU 22, IRP #4	Landfill 01, SWMU 28, IRP #1	Entomology Dry Well, SWMU 63, IRP #15
LF04-4A	LF01-1A	
LF04-4B	LF01-1C	OT15C
LF04-4D	LF01-1D	
LF04-4E	LF01-1E	Unnamed Stream, SWMU 64, IRP #16
LF04-4F		
LF04-04	POL Tank Farm, SWMU 68, IRP #17	
LF04-10		SD13-01
GM104-01M	ST14-01	SD13-02
	ST14-02	SD13-03
Landfill 05, SWMU 23, IRP #5	ST14-03	SD13-05
LF05-2	ST14-04	SD13-06
LF05-5C	ST14-W05	SD13-07
LF05-5D	ST14-W06	
LF05-5G	ST14-W07	
LF05-18	ST14-W08	
	ST14-W09	
FDTA 1, SWMU 18, IRP #11	ST14-W11	
	ST14-W13	
	ST14-W15	
FT08-11A	ST14-W16	
FT08-11B	ST14-W19	
	ST14-W20	
FDTA 2, SWMU 19, IRP #12	ST14-W21	
	ST14-W22	
FT09-12A	ST14-W23	
FT09-12B		
FT09-12C	Base Service Station	
Waste Burial Site, SWMU 24, IRP #10	BSSA	Building 3340
	BSSB	
WP07-10B	MW-5	P3A
WP07-10C	MW-7	
	MW-8	Building 3249
Building 1027	MW-9	
	MW-10	T3
T4A	MW-11	
	MW-12	2nd & Boyston, Open Lot
Southwest Area, East of Taxiway Drive		
		T7
P6A		
		Building 1628
		LSA1628-1
		LSA1628-2
		LSA1628-3

PREPARED/DATE: _____
 CHECKED/DATE: _____

293107

Phthalate esters, common semi-volatile laboratory contaminants, were detected in many samples; however, phthalate contamination was not consistently detected in the method blanks analyzed with sample batches. Phthalate contamination is believed to be introduced by individual pieces of glassware used by the laboratory for sample processing, which accounts for the apparently random occurrence of phthalates in samples. Phthalates detected in samples collected during the third and fourth quarter sampling events include: bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, diethylphthalate, dimethylphthalate, and di-n-butylphthalate. Results associated with contaminated method blanks were qualified "JB."

Dilutions were performed on samples containing high concentrations of analytes which exceeded the calibration range of the analytical instrument. When necessary, reporting limits were adjusted by the dilution factor. For volatiles analyses, method SW-8240 was performed when dilutions were required, based on the results of the volatiles screening procedure.

3.2.1 Data Summary for Area 1

Figure 3-3 depicts the locations of the monitoring wells in Area 1. The following sections describe the third and fourth quarter results for Area 1.

3.2.1.1 Third Quarter Results - The analytical data for the third quarter are discussed by chemical class below.

Volatile Organic Compounds - The following volatile constituents were detected in monitoring wells located in Area 1: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1-dichloroethane, vinyl chloride, benzene, toluene, xylenes, chlorobenzene, chloroform, and carbon disulfide.

Trichloroethene was detected at 15 of 18 locations at concentrations up to 1590 $\mu\text{g/L}$, with the highest concentration occurring at monitoring well, LF04-4F. The trichloroethene degradation products, cis-1,2-dichloroethene and trans-1,2-dichloroethene, were associated with many of the

trichloroethene detections. Another degradation product, vinyl chloride, was detected at three locations with a maximum concentration of 31.8 $\mu\text{g/L}$ at monitoring well, WP07-10C.

Tetrachloroethene was detected in three monitoring wells, P6A, FT09-12B, and FT09-12C, with a maximum concentration of 11.4 $\mu\text{g/L}$ at FT09-12B. BTEX constituents were detected at low concentrations in three monitoring wells. The highest concentration calculated for total BTEX was 18.6 $\mu\text{g/L}$ at LF05-5G. No free product was detected in Area 1 monitoring wells.

Metals - No metals were detected above MSC concentrations in monitoring wells located in Area 1.

Semi-Volatile Organic Compounds - Semi-volatile compounds detected at Area 1 include single occurrences of acenaphthene, naphthalene, and phenol reported at low concentrations. Phthalates were detected in 14 of 18 samples.

3.2.1.2 Fourth Quarter Results - The analytical data for the fourth quarter are discussed by chemical class below.

Volatile Organic Compounds - The following volatile constituents were detected in monitoring wells located in Area 1: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,1-dichloroethane, 1,1-dichloroethene, vinyl chloride, benzene toluene, and chloroform. Trichloroethene was detected at 15 of 21 locations at concentrations up to 2550 $\mu\text{g/L}$, with the highest concentration occurring in monitoring well, WP07-10B. The trichloroethene degradation products, cis-1,2-dichloroethene and trans-1,2-dichloroethene, were associated with many of the trichloroethene detections. Vinyl chloride was detected at one location, FT09-12C, at 6.1 $\mu\text{g/L}$.

Tetrachloroethene was detected in three monitoring wells, P6A, FT09-12B, and FT09-12C, with a maximum concentration of 13.7 $\mu\text{g/L}$ in FT09-12B. BTEX constituents were detected at low

concentrations in three monitoring wells. The highest concentration calculated for total BTEX was 1.6 $\mu\text{g/L}$ in FT09-12C. No free product was detected in Area 1 monitoring wells.

Metals - Beryllium was detected above the MSC of 4 $\mu\text{g/L}$ in monitoring well, P6A. The reported concentration was 10,100 $\mu\text{g/L}$.

Semi-Volatile Organic Compounds - Semi-volatile compounds detected during the fourth quarter include single occurrences of 1,2-dichlorobenzene and phenol reported at low concentrations. Phthalates were detected in 14 of 21 samples.

3.2.2 Data Summary for Area 2

The following sections describe the third and fourth quarter results for Area 2.

3.2.2.1 Third Quarter Results - The analytical data for the third quarter are discussed by chemical class below.

Volatile Organic Compounds - The following volatile constituents were detected in monitoring wells located in Area 2: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, vinyl chloride, benzene, ethylbenzene, toluene, xylenes, bromoform, chloroform, acetone, bromodichloromethane, and dibromochloromethane.

Trichloroethene was detected at 4 of 38 locations at concentrations up to 6.6 $\mu\text{g/L}$, with the highest concentration occurring at monitoring well, ST14-W09. The trichloroethene degradation products, cis-1,2-dichloroethene and trans-1,2-dichloroethene, were also detected at this location. Vinyl chloride was detected only in ST14-W05 at a concentration of 2.9 $\mu\text{g/L}$.

Tetrachloroethene was detected in ST14-W22 at a concentration of 3.5 $\mu\text{g/L}$. BTEX constituents were detected at seven locations with the highest total BTEX concentration, 34,100 $\mu\text{g/L}$,

reported at MW-10. A trace of free product was detected in monitoring wells MW-8, MW-9, MW-10, and SD13-07 during the third quarter sampling event.

Metals - Arsenic, beryllium, cadmium, chromium, lead, and nickel were detected above MSCs in monitoring wells located in Area 2. Lead was reported over the MSC in 9 wells, with the highest concentration, 161 $\mu\text{g/L}$, reported in monitoring well SD13-07. Arsenic was detected above the MSC concentration of 50 $\mu\text{g/L}$ in three monitoring wells: BSSB, MW-5, ST14-01. Beryllium was reported over the MSC at two locations, with a maximum concentration of 850 $\mu\text{g/L}$. Cadmium, chromium, and nickel each exceeded MSCs at only one location.

Semi-Volatile Organic Compounds - Semi-volatile compounds detected during the third quarter were: 2-methylnaphthalene, naphthalene, acenaphthene, acenaphthylene, dibenzofuran, fluorene, phenanthrene, pyrene, 2-methylphenol, 4-methylphenol, phenol, benzoic acid, and phthalates. Naphthalene was detected in 8 of 38 monitoring wells with a maximum concentration of 398 $\mu\text{g/L}$ at BSSB, and 2-methylnaphthalene was detected in 10 wells with a maximum concentration of 493 $\mu\text{g/L}$ at SD13-07. Phthalates were detected in 27 of 38 samples. Bis(2-ethylhexyl)phthalate was detected in seven locations with a maximum concentration of 59.4 $\mu\text{g/L}$.

Pesticides/PCBs - The only sample collected for pesticides/PCBs was OT15C. There were no detections of pesticides or PCBs.

3.2.2.2 Fourth Quarter Results - The analytical data for the fourth quarter are discussed by chemical class below.

Volatile Organic Compounds - The following volatile constituents were detected in monitoring wells located in Area 2: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, benzene, ethylbenzene, toluene, xylenes, chloroform, chlorobenzene, bromodichloromethane, and dibromochloromethane.

Trichloroethene was detected at one location, ST14-W09, at a concentration of 1.5 $\mu\text{g/L}$. The trichloroethene degradation product, cis-1,2-dichloroethene, was detected at two locations.

Tetrachloroethene was detected at ST14-W22 at a concentration of 6.1 $\mu\text{g/L}$. BTEX constituents were detected at eight locations with the highest total BTEX concentration, 28,800 $\mu\text{g/L}$, reported at BSSB. Free product was measured at a thickness of 0.02 foot in monitoring well SD13-07; therefore samples were not collected for chemical analysis.

Metals - Arsenic, barium, beryllium, and lead were detected above MSCs in monitoring wells located in Area 2. Lead was detected in 15 of 37 locations, with the highest concentration, 159 $\mu\text{g/L}$, reported at monitoring well ST14-W16. Arsenic was detected over MSC concentrations at three locations, BSSB, ST14-01, and ST14-W20, with a maximum concentration of 173 $\mu\text{g/L}$ at ST14-01.

Semi-Volatile Organic Compounds - Semi-volatile compounds detected during the fourth quarter were: 2-methylnaphthalene, naphthalene, acenaphthene, benz(a)anthracene, dibenzofuran, fluorene, phenanthrene, pyrene, 2-methylphenol, 4-methylphenol, phenol, isophorone, and phthalates. Naphthalene was detected in 7 of 37 monitoring wells with a maximum concentration of 598 $\mu\text{g/L}$ at MW-10, and 2-methylnaphthalene was detected in 5 wells with a maximum concentration of 176 $\mu\text{g/L}$ at BSSB. Phthalates were detected in 31 of 37 samples. Bis(2-ethylhexyl)phthalate was detected at four locations with a maximum concentration of 46.3 $\mu\text{g/L}$.

Pesticides/PCBs - There were no detections of pesticides or PCBs in well OT15C.

3.2.3 Data Summary for Area 3

The following sections describe the third and fourth quarter results for Area 3.

3.2.3.1 Third Quarter Results - The analytical data for the third quarter are discussed by chemical class below.

Volatile Organic Compounds - The following volatile constituents were detected in monitoring wells located in Area 3: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, benzene, ethylbenzene, toluene, and xylenes.

Trichloroethene was detected in 8 of 13 monitoring wells with the highest concentration, 361 $\mu\text{g/L}$, occurring at well GMI22-04M. The degradation products cis-1,2-dichloroethene and trans-1,2-dichloroethene, were associated with many of the trichloroethene detections.

Tetrachloroethene was detected at well GMI22-03M, at a concentration of 12.7 $\mu\text{g/L}$. Free product was measured in monitoring wells LSA1628-1 and LSA1628-2 at a thickness of 0.19 foot and 0.11 foot, respectively. The wells were purged and samples were collected for chemical analysis. BTEX constituents were detected in both wells, with a maximum concentration of 2,540 $\mu\text{g/L}$ reported in LSA1628-1. Two additional wells in Area 3 exhibited BTEX at low concentrations.

Metals - Lead was the only metals constituent detected above MSCs in monitoring wells located in Area 3. Lead was detected at two locations, with the highest concentration, 26.8 $\mu\text{g/L}$, reported at monitoring well T3.

Semi-Volatile Organic Compounds - Semi-volatile compounds detected during the third quarter include: 2-methylnaphthalene, naphthalene, fluoranthene, phenanthrene, pyrene, dibenzofuran, phenol, 4-methylphenol, and phthalates. Phthalates were detected in 12 of 13 samples. Bis(2-ethylhexyl)phthalate was detected at three locations with a maximum concentration of 1,150 $\mu\text{g/L}$ at LSA1628-1.

3.2.3.2 Fourth Quarter Results - The analytical data for the fourth quarter are discussed by chemical class below.

Volatile Organic Compounds - The following volatile constituents were detected in monitoring wells located in Area 3: trichloroethene, tetrachloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, vinyl chloride, benzene, ethylbenzene, toluene, xylenes, and chloroform.

Trichloroethene was detected in 5 of 12 monitoring wells with the highest concentration, 463 $\mu\text{g/L}$, occurring at well GMI22-04M. The degradation products cis-1,2-dichloroethene and trans-1,2-dichloroethene, were associated with many of the trichloroethene detections.

Tetrachloroethene was detected at well GMI22-03M, at a concentration of 11.6 $\mu\text{g/L}$. Free product was measured in monitoring well LSA1628-1 at a thickness of 0.11 foot. As a result, this well was not sampled for chemical analysis. Total BTEX was reported at LSA1628-2 at a concentration of 1,320 $\mu\text{g/L}$.

Metals - Beryllium, lead, and nickel were detected above MSCs in monitoring wells located in Area 3. Lead was detected in 5 of 12 locations, with the highest concentration, 63.9 $\mu\text{g/L}$, reported at monitoring well P3A. Beryllium was detected over MSC concentrations at two locations with a maximum concentration of 7.0 $\mu\text{g/L}$. Nickel was reported above the MSC of 100 $\mu\text{g/L}$ at P3A.

Semi-Volatile Organic Compounds - Semi-volatile compounds detected during the fourth quarter include single occurrences of naphthalene and 2-methylnaphthalene, and phthalates reported in 6 of 12 samples. Naphthalene and 2-methylnaphthalene were detected at LSA1628-2 at concentrations of 53.9 $\mu\text{g/L}$ and 32.0 $\mu\text{g/L}$, respectively. Bis(2-ethylhexyl)phthalate was reported at LSA1628-2 at a concentration of 1030 $\mu\text{g/L}$. As previously indicated, monitoring well LSA1628-1 was not sampled for chemical analysis due to the presence of free product.

3.3 BACKGROUND LEVELS

A basewide background study has not yet been performed at NAS Fort Worth. None of the monitoring wells selected for the quarterly ground-water monitoring project are considered

background or upgradient locations. Because background data were not available, the data reported from the quarterly ground-water monitoring events were compared to USEPA Maximum Contaminant Levels and TNRCC Medium-Specific Concentrations. It is recommended that a study be conducted to compare the ground-water data to background concentrations when the results from the ground-water background study become available.

3.4 NATURE AND EXTENT OF CONTAMINATION

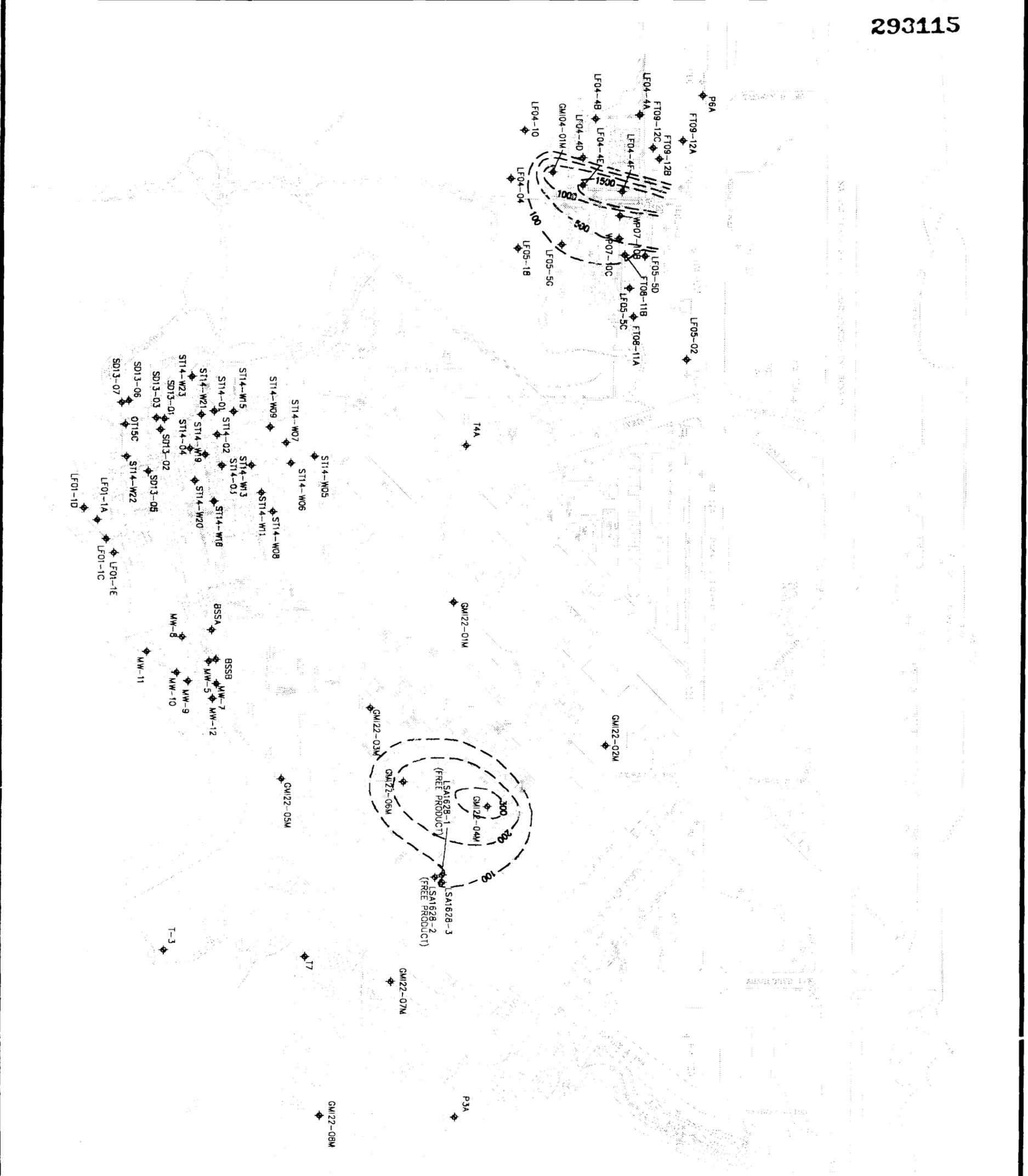
The following sections discuss the nature and extent of contamination based on the results of the third and fourth quarter sampling events. Figures depicting estimated concentration contours for trichloroethene, cis-1,2-dichloroethene, total BTEX, and lead are provided for both quarters. Because only existing monitoring wells were sampled during the course of this monitoring program, delineation of the constituents detected is limited.

3.4.1 Volatile Organic Compounds

The nature and extent of volatile constituents detected during the third and fourth quarters is generally consistent with the findings of the first and second quarter sampling events (LAW 1996). The findings for trichloroethene, cis-1,2-dichloroethene, and total BTEX are discussed below.

3.4.1.1 Trichloroethene - Trichloroethene ground-water plumes for third and fourth quarters are depicted in Figures 3-10 and 3-11, respectively. Two areas of contamination are apparent.

Trichloroethene was detected in Area 1 in the vicinity of Landfill 4 and Landfill 5. Monitoring well, LF04-4F, exhibited the highest concentration of trichloroethene third quarter with a concentration of 1590 $\mu\text{g/L}$. The fourth quarter maximum concentration of 2550 $\mu\text{g/L}$ occurred in well WP07-10B. The eastern extent of the trichloroethene plume has been defined based on the results of three monitoring wells added to the sampling program fourth quarter. All three locations were non-detect for trichloroethene; however, the trichloroethene degradation product cis-1,2-dichloroethene was detected in two of the wells, as discussed below. The fourth



LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100 — CONCENTRATION CONTOUR
- - - 100 - - ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN ug/L.



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

TRICHLOROETHENE DETECTED IN GROUND WATER - 3RD QUARTER

BASE-WIDE QUARTERLY GROUND-WATER MONITORING			
PREPARED BY:	DSS	FIGURE NUMBER:	05, APRIL 96
CHECKED BY:	JRF	PLOT DATE:	11, APRIL 96
PROJECT NO.	11-3517-3201	FILE NAME:	TRCH3POT.DWG

293117

monitoring well added to the fourth quarter sampling program, LF05-02 located to the northwest of the Landfill 5 Area, was also non-detect for trichloroethene; however, this location exhibited elevated concentrations of cis-1,2-dichloroethene and trans-1,2-dichloroethene.

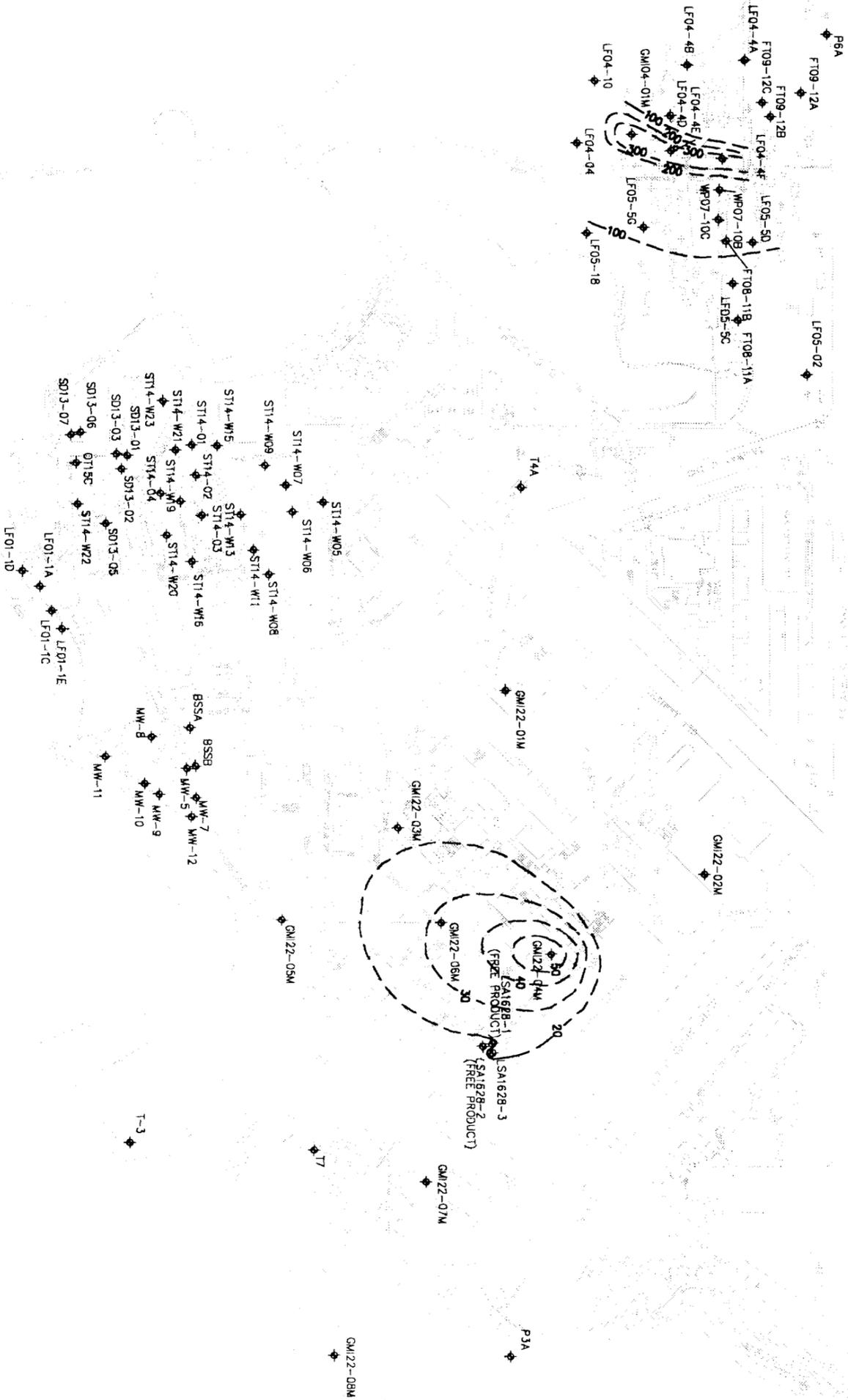
A second trichloroethene plume is apparent in Area 3 in the vicinity of monitoring wells GMI22-04M and GMI22-06M. Maximum concentrations reported for GMI22-04M were 361 $\mu\text{g/L}$ for third quarter, and 463 $\mu\text{g/L}$ for fourth quarter. Lower concentrations of trichloroethene were also detected in monitoring wells located near Building 1628, north of this area of contamination.

3.4.1.2 Cis-1,2-dichloroethene - Cis-1,2-dichloroethene is a degradation product of trichloroethene and its presence was closely associated with the occurrence of trichloroethene in Areas 1 and 3, as depicted in Figures 3-12 and 3-13, respectively.

In Area 1, the highest concentrations of cis-1,2-dichloroethene reported third quarter were in GMI04-01M (337 $\mu\text{g/L}$), LF04-4E (311 $\mu\text{g/L}$) and LF04-4F (308 $\mu\text{g/L}$). Fourth quarter results included: LF05-5D (386 $\mu\text{g/L}$), LF04-4E (326 $\mu\text{g/L}$), LF04-4F (366 $\mu\text{g/L}$), LF04-04 (359 $\mu\text{g/L}$), LF05-18 (308 $\mu\text{g/L}$), and LF05-02 (604 $\mu\text{g/L}$). The fourth quarter addition of monitoring well LF05-02 had an impact on the shape of the western portion of the concentration contour. The eastern edge of the plume has also been extended by the addition of the three wells previously mentioned, two of which contained high concentrations of cis-1,2-dichloroethene.

Cis-1,2-dichloroethene also occurred in Area 3 in the vicinity of monitoring wells GMI22-04M and GMI22-06M. Maximum concentrations were reported for GMI22-04M at 56.1 $\mu\text{g/L}$ third quarter, and 59.0 $\mu\text{g/L}$ fourth quarter. Lower concentrations of cis-1,2-dichloroethene were also detected both quarters in monitoring well GMI22-03M and in the area of Building 1628.

3.4.1.3 Total BTEX - Total BTEX concentration contours are depicted in Figure 3-14 for the third quarter and Figure 3-15 for the fourth quarter. There appear to be three areas of BTEX contamination.



LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100 — CONCENTRATION CONTOUR
- - - 100 - - - ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN UG/L.

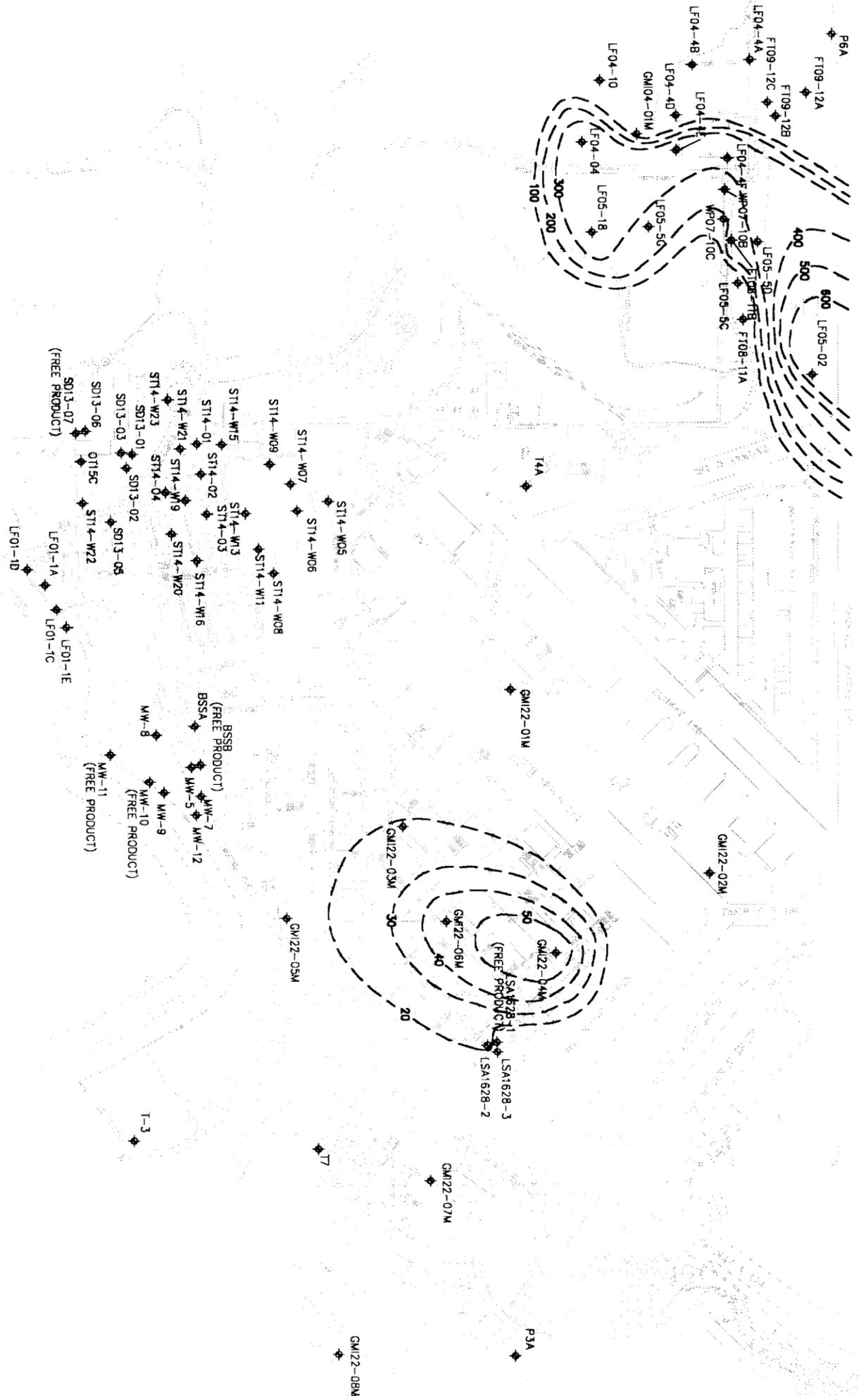


CIS-1,2-DICHLOROETHENE DETECTED IN GROUND WATER - 3RD QUARTER

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

BASE-WIDE QUARTERLY GROUND-WATER MONITORING

PREPARED BY: DSS	FILE DATE: 05 APRIL 96
CHECKED BY: JRF	FIGURE NUMBER: 3-12
PROJECT NO. 11-3517-3201	FILE NAME: CIS3POT.DWG



LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- EXISTING MONITORING WELL
- 100 — CONCENTRATION CONTOUR
- - - 100 - - ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN ug/L.



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

**CIS-1,2-DICHLOROETHENE DETECTED
IN GROUND WATER - 4TH QUARTER**

BASE-WIDE QUARTERLY GROUND-WATER MONITORING

PREPARED BY: DSS	FILE DATE: 05.APRIL.96
CHECKED BY: JRF	PLOT DATE: 11.APRIL.96
PROJECT NO: 11-3517-3201	FIGURE NUMBER: 3-13
	FILE NAME: CIS4P01.DWG



LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100 CONCENTRATION CONTOUR
- - - 100 ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN ug/L.

TOTAL BTX DETECTED IN GROUND WATER - 3RD QUARTER

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

BASE-WIDE QUARTERLY GROUND-WATER MONITORING

PREPARED BY:	DSS	FIGURE NUMBER:	3-14	FILE DATE:	05 APRIL 96
CHECKED BY:	JRF	PLOT DATE:	11 APRIL 96	FILE NAME:	TBCW3POT.DWG
PROJECT NO:	11-3517-3201				



LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100 --- CONCENTRATION CONTOUR
- 1000 --- ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN ug/L.



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

**TOTAL BTEX DETECTED IN
GROUND WATER - 4TH QUARTER**

BASE-WIDE QUARTERLY GROUND-WATER MONITORING

PREPARED BY:	DSS	FIGURE NUMBER:	3-15
CHECKED BY:	JRF	FILE DATE:	05, APRIL, 96
PROJECT NO.:	11-3517-3201	PLOT DATE:	11, APRIL, 96
		FILE NAME:	TBGW1POT.DWG

In the area of the POL Tank Farm, a total of four monitoring wells contained BTEX constituents both quarters. For this area, the maximum concentration of total BTEX for third and fourth quarters was reported at ST14-W19, at 105 $\mu\text{g/L}$ and 109 $\mu\text{g/L}$, respectively.

The second area of BTEX contamination occurred at the Base Service Station Area and included monitoring wells BSSB, MW-5, and MW-10. These wells exhibited high concentrations of total BTEX, with maximum concentrations of 34,100 $\mu\text{g/L}$ third quarter and 28,800 $\mu\text{g/L}$ fourth quarter.

Total BTEX was also detected in Area 3 during the third and fourth quarters. Monitoring well LSA1628-1 contained 2540 $\mu\text{g/L}$ total BTEX third quarter, and LSA1628-2 contained 1320 $\mu\text{g/L}$ total BTEX fourth quarter. Monitoring well LSA1628-1 was not sampled fourth quarter due to the presence of free product.

In addition to these three areas of BTEX contamination, low concentrations of BTEX constituents occurred in the Fire Training Area 2, both third and fourth quarters and the Landfill 5 area third quarter only.

Free product samples were collected during the fourth quarter from monitoring wells LSA1628-1 and SD13-07 in an attempt to identify the source of the product found at each location. The samples were submitted to Core Laboratories, Inc. in Houston, Texas for hydrocarbon analysis. Their report is presented in Appendix J. The results of the analyses indicated that both wells contained weathered product and, as a result, further product characterization was not possible. Therefore, the attempt to identify the source of the product contained in each well was unsuccessful.

3.4.1.4 Lead - Lead concentrations are depicted in Figure 3-16 for third quarter, and Figure 3-17 for fourth quarter. In many areas, the occurrence of lead appears to be related to the presence of total BTEX.



LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100 — CONCENTRATION CONTOUR
- - - 100 - - - ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN ug/L.

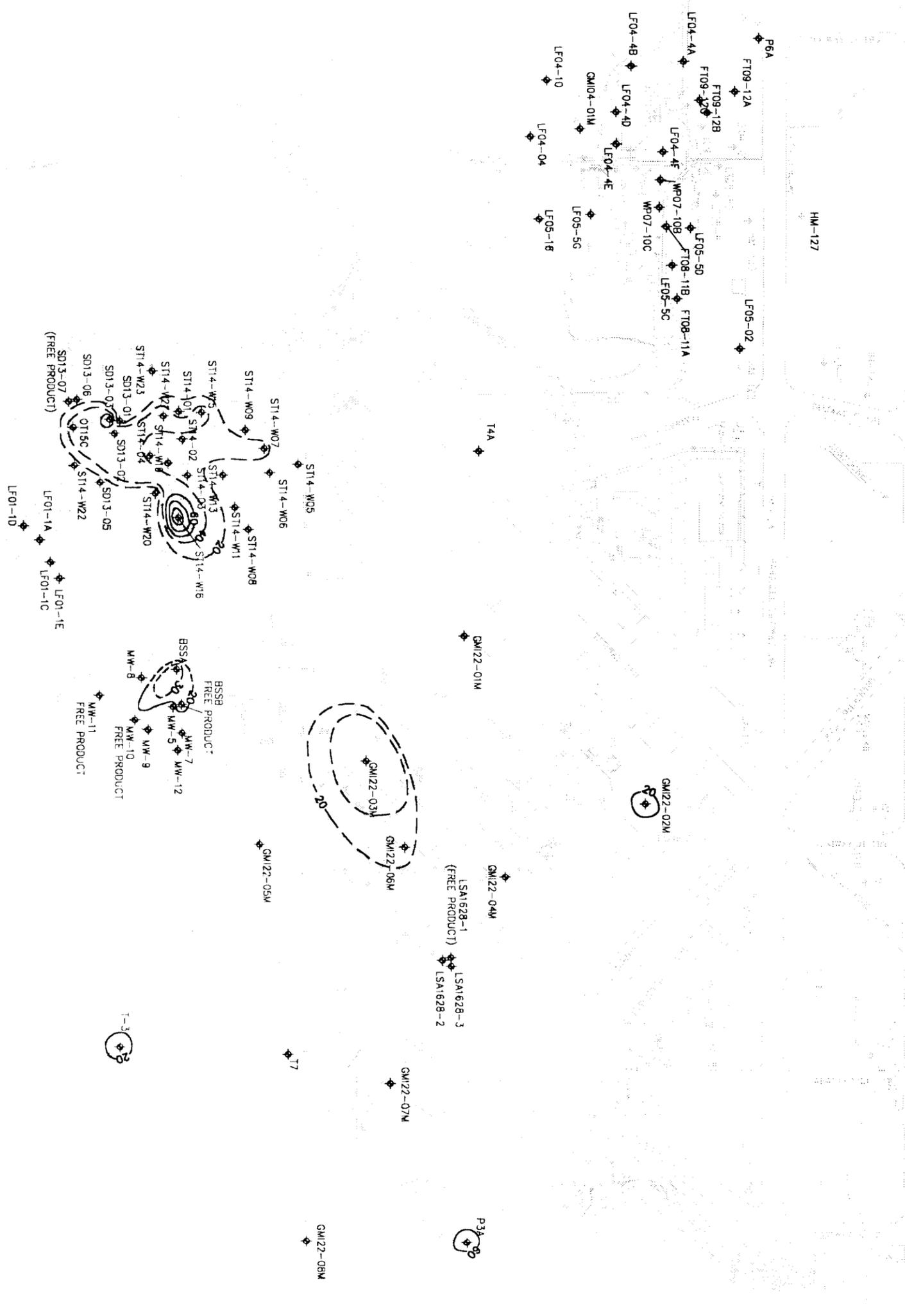


NAVAL AIR STATION
FORT WORTH JOINT RESERVE BASE
FORT WORTH, TEXAS

**LEAD DETECTED IN
GROUND WATER - 3RD QUARTER**

BASE-WIDE QUARTERLY GROUND-WATER MONITORING

PREPARED BY: DSS	FILE DATE: 05.APRIL.96
CHECKED BY: JRF	PLOT DATE: 11.APRIL.96
PROJECT NO: 11-3517-3201	FILE NAME: LDGW3POT.DWG
FIGURE NUMBER: 3-16	

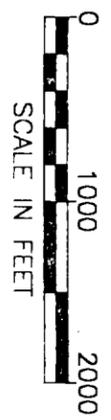


LEGEND

- ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
- ◆ EXISTING MONITORING WELL
- 100 — CONCENTRATION CONTOUR
- - - 100 - - ESTIMATED CONCENTRATION CONTOUR

NOTES

1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
2. ALL CONCENTRATIONS MEASURED IN $\mu\text{g/L}$.



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

**LEAD DETECTED IN
GROUND WATER - 4TH QUARTER**

BASE-WIDE QUARTERLY GROUND-WATER MONITORING

PREPARED BY: DSS	FILE DATE: 05 APRIL 96
CHECKED BY: JRF	PLOT DATE: 11 APRIL 96
PROJECT NO.: 44-3517-3201	FIGURE NUMBER: 3-17
	FILE NAME: EDGWAQ01.DWG

In Area 2, elevated lead concentrations were reported in ST14-04 (67.2 $\mu\text{g/L}$) and ST14-W16 (86.8 $\mu\text{g/L}$) during the third quarter. In addition, SD13-07, in the Unnamed Stream Area, was reported with the maximum concentration of 161 $\mu\text{g/L}$.

During the fourth quarter, the lead concentrations increased in ST14-W16 (159 $\mu\text{g/L}$) and BSSA (36.8 $\mu\text{g/L}$). SD13-07 was not sampled fourth quarter due to the presence of free product.

In Area 3, elevated lead levels were reported third quarter for T3 (26.8 $\mu\text{g/L}$) and LSA1628-1 (25.8 $\mu\text{g/L}$), and fourth quarter for GMI22-02M (28.2 $\mu\text{g/L}$), GMI22-03M (33.3 $\mu\text{g/L}$), GMI22-06M (25.9 $\mu\text{g/L}$), P3A (63.9 $\mu\text{g/L}$), and T3 (25.4 $\mu\text{g/L}$).

3.5 CONSTITUENTS OF CONCERN

The following sections discuss the constituents of concern based on four quarters of groundwater results collected from April 1995 through January 1996. Tables 3-2 through 3-5 present the frequency of detection of volatile and semi-volatile constituents for Quarters 1 through 4, along with the maximum concentrations reported, the applicable MSC values, and the corresponding frequency of detection at concentrations greater than the MSC. Metals constituents which exceeded MSC values are also presented in the table, along with the maximum concentrations, MSC values, and frequency of detections greater than the MSC. Field duplicate results were used only when the corresponding sample results were non-detect.

The results indicate that the constituents most frequently detected above MSC values were trichloroethene, cis-1,2-dichloroethene, benzene, and lead. The following sections discuss the constituents of concern by chemical class.

TABLE 3-2

CONSTITUENTS OF CONCERN - FIRST QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (69 Total Samples)	Maximum Concentration (ug/L)	MCL/MSL Concentration (ug/L)	Exceedances (1)
<u>Volatile Organic Compounds</u>				
1,1-Dichloroethane	2	0.84	10,200	
1,1-Dichloroethene	1	0.95	7	
Acetone			10,200	
Benzene	16	5800	5	8
Bromodichloromethane	1	0.38	100	
Bromoform			100	
Carbon disulfide			10,200	
Chlorobenzene	1	3.1	100	
Chloroform	4	0.51	100	
Dibromochloromethane			100	
Ethylbenzene	7	1700	700	1
Methylene chloride	52	150	5	17
Styrene			100	
Tetrachloroethene	7	14	5	3
Toluene	15	20,000	1000	2
Trichloroethene	21	2000	5	18
Vinyl chloride	2	5.6	2	2
Xylenes	5	9300	10,000	
cis-1,2-Dichloroethene	20	520	70	10
trans-1,2-Dichloroethene	16	68	100	
<u>Semi-Volatile Organic Compounds</u>				
1,2-Dichlorobenzene			600	
1,4-Dichlorobenzene	1	3.0	75	
2,4-Dimethylphenol	1	74	2040	
2-Methylnaphthalene	11	2100	NA	
2-Methylphenol	1	40	NA	
4-Methylphenol	1	55	NA	

293128

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TABLE 3-2

CONSTITUENTS OF CONCERN - FIRST QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (69 Total Samples)	Maximum Concentration (ug/L)	MCL/MS Concentration (ug/L)	Exceedances (1)
<u>Semi-Volatile Organic Compounds (cont'd)</u>				
Acenaphthene	4	110	6130	
Acenaphthylene	2	0.93	NA	
Benz(a)anthracene			NA	
Benzo(a)pyrene	1	0.86	NA	
Benzoic acid			NA	
Butyl benzyl phthalate	1	1.6	NA	
Chrysene	1	1.8	NA	
Di-n-butylphthalate	17	2.2	10,200	
Di-n-octyl phthalate	1	17	2040	
Dibenzofuran	5	1.8	NA	
Diethylphthalate			81,800	
Dimethylphthalate			NA	
Fluoranthene	1	4.5	4090	
Fluorene	4	120	4090	
Isophorone			NA	
Naphthalene	14	1400	4090	
Phenanthrene	1	8.1	NA	
Phenol			61,300	
Pyrene	1	1.4	3070	
bis(2-Ethylhexyl)phthalate	5	7.5	20.4	
<u>Metals</u>				
Barium		2400	2000	1
Beryllium		30	4	3
Cadmium		94	5	7
Chromium		340	100	3
Lead		270	15	15
Nickel		530	100	6

(1) Number of sample results greater than MSC values.

PREPARED/DATE: _____
 CHECKED/DATE: _____

TABLE 3-3

CONSTITUENTS OF CONCERN - SECOND QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (70 Total Samples)	Maximum Concentration (ug/L)	MCL/MSC Concentration (ug/L)	Exceedances ⁽¹⁾
<u>Volatile Organic Compounds</u>				
1,1 Dichloroethane	2	0.73	10,200	
1,1-Dichloroethene	1	0.85	7	
Acetone			10,200	
Benzene	16	5340	5	9
Bromodichloromethane			100	
Bromoform			100	
Carbon disulfide	1	5.1	10,200	
Chlorobenzene			100	
Chloroform	2	0.38	100	
Dibromochloromethane			100	
Ethylbenzene	11	3830	700	3
Methylene chloride	27	1000	5	15
Styrene	1	106	100	1
Tetrachloroethene	6	14.3	5	2
Toluene	9	13,200	1000	3
Trichloroethene	22	2180	5	17
Vinyl chloride	2	5.6	2	2
Xylenes	9	11,100	10,000	1
cis-1,2-Dichloroethene	24	370	70	8
trans-1,2-Dichloroethene	15	50	100	
<u>Semi-Volatile Organic Compounds</u>				
1,2 Dichlorobenzene			600	
1,4-Dichlorobenzene	4	6.19	75	
2,4-Dimethylphenol	1	14.6	2040	
2-Methylnaphthalene	15	404	NA	
2-Methylphenol		40	NA	
4-Methylphenol	4	36	NA	
Acenaphthene	6	3.54	6130	
Acenaphthylene			NA	

293128

TABLE 3-3
CONSTITUENTS OF CONCERN - SECOND QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (70 Total Samples)	Maximum Concentration (ug/L)	MCL/MS Concentration (ug/L)	Exceedances ⁽¹⁾
<u>Semi-Volatile Organic Compounds (cont'd)</u>				
Benzo(a)anthracene			NA	
Benzo(a)pyrene			NA	
Benzoic acid			NA	
Butyl benzyl phthalate	61	332	NA	
Chrysene			NA	
Di-n-butylphthalate	36	3.28	10,200	
Di-n-octyl phthalate			2040	
Dibenzofuran	5	3.07	NA	
Diethylphthalate	1	1.56	81,800	
Dimethylphthalate			NA	
Fluoranthene			4090	
Fluorene	5	1.73	4090	
Isophorone			NA	
Naphthalene	19	583	4090	
Phenanthrene	1	2.34	NA	
Phenol	13	28.5	61,300	
Pyrene	2	9.7	3070	
bis(2-Ethylhexyl)phthalate	18	2330	20.4	2
<u>Metals</u>				
Arsenic		72	50	2
Beryllium		5560	4	2
Cadmium		16	5	1
Chromium		283	100	1
Lead		130	15	16
Nickel		8470	100	2

⁽¹⁾ Number of sample results greater than MSC values.

PREPARED/DATE: _____
 CHECKED/DATE: _____

TABLE 3-4

CONSTITUENTS OF CONCERN - THIRD QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (69 Total Samples)	Maximum Concentration (ug/L)	MCL/MSC Concentration (ug/L)	Exceedances ⁽¹⁾
<u>Volatiles Organic Compounds</u>				
1,1-Dichloroethane	1	0.43	10,200	
1,1-Dichloroethene			7	
Acetone	1	5.7	10,200	
Benzene	11	5060	5	9
Bromodichloromethane	1	1.55	100	
Bromoform	1	0.22	100	
Carbon disulfide	2	2.7	10,200	
Chlorobenzene	1	1.3	100	
Chloroform	2	1.06	100	
Dibromochloromethane	1	1.25	100	
Ethylbenzene	9	4170	700	2
Methylene chloride			5	
Styrene			100	
Tetrachloroethene	5	12.7	5	2
Toluene	8	14,900	1000	2
Trichloroethene	27	1590	5	20
Vinyl chloride	4	31.8	2	4
Xylenes	10	11,500	10,000	1
cis-1,2-Dichloroethene	23	337	70	8
trans-1,2-Dichloroethene	17	32.5	100	
<u>Semi-Volatile Organic Compounds</u>				
1,2-Dichlorobenzene			600	
1,4-Dichlorobenzene			75	
2,4-Dimethylphenol			2040	
2-Methylnaphthalene	12	561	NA	
2-Methylphenol	1	8.8	NA	
4-Methylphenol	2	36	NA	
Acenaphthene	3	2.65	6130	

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TABLE 3-4

CONSTITUENTS OF CONCERN - THIRD QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (69 Total Samples)	Maximum Concentration (ug/L)	MCL/MS Concentration (ug/L)	Exceedances ⁽¹⁾
<u>Semi-Volatile Organic Compounds (cont'd)</u>				
Acenaphthylene	1	33.3	NA	
Benz(a)anthracene			NA	
Benzo(a)pyrene			NA	
Benzoic acid	1	119	NA	
Butyl benzyl phthalate	53	201	NA	
Chrysene			NA	
Di-n-butylphthalate	2	1.29	10,200	
Di-n-octyl phthalate			2040	
Dibenzofuran	5	6.5	NA	
Diethylphthalate	2	3.67	81,800	
Dimethylphthalate			NA	
Fluoranthene	1	10.2	4090	
Fluorene	1	0.61	4090	
Isophorone			NA	
Naphthalene	13	1150	4090	
Phenanthrene	2	16.4	NA	
Phenol	13	24.6	61,300	
Pyrene	2	11.5	3070	
bis(2-Ethylhexyl)phthalate	12	1150	20.4	3
<u>Metals</u>				
Arsenic		65	50	3
Beryllium		850	4	2
Cadmium		10	5	1
Chromium		214	100	1
Lead		161	15	11
Nickel		248	100	1

293131

⁽¹⁾ Number of sample results greater than MSC values.

PREPARED/DATE: _____
 CHECKED/DATE: _____

TABLE 3-5

CONSTITUENTS OF CONCERN - FOURTH QUARTER
Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
Fort Worth, Texas

Parameter	Frequency of Detection (70 Total Samples)	Maximum Concentration (ug/L)	MCL/MSC Concentration (ug/L)	Exceedances (1)
<u>Volatile Organic Compounds</u>				
1,1 Dichloroethane	2	0.52	10,200	
1,1-Dichloroethene	1	0.58	7	
Acetone			10,200	
Benzene	12	5650	5	4
Bromodichloromethane	1	1.4	100	
Bromoform			100	
Carbon disulfide			10,200	
Chlorobenzene	1	0.61	100	
Chloroform	5	2.04	100	
Dibromochloromethane	1	1.24	100	
Ethylbenzene	6	3670	700	2
Methylene chloride			5	
Styrene			100	
Tetrachloroethene	5	13.7	5	3
Toluene	6	18,200	1000	2
Trichloroethene	21	2550	5	17
Vinyl chloride	2	55	2	2
Xylenes	5	10,300	10,000	1
cis-1,2-Dichloroethene	25	604	70	12
trans-1,2-Dichloroethene	14	68	100	
<u>Semi-Volatile Organic Compounds</u>				
1,2 Dichlorobenzene	1	1.98	600	
1,4-Dichlorobenzene			75	
2,4-Dimethylphenol			2040	
2-Methylnaphthalene	6	176	NA	
2-Methylphenol	1	14.7	NA	
4-Methylphenol	1	29.9	NA	
Acenaphthene	4	3.07	6130	

293132

TABLE 3-5

CONSTITUENTS OF CONCERN - FOURTH QUARTER
 Naval Air Station Fort Worth Joint Reserve Base, Carswell Field
 Fort Worth, Texas

Parameter	Frequency of Detection (70 Total Samples)	Maximum Concentration (ug/L)	MCL/MS Concentration (ug/L)	Exceedances (1)
<u>Semi-Volatile Organic Compounds (cont'd)</u>				
Benz(a)anthracene	1	1.23	NA	
Acenaphthylene			NA	
Benzo(a)pyrene			NA	
Benzoic acid			NA	
Butyl benzyl phthalate	51	189	NA	
Chrysene			NA	
Di-n-butylphthalate	3	0.89	10,200	
Di-n-octyl phthalate			2040	
Dibenzofuran	2	1.95	NA	
Diethylphthalate			81,800	
Dimethylphthalate	1	109	NA	
Fluoranthene			4090	
Fluorene	2	0.47	4090	
Isophorone	1	12.9	NA	
Naphthalene	8	598	4090	
Phenanthrene	1	2.75	NA	
Phenol	4	43.7	61,300	
Pyrene	1	1.08	3070	
bis(2-Ethylhexyl)phthalate	6	1030	20.4	2
<u>Metals</u>				
Arsenic		173	50	3
Barium		4560	2000	1
Beryllium		10,100	4	2
Lead		159	15	21
Nickel		118	100	1

(1) Number of sample results greater than MSC values.

PREPARED/DATE: _____
 CHECKED/DATE: _____

293130

3.5.1 Volatile Organic Compounds

Trichloroethene was detected in up to 27 monitoring wells over the course of the quarterly sampling program. Maximum concentrations remained relatively constant during all four quarters. The highest concentration, 2550 $\mu\text{g/L}$, was reported from the fourth quarter results. A maximum of 20 wells exceeded the MSC value of 5 $\mu\text{g/L}$ during the third quarter sampling event.

Cis-1,2-dichloroethene was detected in up to 25 monitoring wells over the four quarters of sampling. Maximum concentrations ranged from 337 $\mu\text{g/L}$ third quarter to 604 $\mu\text{g/L}$ fourth quarter. The incidence of wells exceeding the MSC value of 70 $\mu\text{g/L}$ also increased from 8 during second and third quarters, to 12 during the fourth quarter. The increased incidence of wells exceeding the MSC value during the fourth quarter is attributable to the addition of four monitoring wells in the Landfill 4 Area and Landfill 5 Area.

Vinyl chloride was detected in up to four wells over the four quarters of sampling. Maximum concentrations ranged from 5.6 $\mu\text{g/L}$ first and second quarters, to 55 $\mu\text{g/L}$ at LSA1628-2 during the fourth quarter. Two to four wells exceeded the MSC value of 2 $\mu\text{g/L}$ each quarter.

Tetrachloroethene was detected in five to seven wells over the four quarters of sampling. Concentrations remained relatively constant over the course of the four quarters. The highest concentration detected was 14.3 $\mu\text{g/L}$ during the second sampling event. Two to three wells exceeded the MSC value of 5 $\mu\text{g/L}$ each quarter.

Methylene chloride was reported in several samples during the first and second quarter sampling events. However, there were no detections of methylene chloride during the third and fourth quarters. It is believed that the first and second quarter positive results were associated with methylene chloride contamination in the laboratory. After the laboratory moved their operations into a new facility in September 1995, the methylene chloride contamination ceased, and the sample results reported were consistently non-detect.

Benzene was detected in up to 16 wells over the four quarters of sampling. Maximum concentrations have remained relatively stable. The highest concentration, 5800 $\mu\text{g/L}$, was reported from the first quarter. The incidence of wells exceeding the MSC value of 5 $\mu\text{g/L}$ varied from four (fourth quarter) to nine (second and third quarters). However, two wells with free product were not sampled for chemical analysis during the fourth quarter sampling event.

Toluene was detected in up to 15 wells sampled over the four quarters. The highest concentration, 20,000 $\mu\text{g/L}$, was reported from the first quarter sampling event. The incidence of wells exceeding the MSC value of 1000 $\mu\text{g/L}$ varied from two to three.

Ethylbenzene was detected in up to 11 wells sampled over the four quarters. The highest concentration, 4170 $\mu\text{g/L}$, was reported from the third quarter sampling event. The incidence of wells exceeding the MSC value of 700 $\mu\text{g/L}$ varied from one to three.

Xylenes were detected in up to 10 wells sampled over the four quarters. The highest concentration, 11,500 $\mu\text{g/L}$, was reported from the third quarter sampling event. One well exceeded the MSC value of 10,000 $\mu\text{g/L}$ during each of the second, third, and fourth quarters. No results exceeded the MSC for xylenes during the first quarter.

Styrene was detected once, at a concentration of 106 $\mu\text{g/L}$, during the four quarters of sampling. This single detection of styrene occurred in MW-10 during the second quarter and exceeded the MSC value of 100 $\mu\text{g/L}$ for this constituent.

3.5.2 Semi-Volatile Organic Compounds

Bis(2-ethylhexyl)phthalate was detected in many of the wells sampled during the quarterly sampling program, however the results reported may be related to phthalate contamination resulting from sampling activities or sample handling at the laboratory. Maximum concentrations changed significantly between first quarter (7.5 $\mu\text{g/L}$) and second quarter (2330 $\mu\text{g/L}$). The highest concentrations were observed in Building 1628 wells and were associated with high

concentrations of BTEX constituents. Two to three samples exceeded the MSC value of 20.4 $\mu\text{g/L}$ during the second, third, and fourth quarters. No results exceeded the MSC for bis(2-ethylhexyl)phthalate during the first quarter.

3.5.3 Metals

The frequency of metals exceeding MSC values is presented in Tables 3-2 through 3-5 for each of the four quarters of sampling.

Arsenic exceeded the MSC value of 50 $\mu\text{g/L}$ during the second, third, and fourth quarters. Two to three wells exceeded the MSC each of these quarters. The maximum concentration detected was 173 $\mu\text{g/L}$ during the fourth quarter. No results exceeded the MSC for arsenic during the first quarter.

Barium exceeded the MSC value of 2000 $\mu\text{g/L}$ in only one well during the first and fourth quarters. The maximum concentration detected was 4560 $\mu\text{g/L}$ during the fourth quarter. No results exceeded the MSC for barium second and third quarters.

Beryllium exceeded the MSC value of 4 $\mu\text{g/L}$ in two to three wells during each of the four quarterly sampling events. The maximum concentration detected was 10,100 $\mu\text{g/L}$ during the fourth quarter.

Cadmium exceeded the MSC value of 5 $\mu\text{g/L}$ in seven wells first quarter, and one well both second and third quarters. The maximum concentration detected was 94 $\mu\text{g/L}$ during the first quarter. No results exceeded the MSC for cadmium during the fourth quarter.

Chromium exceeded the MSC value of 100 $\mu\text{g/L}$ in one to three wells first, second, and third quarters. The maximum concentration detected was 340 $\mu\text{g/L}$ during the first quarter. No results exceeded the MSC for chromium during the fourth quarter.

Lead exceeded the MSC value of 15 $\mu\text{g/L}$ in 11 to 21 wells during each of the four quarters. The maximum concentration detected was 270 $\mu\text{g/L}$ during the first quarter.

Nickel exceeded the MSC value of 100 $\mu\text{g/L}$ in one to six wells during each of the four quarters. The maximum concentration detected was 3470 $\mu\text{g/L}$ during the second quarter.

Silver exceeded the MSC value of 511 $\mu\text{g/L}$ in only one well, and only during the second quarterly sampling event. The concentration reported for this sample was 16,600 $\mu\text{g/L}$.

3.6 TREND ANALYSIS

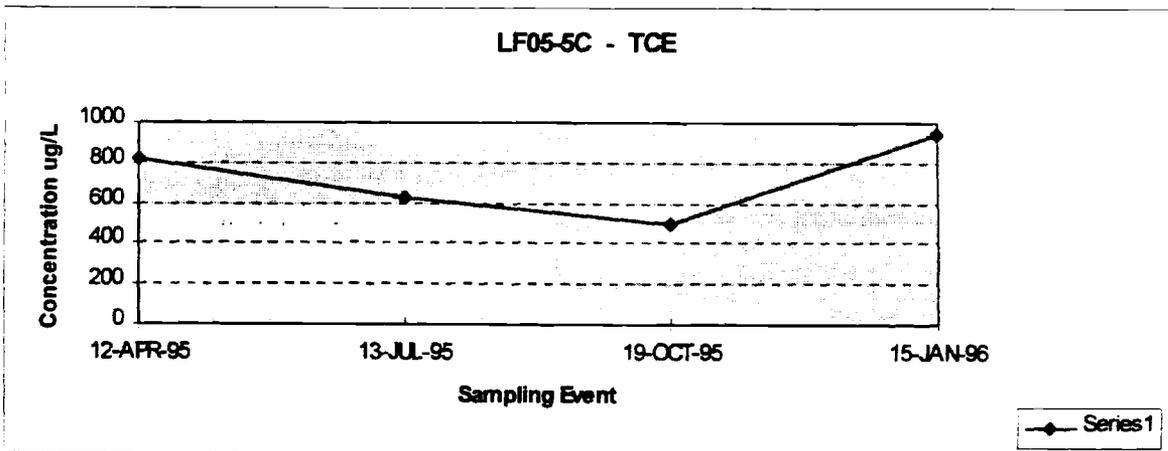
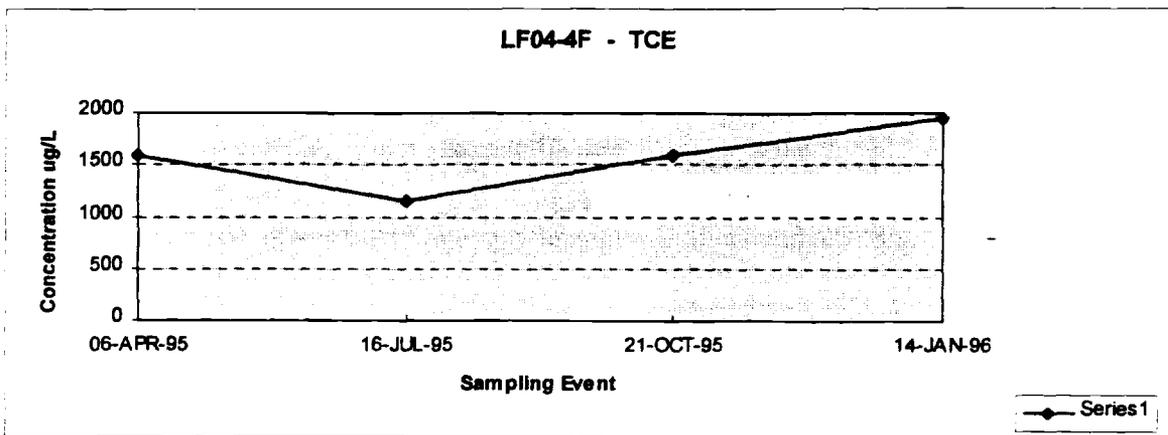
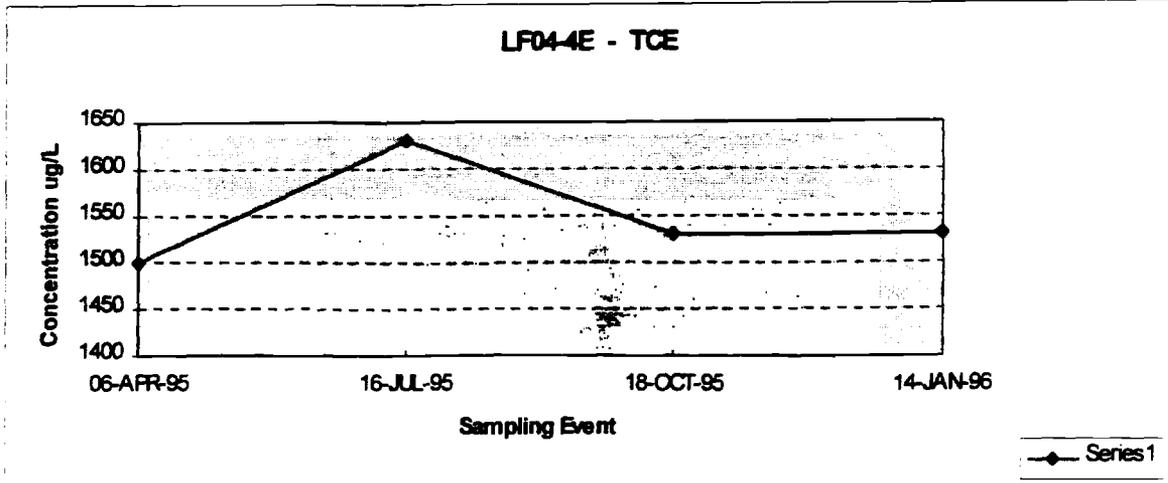
The following section presents a discussion of the trends observed for the constituents of concern identified from the monitoring program. Graphs depicting concentration trends were generated for monitoring wells located in areas where plume movement was anticipated or where concentration trends were apparent. Representative wells were selected to illustrate conditions within and at the periphery of individual plumes.

The following is a discussion of basewide patterns and trends observed since LAW began the quarterly ground-water monitoring program in April 1995. Charts presented in Figures 3-18 through 3-23 depict the general concentration trends of constituents of concern reported in selected monitoring wells. Please note that the vertical scale of the graphs is not constant in order to more clearly indicate the constituent trends of individual monitoring wells.

3.6.1 Trichloroethene

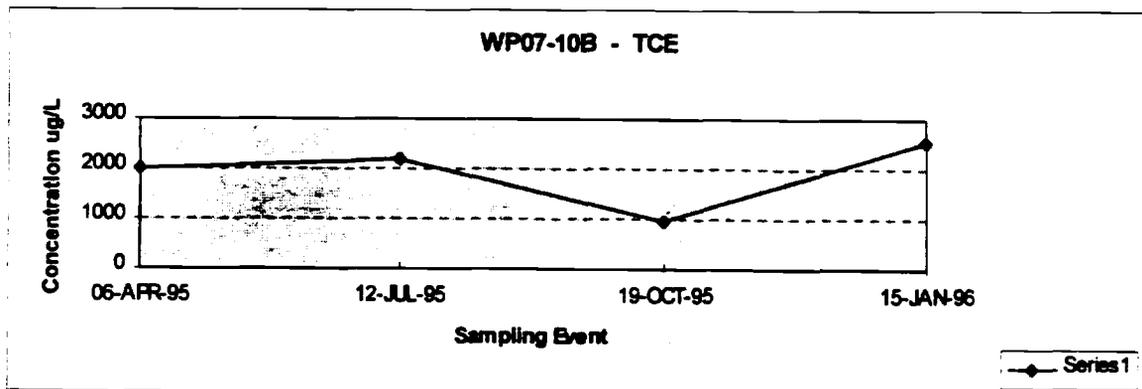
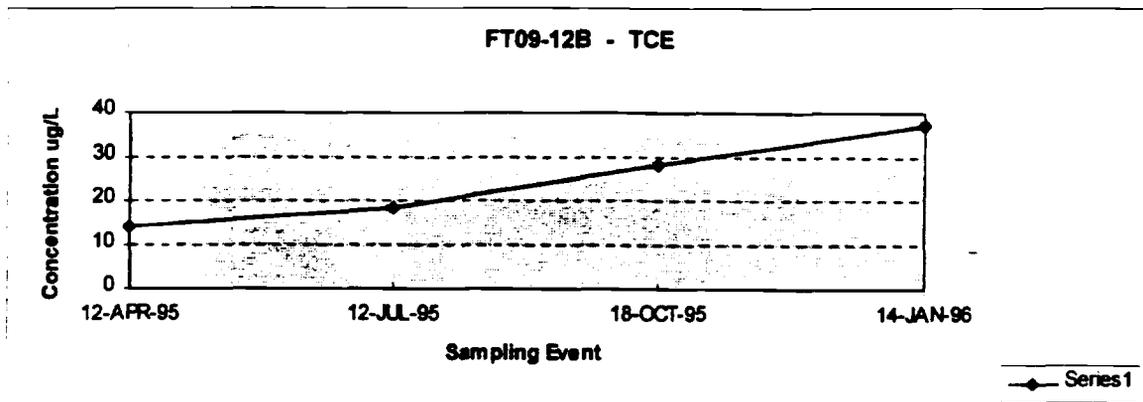
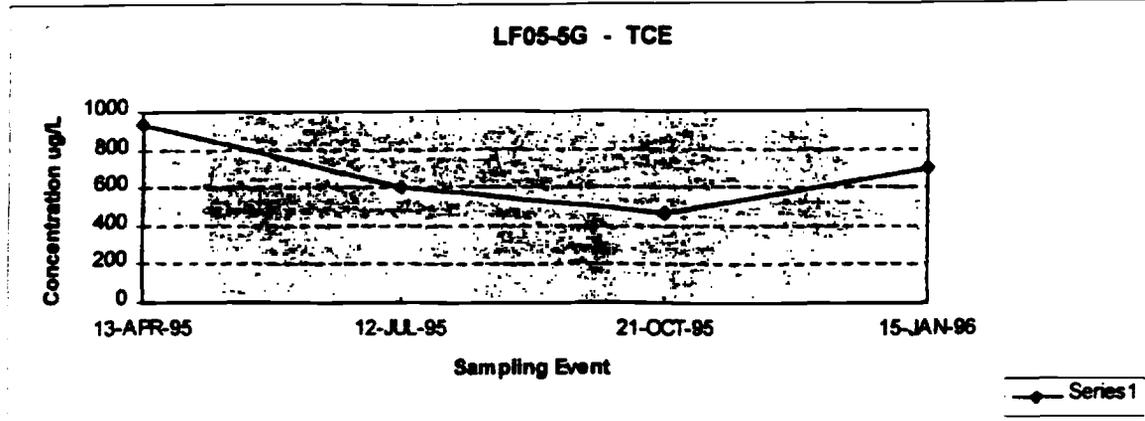
Charts depicting the concentrations of trichloroethene (TCE) in selected wells are presented in Figure 3-18. TCE concentration trends were evaluated for the following monitoring wells located in the Landfill 4 and Landfill 5 Area: LF04-4E, LF04-4F, LF05-5C, LF05-5G, FT09-12B, and WP07-10B. With the exception of LF05-5G, these wells exhibited a slight increase in TCE concentrations from the first to the fourth quarter. Monitoring well LF05-5G exhibited

FIGURE 3-18
TCE CONCENTRATIONS



**FIGURE 3-18
TCE CONCENTRATIONS**

293139



**FIGURE 3-18
TCE CONCENTRATIONS**

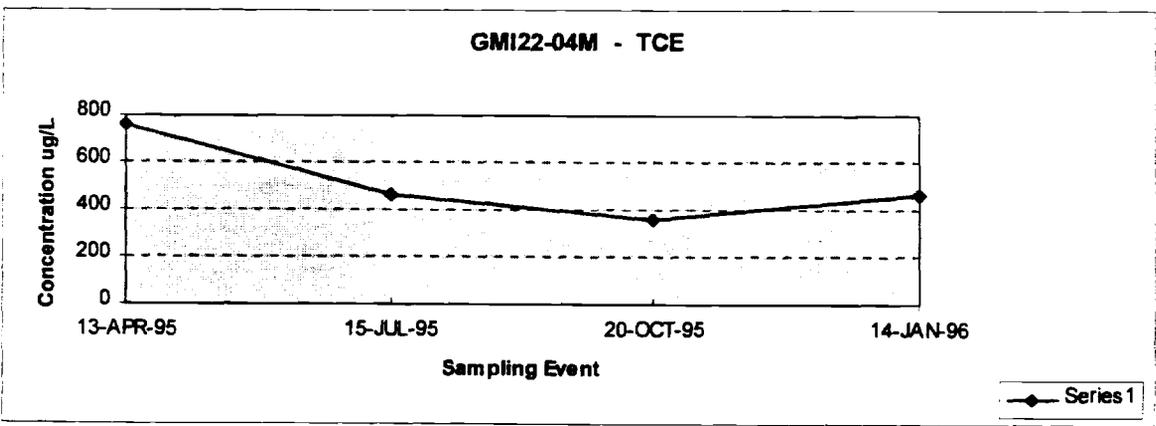
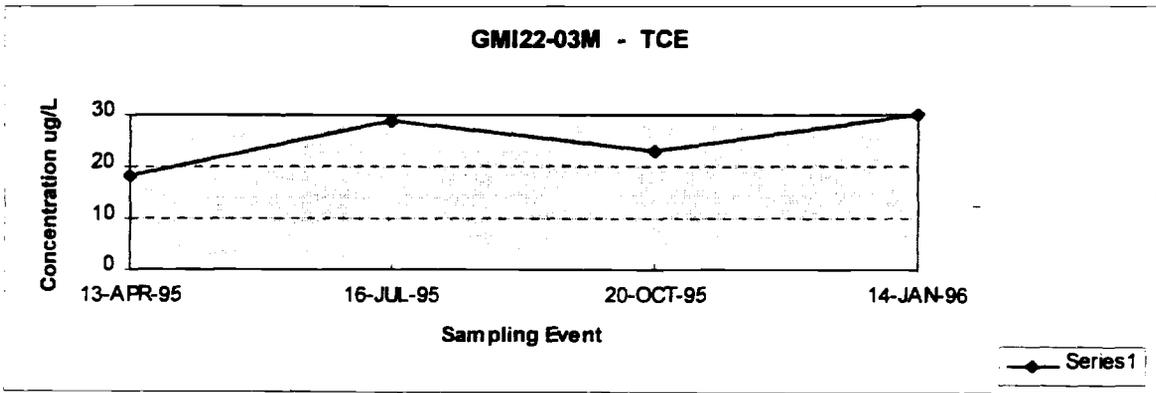
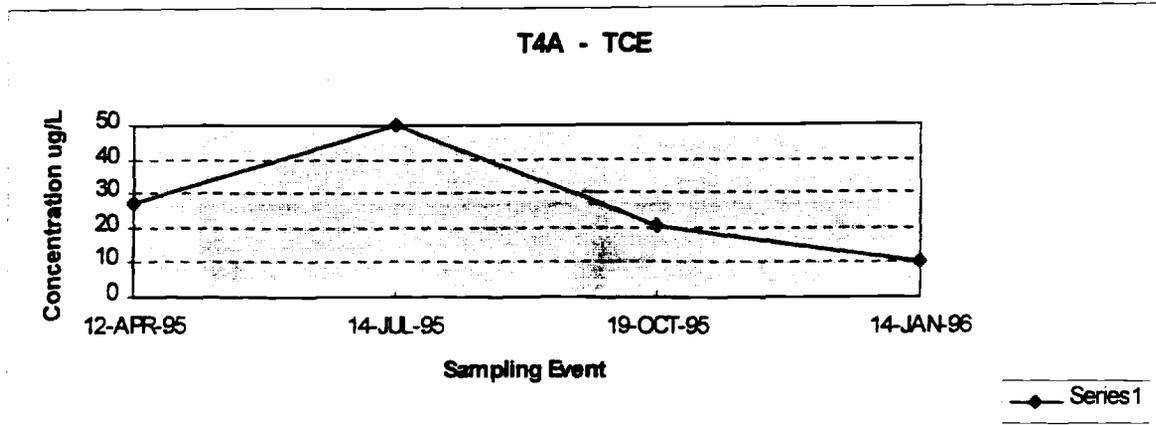


FIGURE 3-18
TCE CONCENTRATIONS

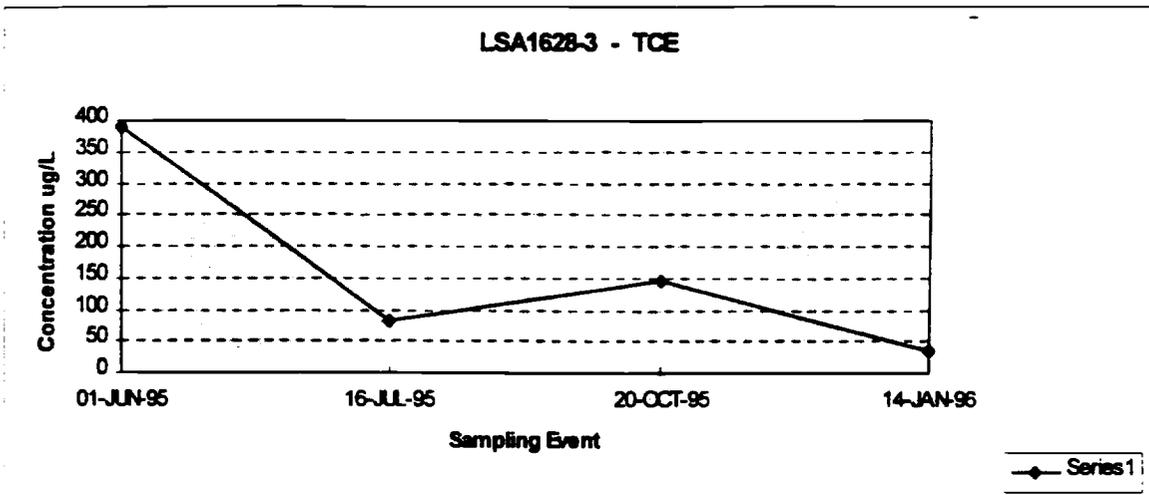
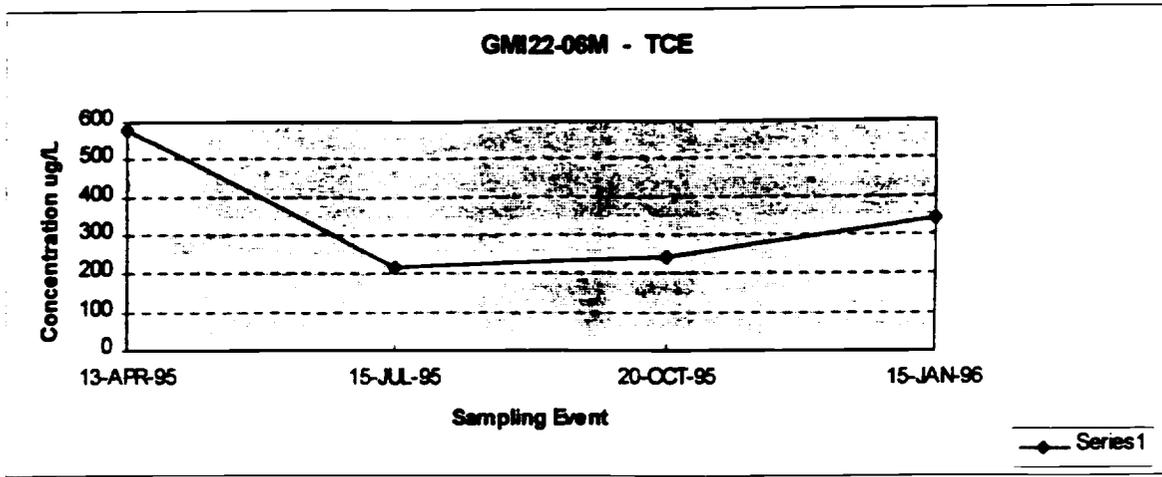


FIGURE 3-19
CIS-1,2 DICHLOROETHANE AND VINYL CHLORIDE CONCENTRATIONS

293142

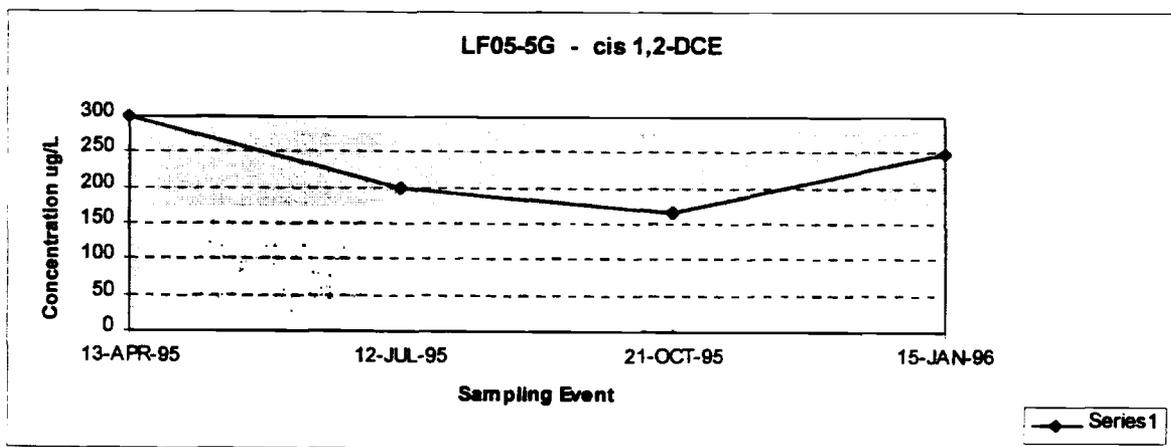
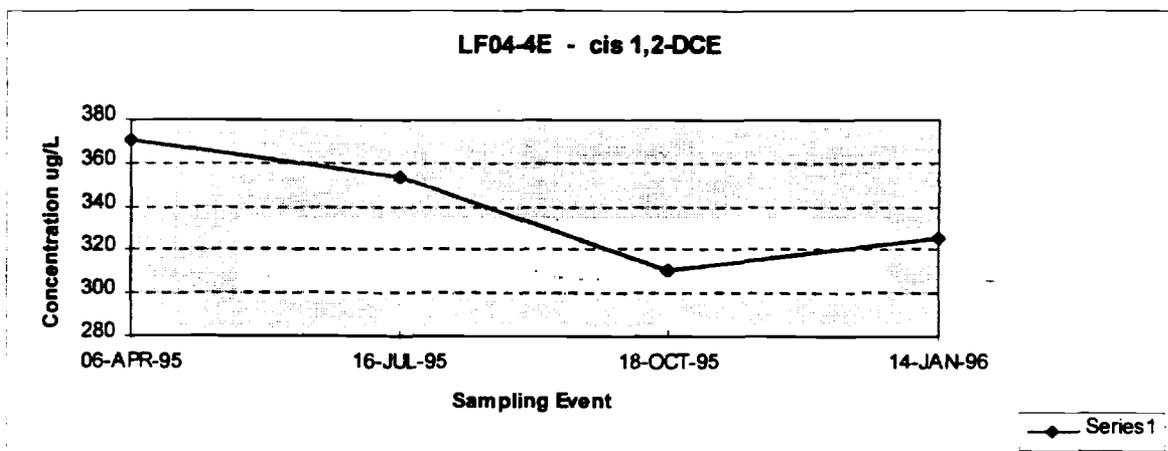
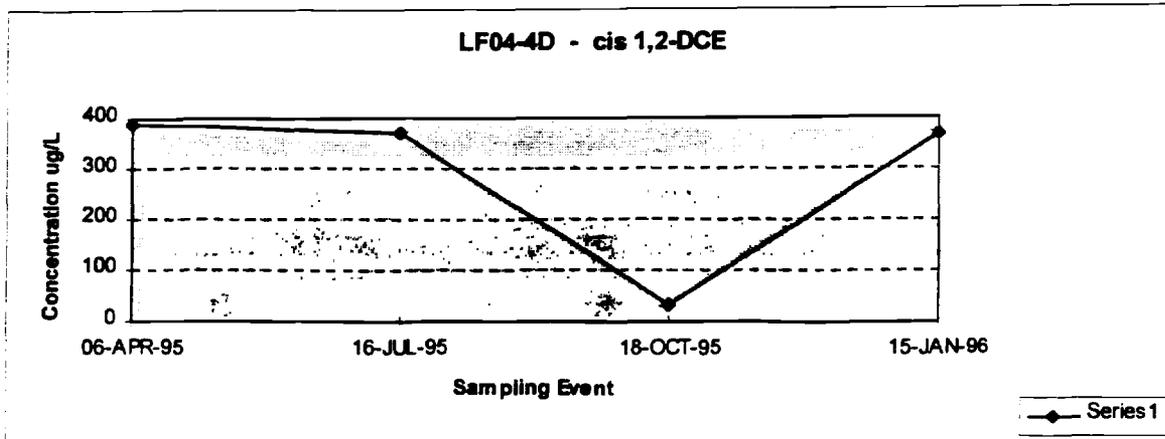


FIGURE 3-19
CIS-1,2 DICHLOROETHANE AND VINYL CHLORIDE CONCENTRATIONS

293143

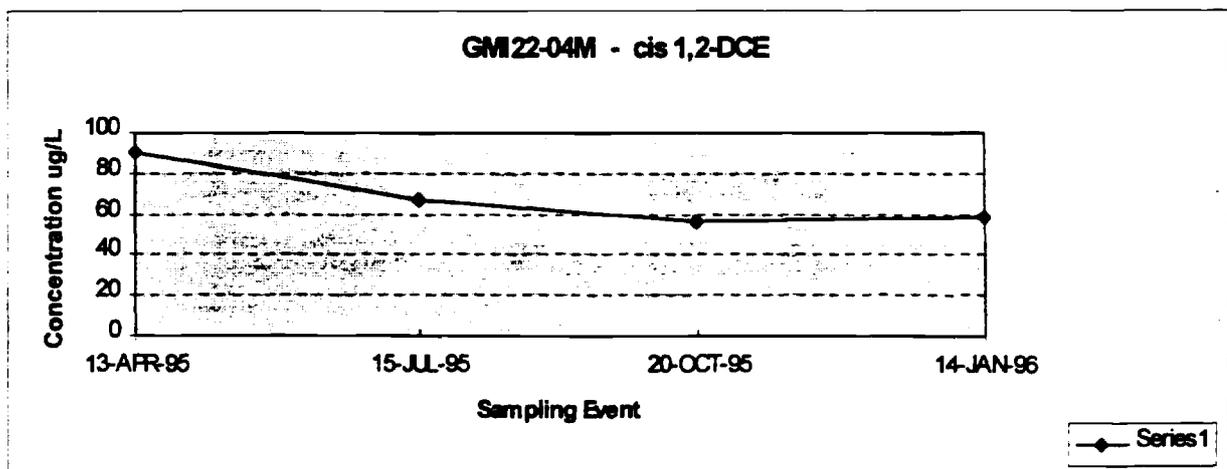
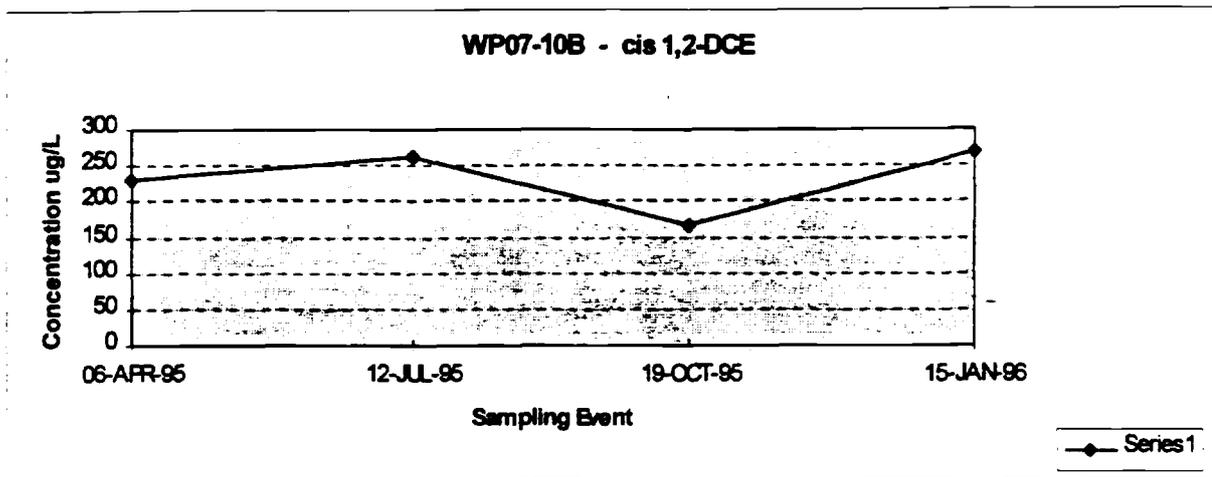
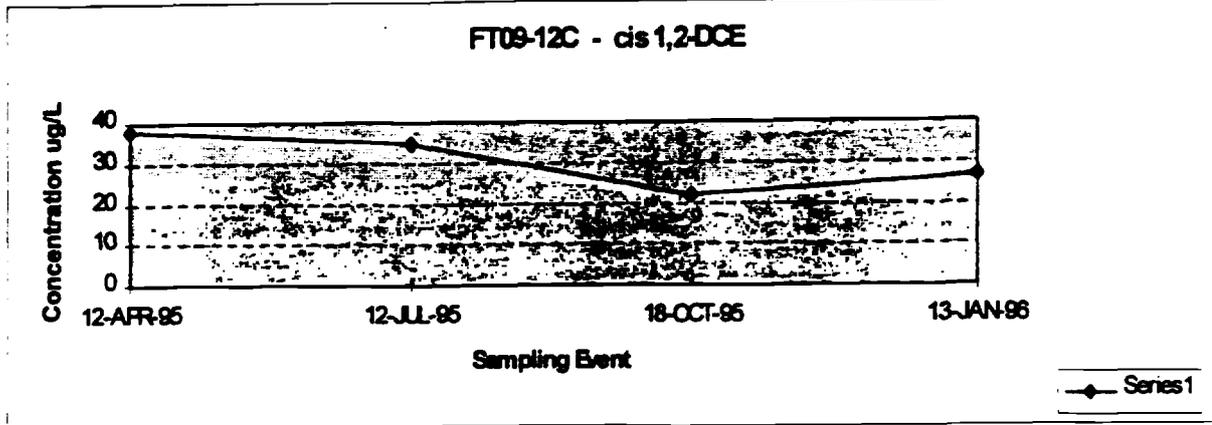


FIGURE 3-19
CIS-1,2 DICHLOROETHANE AND VINYL CHLORIDE CONCENTRATIONS

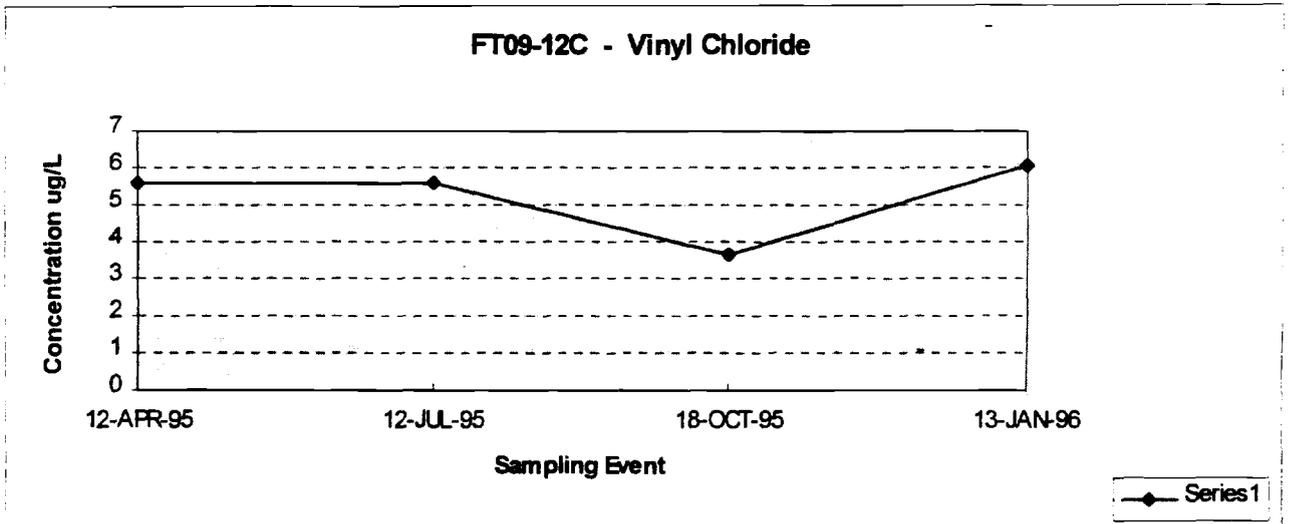
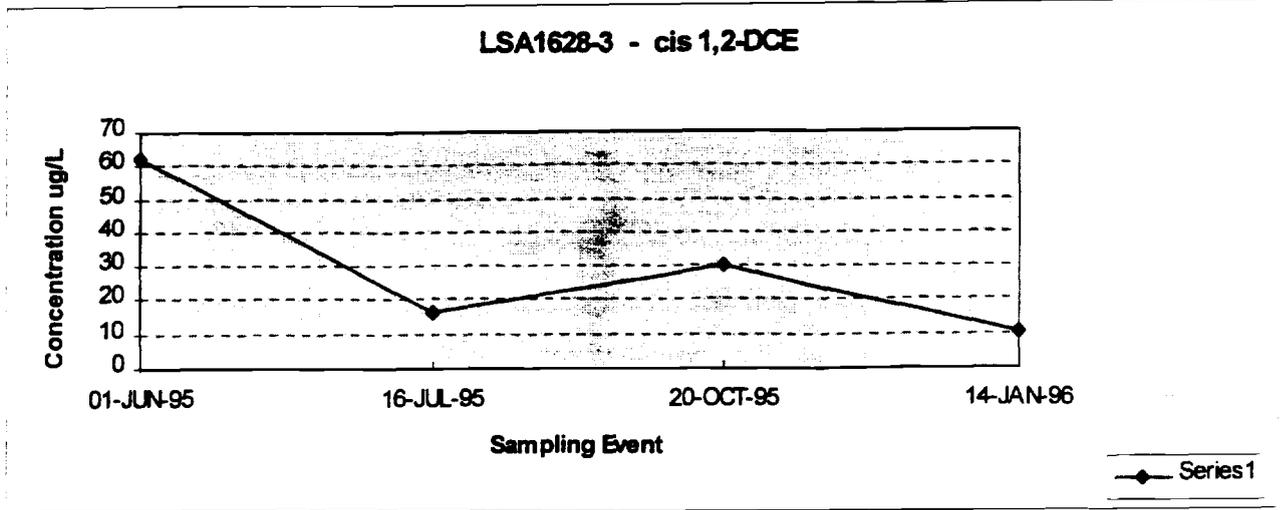
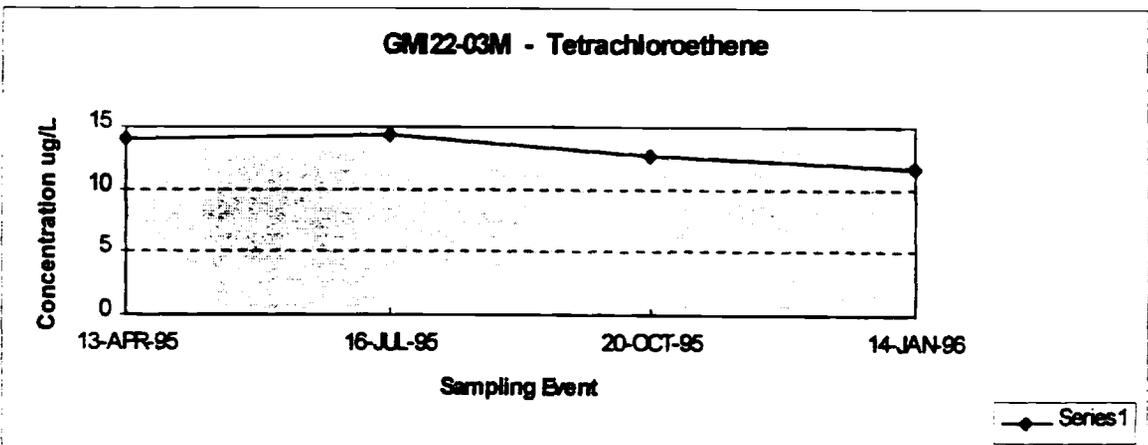
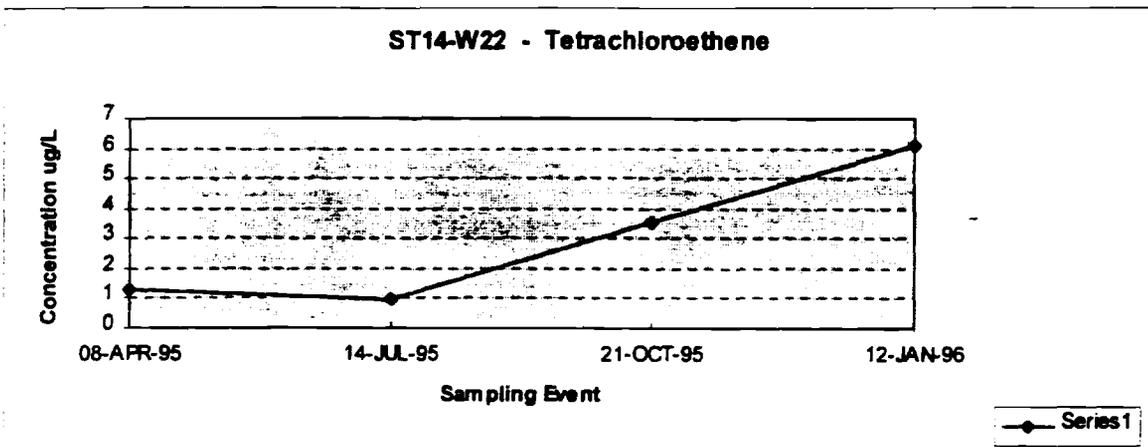
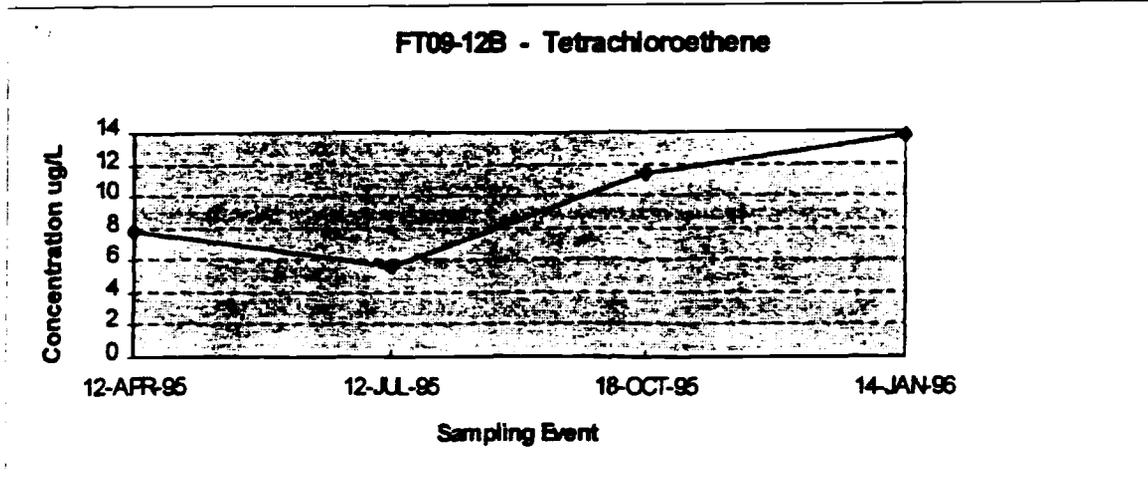
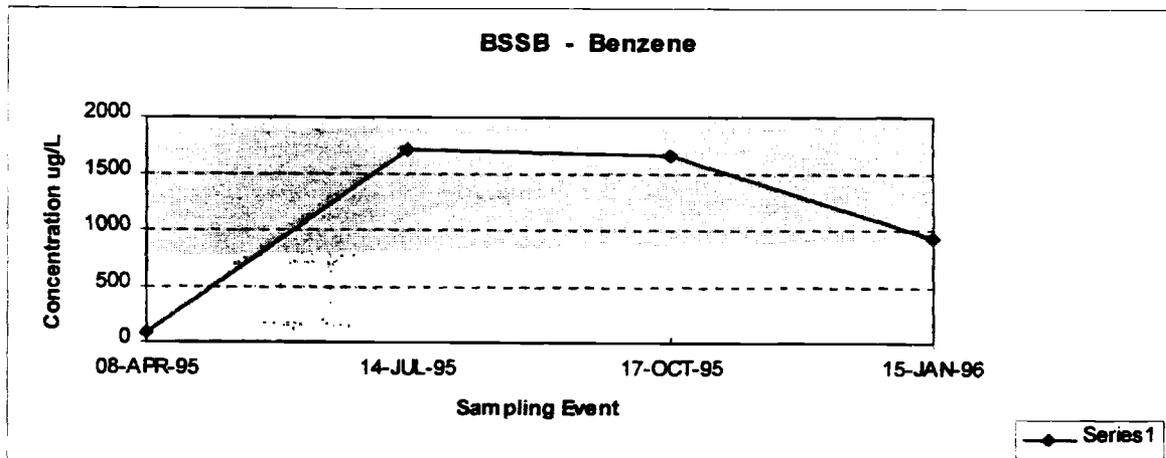
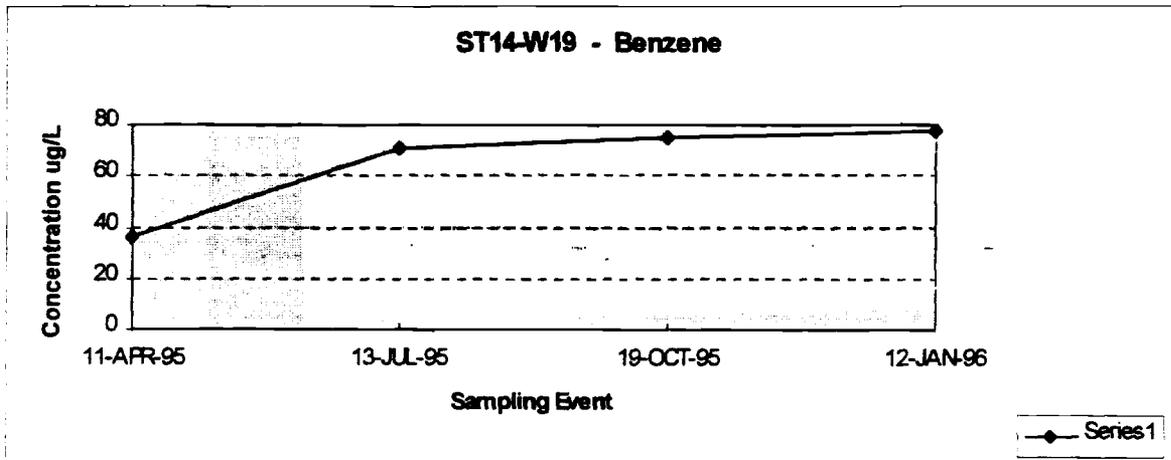
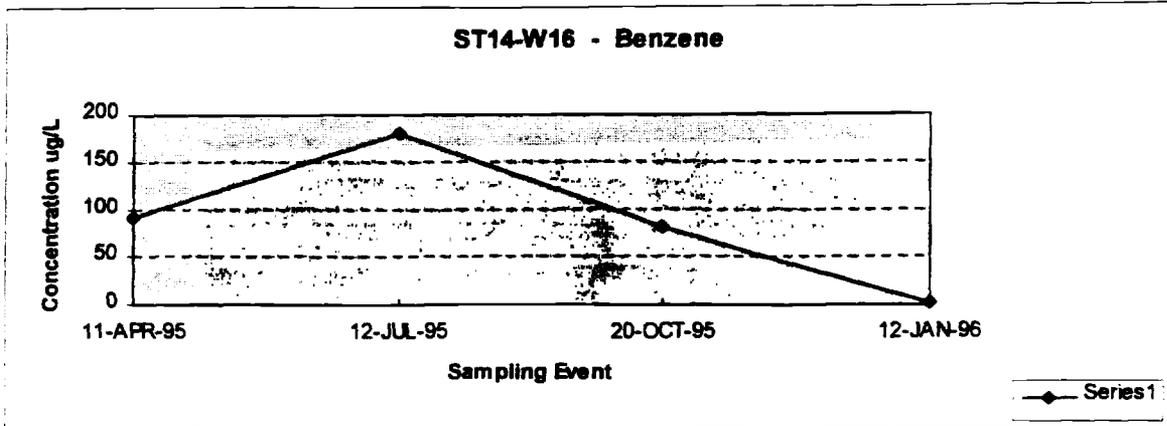


FIGURE 3-20
TETRACHLOROETHENE CONCENTRATIONS

293145



**FIGURE 3-21
BENZENE CONCENTRATIONS**



**FIGURE 3-21
BENZENE CONCENTRATIONS**

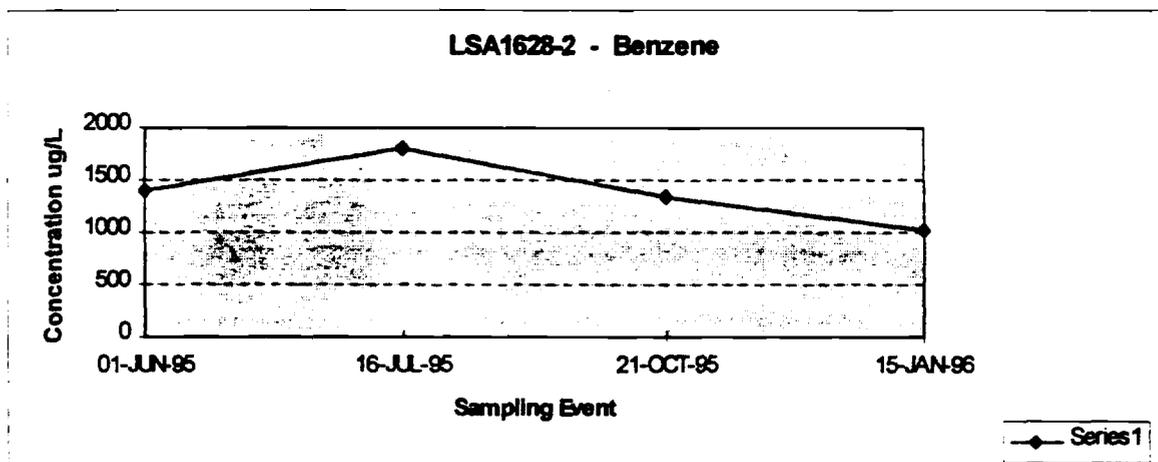
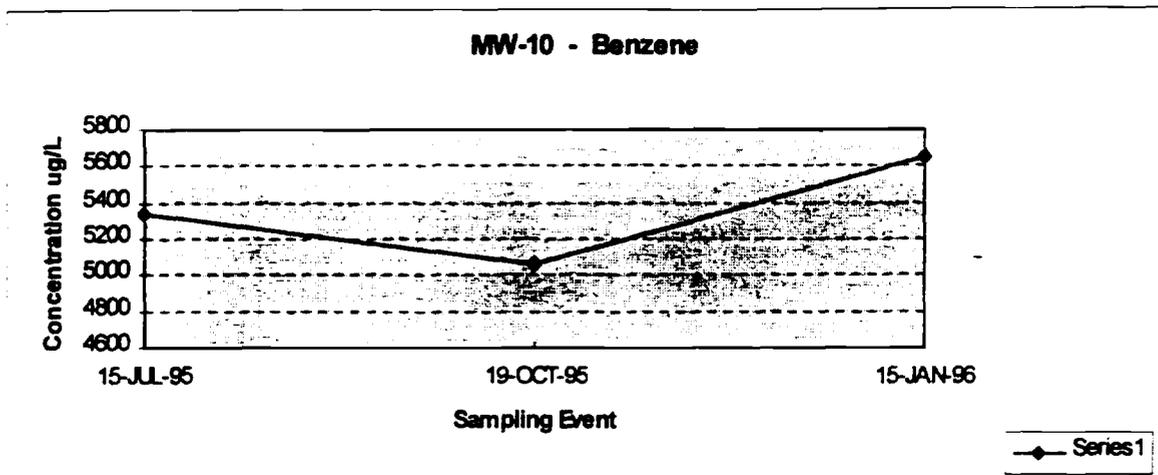
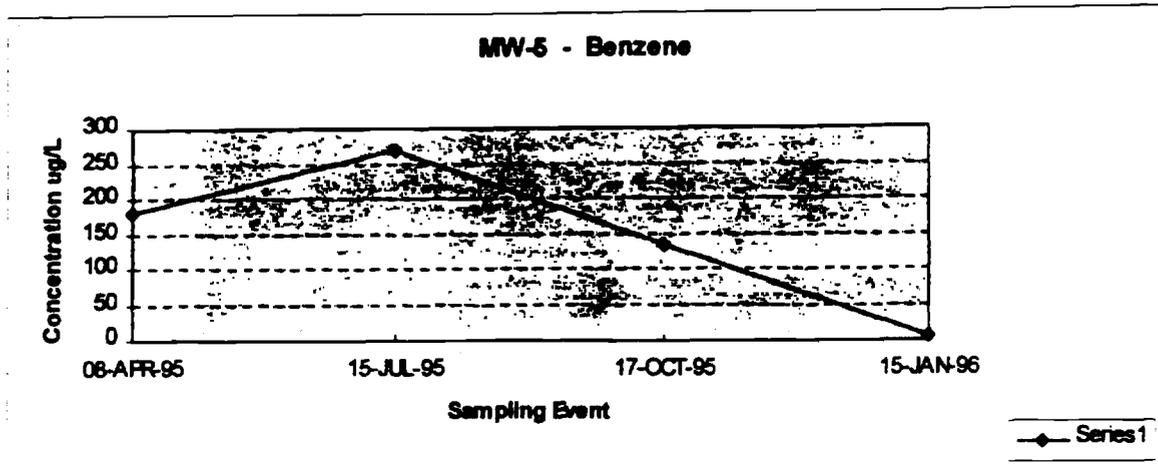
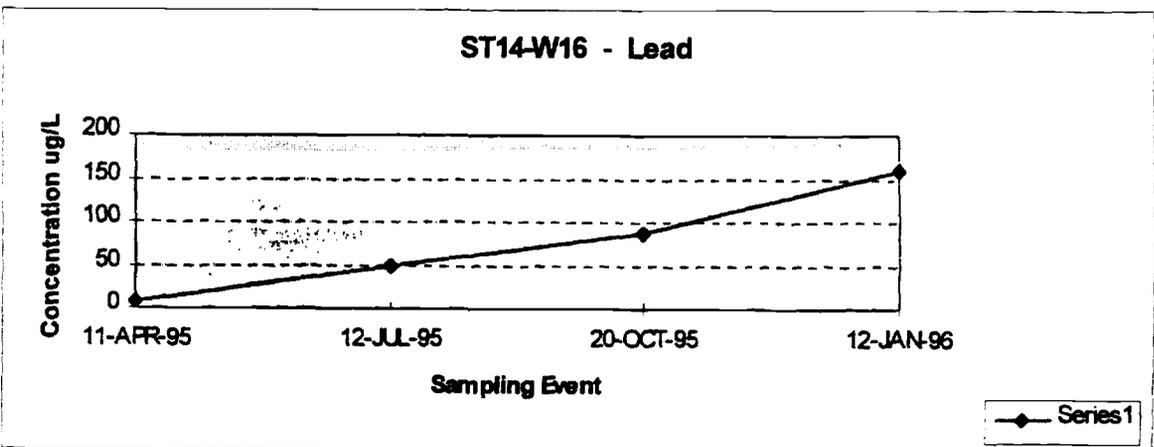
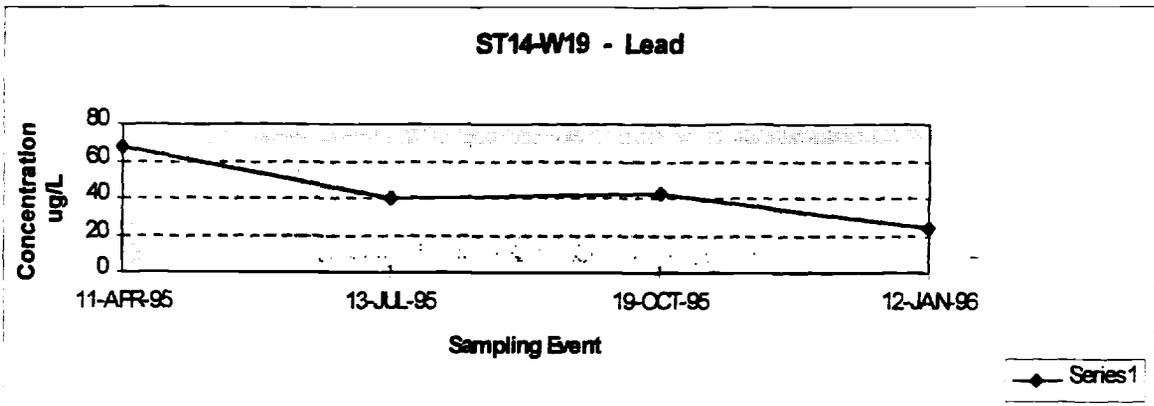
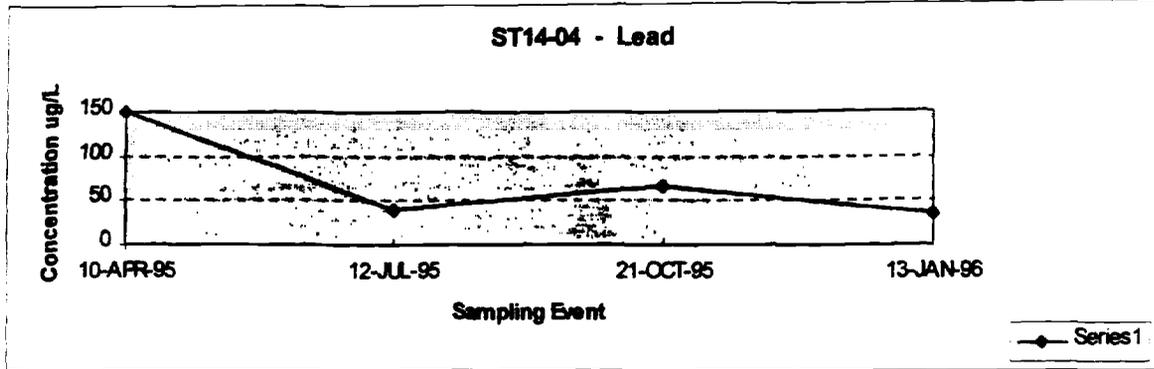
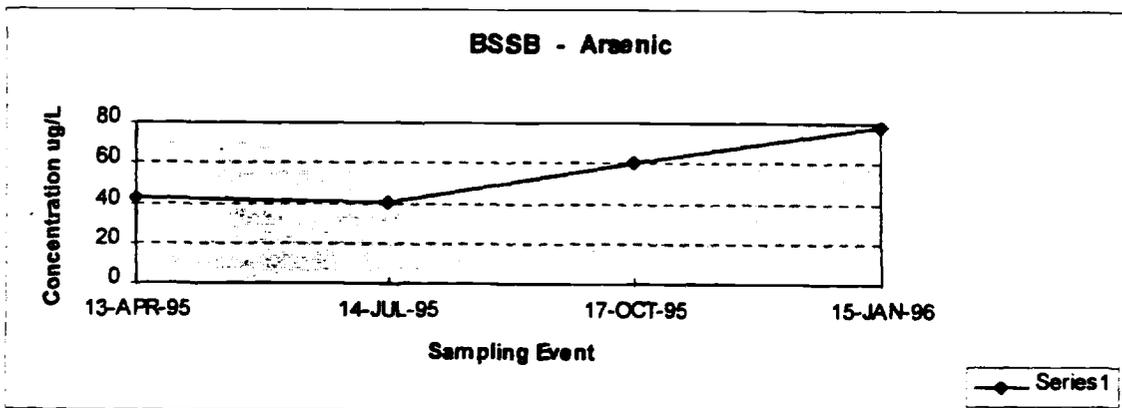
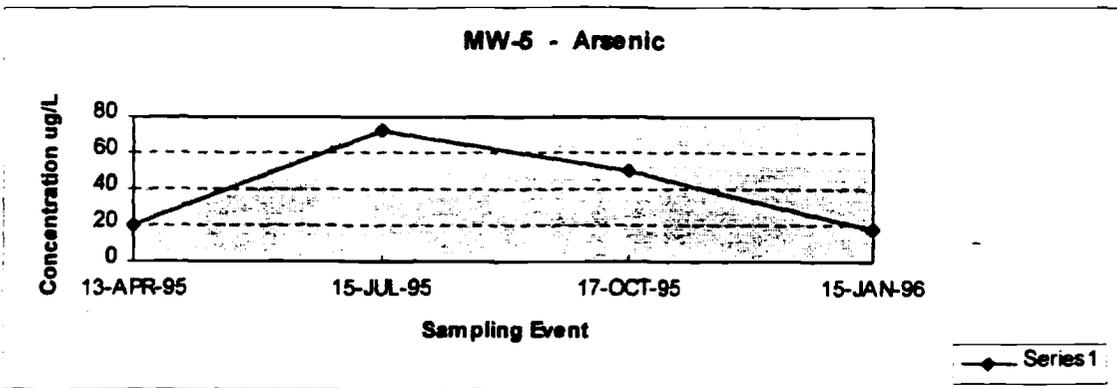
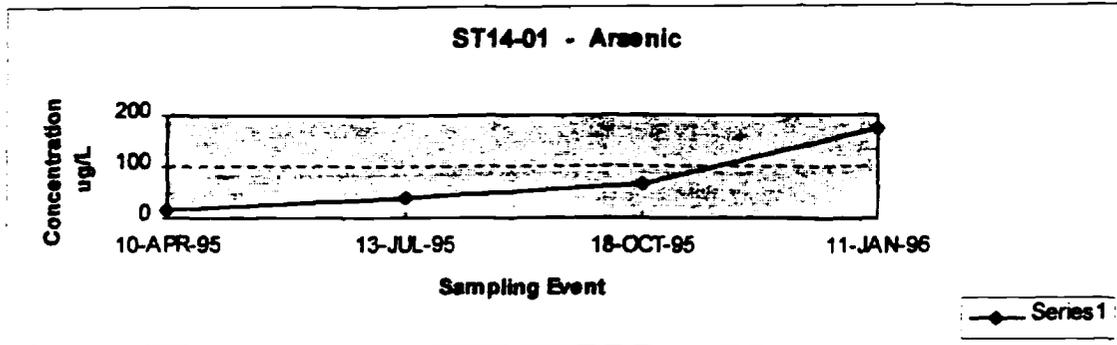


FIGURE 3-22
LEAD CONCENTRATIONS



**FIGURE 3-23
ARSENIC CONCENTRATIONS**



a decrease in TCE concentration from 930 $\mu\text{g/L}$ first quarter to 702 $\mu\text{g/L}$ fourth quarter. FT09-12B, located adjacent to the Fire Training Area 2, exhibited increasing TCE concentrations each quarter. TCE concentrations at FT09-12B were 14 $\mu\text{g/L}$ first quarter and 37 $\mu\text{g/L}$ fourth quarter.

T4A and GMI22-03M are located in the central area of the base. TCE concentrations in T4A increased second quarter, then decreased third and fourth quarters to concentrations less than those reported first quarter. GMI22-03M exhibited a slight increase in TCE concentrations over the four quarters.

Monitoring wells GMI22-04M and GMI22-06M, located in the northern-most TCE plume, exhibited a decrease in TCE concentrations over four quarters resulting in concentrations nearly half those reported during the first quarter. Near Building 1628, TCE concentrations decreased in LSA1628-3 from 390 $\mu\text{g/L}$ to 35 $\mu\text{g/L}$ from the first to the fourth quarter.

3.6.2 Cis-1,2-dichloroethene and Vinyl Chloride

Charts depicting the concentrations of cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride in selected wells are presented in Figure 3-19. Cis-1,2-DCE concentration trends were evaluated for the following monitoring wells located in the Landfill 4 and Landfill 5 Area: LF04-4D, LF04-4E, LF05-5G, FT09-12C, and WP07-10B. With the exception of WP07-10B, these wells exhibited decreasing concentrations of cis-1,2-DCE from the first to the fourth quarter. WP07-10B exhibited increases in cis-1,2-DCE concentrations for the second and fourth quarters. Vinyl chloride concentrations evaluated in FT09-12C indicated little change over four quarters.

Monitoring wells GMI22-04M and LSA1628-3, located in the northern-most TCE plume, exhibited decreasing cis-1,2-DCE concentrations.

3.6.3 Tetrachloroethene

Charts depicting the concentrations of tetrachloroethene in selected wells are presented in Figure 3-20. Tetrachloroethene trends were evaluated for the following monitoring wells: FT09-12B, ST14-W22, and GMI22-03M. Both FT09-12B and ST14-W22 exhibited slight increases in tetrachloroethene concentrations over four quarters. GMI22-03M exhibited a slight decrease in tetrachloroethene concentrations over four quarters.

3.6.4 Benzene

Charts depicting the concentrations of benzene in selected wells are presented in Figure 3-21. Benzene trends were evaluated for the following monitoring wells: ST14-W16, ST14-W19, BSSB, MW-5, MW-10, and LSA1628-1. Decreases in benzene concentrations were observed in ST14-W16, MW-5, and LSA1628-2 from the first to the fourth quarter. Benzene concentrations increased in ST14-W19, BSSB, and MW-10 over the four quarters.

3.6.5 Lead

Charts depicting the concentrations of lead in selected wells are presented in Figure 3-22. Trends in lead concentrations were evaluated for the following monitoring wells: ST14-04, ST14-W19, and ST14-W16. Decreases in lead concentrations were indicated in ST14-04 and ST14-W19. Lead concentrations increased in ST14-W16.

3.6.6 Arsenic

Charts depicting the concentrations of arsenic in selected wells are presented in Figure 3-23. Trends in arsenic concentrations were evaluated for the following monitoring wells: ST14-01, MW-5, and BSSB. Increases in arsenic concentrations were indicated in ST14-01 and BSSB. Arsenic concentrations in MW-5 increased from first to second quarter, but decreased third and fourth quarters, returning to the level reported at the beginning of the monitoring program.

3.6.7 Other Constituents of Concern

The following groups of constituents are addressed in this section: metals, phthalates, and polynuclear aromatic hydrocarbons (PAHs).

Several metals detected are naturally occurring and their presence is not known to be associated with base activities. A basewide background study is required to properly interpret the results of the metals analyses performed as part of the quarterly monitoring program.

Phthalates occurred in an apparently random distribution, possibly due to phthalate contamination of samples occurring during sampling or sample handling in the laboratory. As a result, a trend analysis was not reported.

The presence of naphthalene, 2-methylnaphthalene, and other PAHs was generally associated with elevated BTEX concentrations, therefore no further trend analysis was performed on these constituents.

4.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the basewide quarterly ground-water monitoring investigation, and presents conclusions and recommendations based on the findings of the ground-water investigation for all four quarters.

4.1 SUMMARY

This investigation included the quarterly ground-water sampling events performed in April, July, and October 1995, and January 1996. Seventy monitoring wells were included in the sampling program. During the fourth quarter sampling event, four additional monitoring wells were substituted for four wells that had been eliminated from the sampling program due to field conditions.

Ground-water flow was assessed based on ground-water elevations measured during each quarterly sampling event.

Ground-water samples were analyzed for volatile organic compounds, semi-volatile organic compounds, total metals, and pesticides/PCBs. A single sample, OT15C, required pesticide/PCB analysis.

In general, the data quality for all four quarters was sufficient to identify the nature of contamination in the monitoring wells under investigation. The samples collected were considered representative of the ground water in the alluvial aquifer at the base.

The concentrations of constituents detected were compared to the USEPA Maximum Contaminant Levels and the TNRCC Medium-Specific Concentrations. The extent of contamination of volatile and semi-volatile organic constituents was evaluated based on the presence of these constituents above the quantitation limit. Metals results were only compared to MSC values pending the results of the basewide background study.

4.2 CONCLUSIONS

The following sections present the conclusions of the investigation based on the findings of all four quarters.

4.2.1 Ground-Water Flow and Fluctuations

As part of the effort to identify potential contaminant plumes and their potential paths of migration, ground-water flow vector maps were generated for each quarter of ground-water sampling. The conclusions from this effort are as follows:

The direction of ground-water flow is from southwest to northeast in the southwestern corner of the study area; from west to east in the north-central, south-central, and eastern portions of the study area; and from northwest to southeast in the southeastern portions of the study area. There is insufficient information to determine the ground-water flow direction in the northern portion of the study area.

In general, ground water elevations dropped steadily between the first quarter (April 1995) and the fourth quarter (January 1996) sampling episodes. The greatest fluctuations were measured in the wells located along the eastern boundary of the site (along the West Fork Trinity River) and in the area of Landfills 4 and 5 in the southwest quadrant of the base. Fluctuations in these areas were generally 3 to 5 feet from the first to the fourth quarter, with the maximum fluctuation of 5.97 feet in well MW-12.

The smallest fluctuations were measured in the southeastern quadrant of the site in wells near Farmers Branch. Fluctuations in this area were generally 0.5 to 1 foot from the first to the fourth quarter, with the minimum fluctuation of 0.02 foot in well SD13-02.

The fluctuations in ground-water elevations from the first to the fourth quarters may have an impact on the distribution of the chemical constituents detected in ground water at the base.

4.2.2 Nature of Constituents of Concern

Constituents of concern detected on the base consisted primarily of metals and the volatile organic compounds trichloroethene, cis-1,2-dichloroethene, and BTEX. Basewide trends were not apparent due to the lack of monitoring well data for some areas of the base.

The highest concentrations of trichloroethene and cis-1,2-dichloroethene were reported from monitoring wells in the vicinity of Landfill 4 and 5. BTEX constituents were detected in the vicinity of the POL Tank Farm, the Base Service Station, Building 1628, and Landfill 4 and 5. Other volatile organic compounds reported with concentrations exceeding MSC values include: tetrachloroethene, vinyl chloride, styrene, and methylene chloride. However, methylene chloride was not considered a constituent of concern because there were no further methylene chloride detections after the second quarter.

Total lead was detected primarily in monitoring wells located in the area of the POL Tank Farm and Building 1628. Other metals reported with concentrations exceeding MSC values include: arsenic, barium, beryllium, cadmium, chromium, nickel and silver.

Although bis(2-ethylhexyl)phthalate was detected above its MSC value, the data reported may be the result of random phthalate contamination from the field or the laboratory. There were no detections of pesticides or PCBs in monitoring well OT15C, which was the only well sampled for pesticides/PCBs.

4.3 RECOMMENDATIONS

The data interpretation for this project was limited by several factors. These factors include the limitations imposed by, (1) incomplete survey data, (2) the lack of existing monitoring wells in areas where delineation is needed, and (3) the absence of basewide background ground-water concentrations.

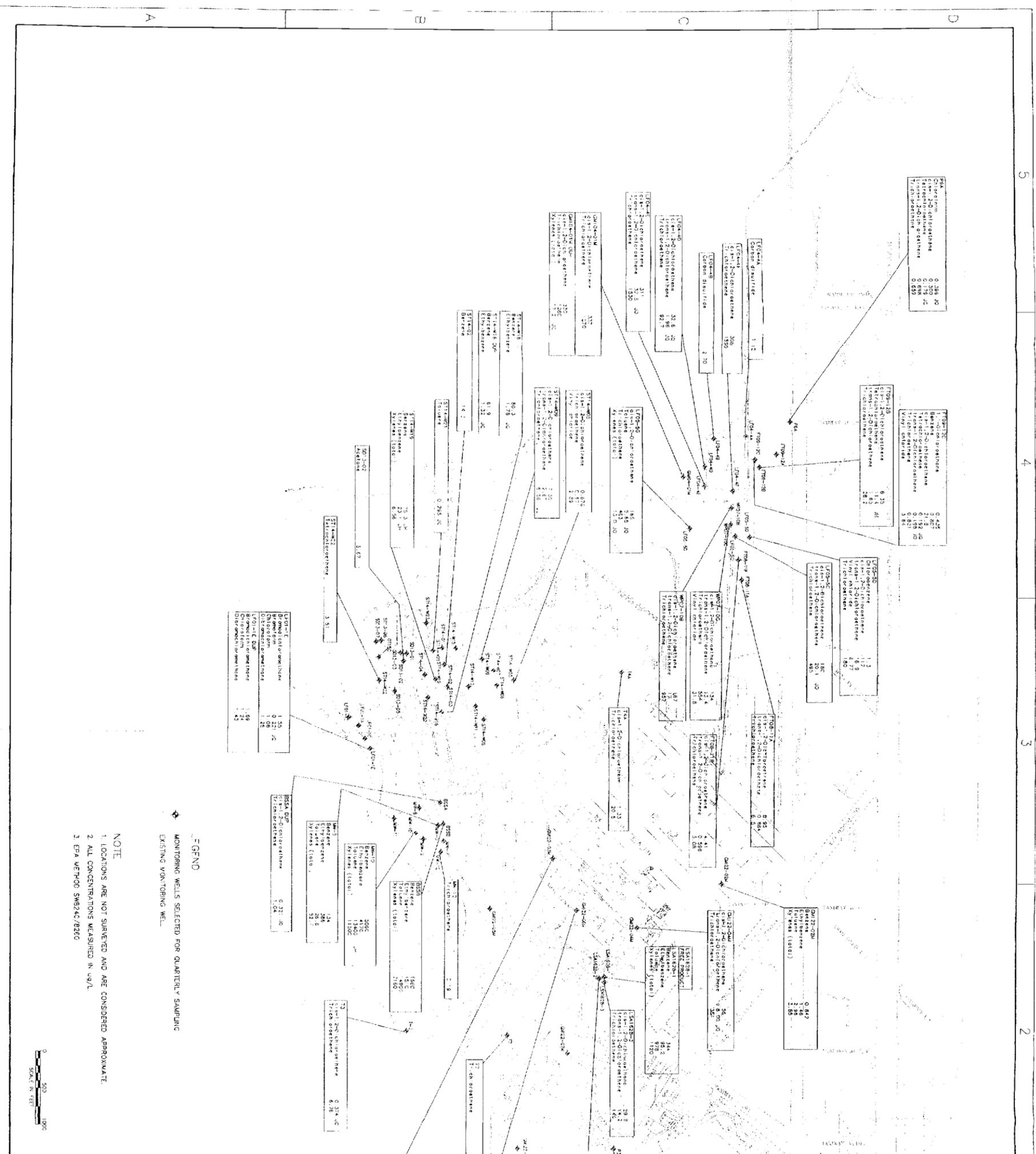
Additional survey data is needed in order to accurately determine ground-water flow patterns and chemical contamination plumes on the base. LAW has recently completed a global positioning satellite (GPS) survey that will provide accurate horizontal and vertical data for each monitoring well to complete the data gaps that currently exist in the survey information.

There is a lack of strategically located monitoring wells where additional delineation is needed for trichloroethene and cis-1,2-dichloroethene. In order to further delineate the extent of contamination for these constituents of concern, substitution with additional existing monitoring wells and/or installation of new monitoring wells is recommended.

A comprehensive basewide background study is recommended to determine the background concentrations of constituents detected in ground water. Under the TNRCC Risk Reduction Standard Number 1, evaluation of ground-water data requires the statistical determination of background concentrations derived from a TNRCC-approved background study. An evaluation of this type would improve the interpretation of metals concentrations in ground water by clearly identifying which metals detected are potential site-related contaminants and which metals are naturally-occurring constituents in ground water for this area. We understand that a study to determine background concentrations is planned for later this year.

It is further recommended that future sampling programs incorporate micro-purging techniques in the field program. This approach typically provides improved water quality parameters and considerably reduces the amount of purge water generated.

In addition, it would be appropriate to evaluate the analysis requirements for future sampling events using the data available from the first four quarters of sampling. Analysis of only the constituents of concern may reduce the analytical costs of future monitoring programs.



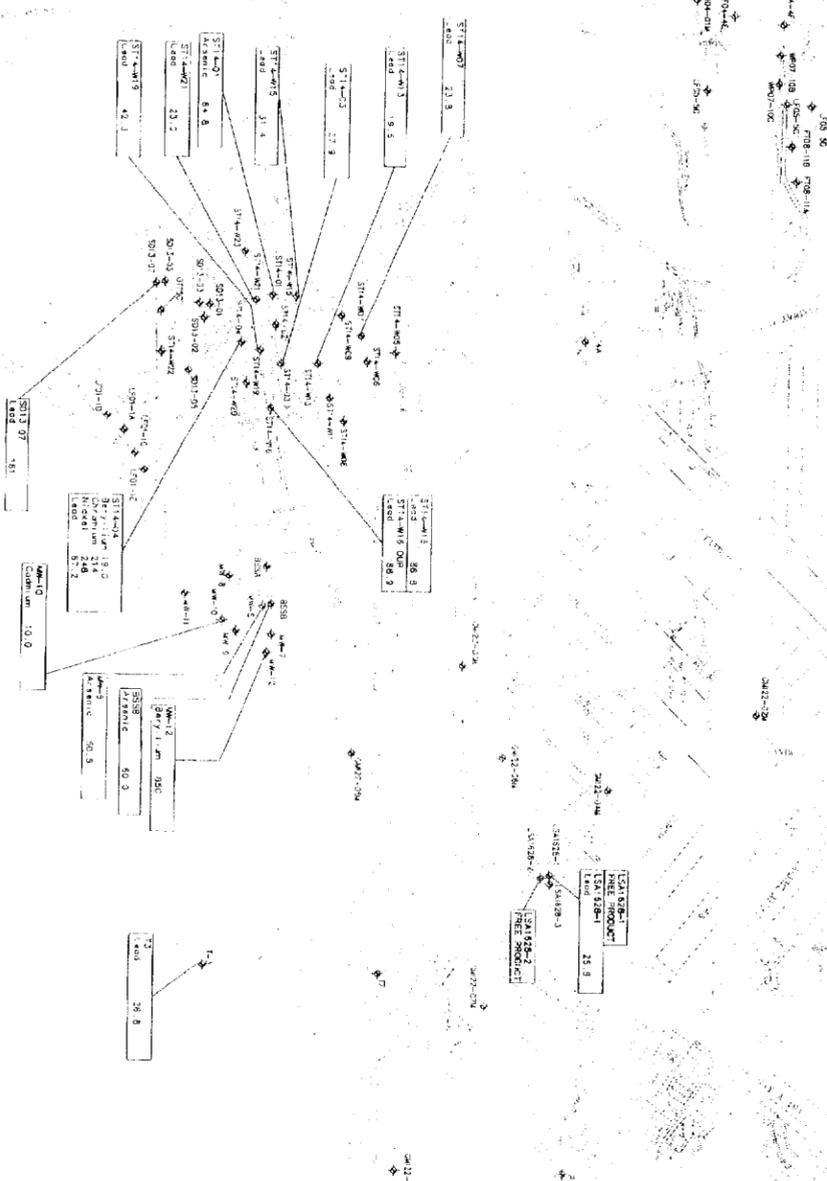
Revisions	Date	Approved

Drawn by: CAO
 Checked by: DSS
 Prepared by: JRS
 Date: 03 APR 95
 A/CLE: JRS

NAVAIL AIR STATION
FORT WORTH JOINT RESERVE BASE
FORTH WORTH, TEXAS
3rd QUARTER
VOLATILES DETECTED IN GROUND WATER

Project No: 11-35-7-320
 Sheet No: 3-4
 Sheet of: 1

5 4 3 2 1



LEGEND
 ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
 ○ EXISTING MONITORING WELL

NOTE
 1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE.
 2. ALL CONCENTRATIONS MEASURED IN ug/L
 3. EPA METHOD 8260/07/2000



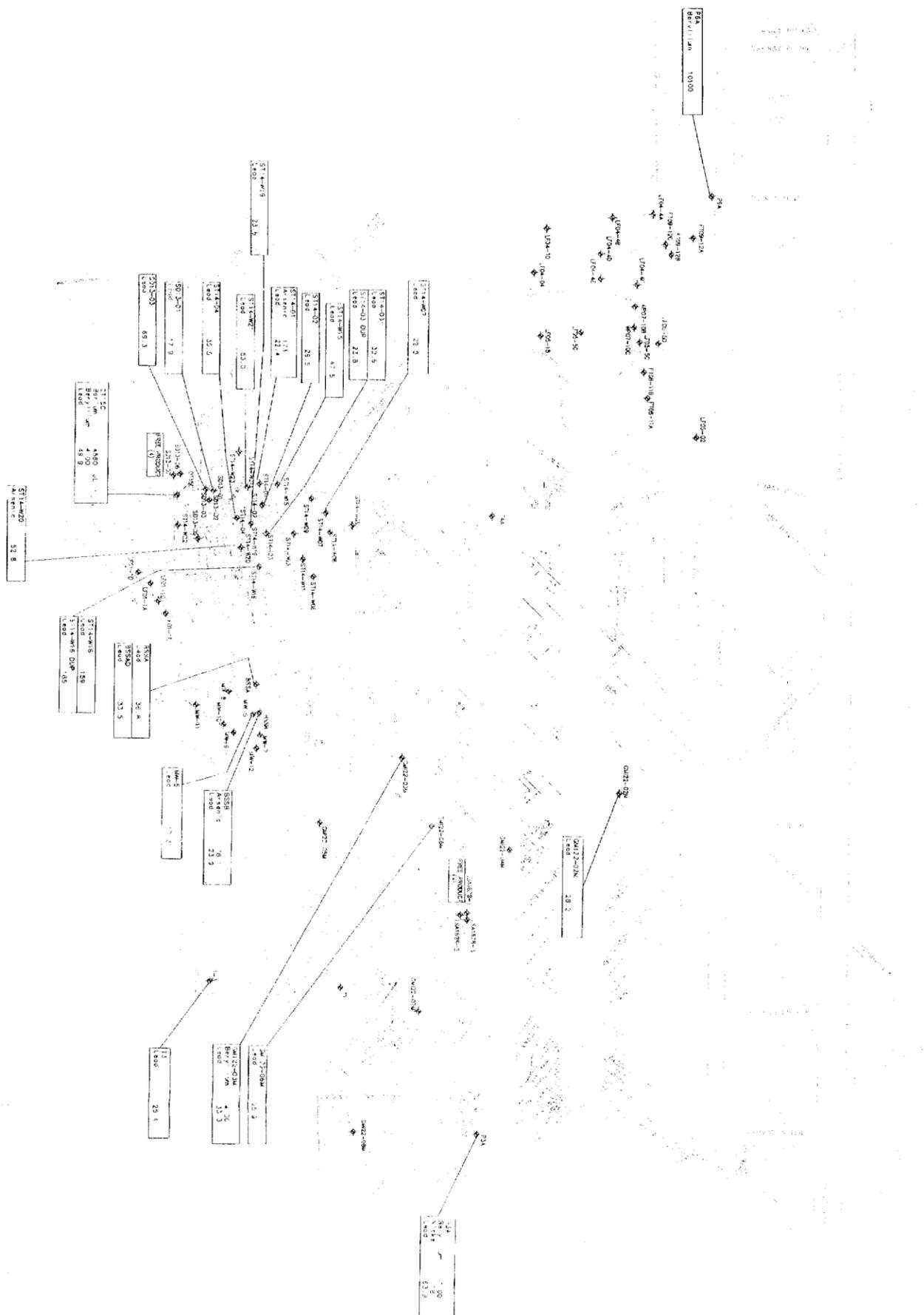
Revision	Description	Date	Approved

Designed by:
 Drawn by: CAD
 Checked by: DSS
 Reviewed by: JRF

**NAVAL AIR STATION
 FORT WORTH MOUNT RESERVE BASE
 FORT WORTH, TEXAS**

**METALS DETECTED IN GROUND WATER
 ABOVE MSCS - 3rd QUARTER**

BASE-WIDE QUARTERLY GROUND-WATER MONITORING
 Scale: AS SHOWN
 Project No: 11-3517-3201
 Date: 10 APR 98
 File Name: J:\dms\dms
 Sheet 1 of 1



LEGEND
 ◆ MONITORING WELLS SELECTED FOR QUARTERLY SAMPLING
 ◆ EXISTING MONITORING WELL

NOTE
 1. LOCATIONS ARE NOT SURVEYED AND ARE CONSIDERED APPROXIMATE
 2. ALL CONCENTRATIONS MEASURED IN UG/L
 3. EPA METHOD SW800/750C
 4. WELL WAS NOT SAMPLED FOR CHEMICAL ANALYSIS



Designed by	CAD		
Checked by	DSS		
Reviewed by	JRP		
APCEE	No		
Reasons	Distortion	Scale	Approved
NAVAL AIR STATION FORT WORTH, TEXAS METALS DETECTED IN GROUND WATER ABOVE MSCS - 4th QUARTER BASE-WIDE QUARTERLY GROUND-WATER MONITORING Project No. 11-2317-2201 Date 11 APR 88 Sheet 1 of 1			

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FINAL PAGE

ADMINISTRATIVE RECORD

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