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SUMMARY OF HYDROLOGIC AND CHEMICAL CHARACTERIZATION STUDIES VOLUME 2 OF 3 NAS FORT WORTH TX
1/15/1994
ENVIRONMENTAL SCIENCE AND ENGINEERING

File: 17G
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NAVAL AIR STATION
FORT WORTH JRB
CARSWELL FIELD
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ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 183

File: 17A-53
D.B. 180

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DRAFT REPORT

Summary of Hydrologic and Chemical Characterization Studies

Volume II

Prepared for:

U.S. Army Engineer District
Ft. Worth, Texas

Prepared by:

Environmental Science & Engineering, Inc.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFP4	Air Force Plant 4
AOC	Areas of Concern
BSS	Base Service Station
CAFB	Carswell Air Force Base
cm/sec	centimeters per second
COC	chemicals of potential concern
CRP	Community Relations Plan
12DCE	1,2-dichloroethene
DNAPL	dense non-aqueous phase liquid
DOD	U.S. Department of Defense
DP12	Chrome Pit No. 3
DP13	Die Yard Chemical Pit
DPM	Defense Priority Model
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science & Engineering, Inc.
FAA	Federal Aviation Administration
FBOP	Federal Bureau of Prisons

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 2 of 5)

FDTA 1	Fire Department Training Area No. 1
FDTA 2	Fire Department Training Area No. 2
FFA	Federal Facilities Agreement
FFSA	Former Fuel Storage Area
FR	Federal Register
ft	foot
ft/ft	feet per foot
ft-bgs	feet below ground surface
ft-msl	feet above mean sea level
ft/day	feet per day
GD	General Dynamics
GOCO	government-owned/contractor-operated
gpd/ft	gallons per day per foot
gpd/ft^2	gallons per day per square foot
gpd	gallons per day
gpm	gallons per minute
HARM	Hazard Assessment Rating Methodology
HSWA	Hazardous and Solid Waste Amendments
IRM	interim remedial action
IRP	Installation Restoration Program

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 3 of 5)

IRPIMS	Installation Restoration Program Information Management System
JETS	Jet Engine Test Stand
lb	pound
LF01	Landfill No. 1
LF02	Landfill No. 2
LF03	Landfill No. 3
LF04	Landfill No. 4
LF05	Landfill No. 5
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
NARF	Nuclear Aerospace Research Facility
NCP	National Oil and Hazardous Substances Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NSI	no significant impact
OAC	other areas of concern
PA/SI	Preliminary Assessment/Site Inspection
PA/SI/RI	Preliminary Assessment/Site Inspection/Remedial Investigation
PCE	tetrachloroethene

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued, Page 4 of 5)

pCi/L	picocuries per liter
POL	petroleum, oil and lubricant
PR	Preliminary Review
R-RAM	Radian Risk Assessment Model
RAM	radioactive material
RAP	remedial action plan
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RFA	RCRA Facility Assessment
RFI	Remedial Feasibility Investigation
RI/FS	remedial investigation/feasibility study
RI	remedial investigation
SARA	Superfund Amendments and Reauthorization Act of 1986
SCS	United States Soil Conservation Service
SOW	scope of work
SV	Sampling Visit
SWMU	solid waste management unit
TCE	trichloroethene
TMV	toxicity, mobility, and volume
TWC	Texas Water Commission

USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
UST	underground storage tank
VOC	volatile organic compound
VSI	Visual Site Inspection
WPAFB	Wright-Patterson Air Force Base
WSA	Weapons Storage Area
WWCB	Wastewater Collection Basins
yd^3	cubic yards
°F	Fahrenheit

Title: Phase I Investigation
Drilling and Construction of Upper Zone Test Holes and Monitor Wells
Author: Hargis and Montgomery
Doc No: AFP-01001
Submittal: January 1983

1. STUDY OBJECTIVES

The objectives of this report were to describe the drilling of shallow test borings and the construction of shallow monitor wells during the Phase I investigation. The test holes were designed to determine the location of historic disposal sites, including the Die Yard, fuel storage area, abandoned waste oil (West Parking Lot), suspect burn pit, and fire training burn pit.

2. STUDY ACCOMPLISHMENTS

Test holes TH-1 through TH-8 were drilled in the Die Yard. Test hole TH-9 was drilled at the site of the old fuel storage tank. Test holes TH-10 and TH-20 through TH-25 were drilled in the West Parking lot in the vicinity of the suspect burn pit south of outfall No. 4 and immediately west of Bomber Plant Road. Test hole TH-26 was drilled in the fire training burn pit. Soil samples were collected for determination of the lithologic character and quality of the soil at the individual target sites.

A total of twelve groundwater monitor wells were installed at the abandoned waste disposal site, the burn pits, and the site of an old fuel storage tank during the Phase I investigation. Monitor well HM-1 was constructed in the center of the abandoned chrome waste pit. Monitor well HM-2 was constructed at the site of a suspected abandoned burn pit location on the northwest side of the Radar Range. Monitor Wells HM-3a, HM-3b, HM-4a, and HM-4b were constructed along the west side of the Die Yard, in the vicinity of abandoned chemical waste pits. Monitor wells HM-5a and HM-9 were constructed at the toe of the landfill, and HM-5b was constructed near the center of the landfill. Monitor wells HM-6, HM-7, and HM-10 were constructed in the vicinity of the abandoned waste oil pits located beneath the West Parking Lot. Monitor well HM-8 was constructed at the site of an old fuel storage tank in the Radar Range.

All test holes and monitor wells were drilled using flight auger or air-rotary drilling methods. Soil samples were collected from each well boring and groundwater samples were collected at each monitor well location in order to assess the quality of the Upper Zone at the individual target sites. Samples were submitted to Allied Analytical & Research Laboratories, Inc., Dallas, Texas for chemical analysis.

3. DATA DEVELOPED

Lithologic data was developed during this investigation.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

The Phase I investigation was completed in 1983.

6. STUDY SCHEDULE

Drilling and construction operations were conducted during the period December 1 through December 10, 1982 by Southwestern Laboratories, Inc., Arlington, Texas.

7. INFORMATION IN IRPIMS

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Phase I Investigation of Subsurface Conditions
Author: Hargis & Montgomery, Inc.
Doc No: AFP-01002
Submittal: February 1982

1. STUDY OBJECTIVES

Hargis & Montgomery (H&M), under contractual arrangements with General Dynamics Corporation, completed a Phase I subsurface investigation of the Air Force Plant No. 4 located in Fort Worth, Texas. The main objectives of the investigation were as follows:

- Determine the concentrations of contaminants in soil and groundwater beneath abandoned waste disposal sites, burn pits, and abandoned fuel storage areas;
- Investigate hydrogeologic conditions in the vicinity of Air Force Plant 4; and
- Determine potential impacts of prior waste disposal practices on the local water supply and aquifer systems.

2. STUDY ACCOMPLISHMENTS

H&M, with information provided by General Dynamics Corporation, determined the possible locations of where solvents, fuel, paints, and other chemical wastes may have been stored, used or disposed of. At these locations, a total of 26 uncased soil borings were completed to locate suspected abandoned waste disposal areas, burn pits and the former fuel storage area and to determine site specific lithology.

Following location of the abandoned waste disposal areas, burn pits and former storage area were located, twelve monitoring wells were installed to determine groundwater quality in the upper groundwater zone. During monitoring well installation activities, soil samples were collected utilizing shelby tube and split spoon sampling. A total of thirty-one soil samples collected from nine of the monitoring wells were submitted for laboratory for analysis.

All soil samples submitted for laboratory analysis contained elevated levels of metals and volatile organics. The most common volatile organics detected in the soil samples were trichloroethylene (TCE), methylene chloride, xylenes, and toluene. Soil samples that contained the highest concentration of volatile organics were collected from the burn, waste oil and chrome pits. High concentrations of organic base/neutral priority pollutants were detected in soil samples collected from the chrome waste pit. Low concentrations of organic base/neutral and priority pollutants were detected in the die yard chemical pits and the west landfill.

Oil and grease was detected in five soil borings. The highest concentration of oil/grease was detected in the soil sample collected from the west landfill. High concentrations of oil/grease were detected in soil samples collected from the abandoned waste oil pits.

Groundwater samples were collected from the eight upper zone monitoring wells and one test boring. The analytical results indicate that the upper zone groundwater at the plant is contaminated with metals, cyanide, organic compounds, oil/grease, and jet fuel. Elevated metal concentrations and volatile organics were detected in all groundwater samples. The volatile organic compounds most frequently detected include TCE, toluene, methylene chloride, xylenes, 1,1-dichloroethylene, ethylbenzene, and tetrachloroethylene. Groundwater samples collected from the waste oil and die yard chemical pits contained the highest concentration of volatile organic compounds. The highest concentration of oil/grease was detected in the groundwater sample collected from the waste oil pits.

A potable well survey conducted during the investigation concluded that more than 100 wells exist within a two to three mile radius of the plant. The closest municipal wells are operated within White Settlement. White Settlement maintains nine municipal wells, two of which are located within 1500 feet of the plant. The seven other wells are located within 1/4 mile radius of the plant. Seven of the wells are installed within the Paluxy Aquifer, and two additional wells are located within the underlying Twin Mountains Aquifer. The closest private well is located approximately 500 feet south of the plant. Due to the nature and amount of contamination present, combined with the time span of disposal activities, the report stated that the potential existed for migration of contamination to the public and private wells. These wells were not sampled during this investigation.

3. DATA/INFORMATION DEVELOPED

As a result of the Phase I activities, six potentially contaminated locations and associated suspect activities were identified;

- Chrome Waste Pit - Disposal of paint wastes including strontium chromate and thinners.
- Chemical Pit (Die Yard) - Consisted of two or three pits, currently filled covered with concrete. Specific nature of chemical waste disposed is unknown.
- Burn Pits - one identified and two suspect areas utilized for fire fighting training and the disposal of fuels, solvents and oils.
- Waste Oil Pits - Several abandoned pits are located under the West Parking Lot. Pits were utilized for disposal and periodic burning of waste and solvents.
- Former Fuel Storage Site - Former jet fuel storage tank location.
- Landfills - Two landfills have been identified. The east landfill contained primarily construction debris. The west landfill, located beneath the West Parking Lot, was utilized for the disposal of steel drums, metal products, and burned refuse.

The findings of the investigation showed that the groundwater within the Upper Zone has been significant impacted by contaminants beneath the plant property. Because of the hydrogeological conditions in the area, there is a viable concern that the groundwater within the Paluxy aquifer is threatened by this contamination. This may occur through direct hydraulic interchange between the two aquifers or indirectly by migration from the Upper Zone into Lake Worth. Lake Worth provides recharge to the Paluxy. The local potable supply is similarly threatened as the Cities of Fort Worth and White Settlement obtain a portion of their potable supply from Lake Worth.

4. RECOMMENDATIONS

The recommendation was made for a Phase II investigation be conducted in order to delineate the areal extent of contamination in the Upper Zone aquifer, and to determine if the contaminants have percolated into the underlying Paluxy Aquifer. Recommendations included the installation and sampling of 29 Upper Zone monitoring wells and 17 Paluxy monitor wells. It was also suggested that all of the public and private wells within a one-mile radius of the site be sampled and be periodically sampled along with the Phase I monitor wells and selected surface water sites.

5. STUDY STATUS

The recommendations suggested by Hargis & Montgomery were enacted at various stages throughout the 1985 and 1986.

6. STUDY SCHEDULE

The Phase II field investigation was performed during December 1984. Additional assessment work and remediation work was subsequently initiated at the various target sites during 1985 and continues to date.

7. STUDY IN IRPIMS

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Investigation of Subsurface Conditions
Phase I
Volume II: Illustrations
Author: Hargis & Montgomery
Doc No: AFP-01003
Submittal: March 1983

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

This report, Volume II, contains the illustrations associated with the Phase I Investigation of Subsurface Conditions at Air Force Plant 4, Fort Worth, Texas. The following illustrations are included:

Figure 1 - Proposed Phase I Investigation
Figure 2 - Locations of Monitor Wells and Test Holes
Figure 3 - Geologic Map
Figure 4 - Hydrogeologic Sections
Figure 5 - Regional Well Location Map
Figure 6 - Selected Trace Metals in Extracts from Soil Samples
Figure 7 - Organic Compounds in Extracts from Soil Samples
Figure 8 - Selected Trace Metals Upper Zone Groundwater
Figure 9 - Organic Compounds Upper Zone Groundwater

Figure 1 (Proposed Phase I Investigation) shows proposed monitor well locations.

Figure 2 (Locations of Monitor Wells and Test Holes) shows the locations of test holes and monitor wells

Figure 3 (Geologic Map) shows the areal limits of the various geologic formations exposed at the surface in the region surrounding Air Force Plant 4.

Figure 4 (Hydrogeologic Sections) portrays 4 hydrogeologic cross sections across the area. The trace of each cross section trace is shown in Figure 2.

Figure 5 (Regional Well Location Map) shows the approximate locations of municipal and private wells in the area.

Figure 6 (Selected Trace Metals in Extracts from Soil Sample) illustrates the metal concentrations detected in the soil samples collected from monitor well borings and test holes.

Figure 7 (Organic Compounds in Extracts from Soil Samples) illustrates the organic compound concentrations detected in the soil samples collected from monitor well borings and test holes.

Figure 8 (Selected Trace Metals Upper Zone Groundwater) illustrates the trace metals concentrations detected in the groundwater samples collected from monitor wells completed in the upper zone.

Figure 9 (Organic Compounds Upper Zone Groundwater) illustrates the organic compound concentrations detected in groundwater samples collected from monitor wells completed in the upper zone.

Title: Phase I Investigation of Subsurface Conditions
Volume III: Appendices A-L
Author: Hargis & Montgomery
Doc No: AFP-01004
Submitted: February 1983

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

This report, Volume III (Appendices A-L) provides tabulated data collected during the Phase I investigation. The individual appendices presented in this report include:

Appendix A:	Drilling, Construction, and Lithologic Logs of Upper Zone Monitor Wells
Appendix B:	Drilling and Lithologic Logs of Upper Zone Test Holes
Appendix C:	Drilling and Lithologic Logs of Miscellaneous Test Holes
Appendix D:	Soil Sample Collection Forms and Analytical Methods
Appendix E:	Results of Chemical Analyses of Extracts from Soil Samples
Appendix F:	Water Sample Collection Forms and Analytical Methods
Appendix G:	Concentrations of Common Ions in Water Samples
Appendix H:	Concentrations of Trace Metals and Cyanide in Water Samples
Appendix I:	Concentrations of Volatile Organic Compounds in Water Samples
Appendix J:	Concentrations of Organic Base/Neutral Compounds in Water Samples
Appendix K:	Concentrations of Organic Acid Compounds in Water Samples
Appendix L:	Concentrations of Oil/Grease and Jet Fuel in Water Samples

Appendix A - Drilling, Construction, and Lithologic Logs of the Upper Zone Monitor Wells

Appendix A provides the well logs and lithologic logs for the 12 monitor wells installed into the Upper Zone beneath abandoned waste disposal sites, burn pits, and the old site of a fuel storage tank during the Phase I investigation. The monitor wells were designed for collection of lithologic, water level, and groundwater and soil sample collection.

Appendix B - Drilling and Lithologic Logs for the Upper Zone Test Holes

This appendix contains the boring logs for 26 uncased test holes drilled during the investigation to assess subsurface conditions at the abandoned waste disposal sites, burn pits, and the old site of a fuel storage tank. The borings were drilled to collect lithologic data. Monitor well were installed at most borings to assess groundwater quality and soil contamination beneath the site.

Appendix C - Drilling Logs for Miscellaneous Test Holes

This appendix contains the boring logs for seventy-eight test holes, ranging in depth from 10 to 113 feet, drilled at the Plant prior to the Phase I Investigation. Drilling data and lithologic logs for these test holes were acquired from the records of General Dynamics Corporation. Test holes AC-l through AC-18, and SL-l through SL-47, were drilled to investigate subsurface conditions associated with foundations for proposed building sites and to describe subsurface conditions in the vicinity of waste oil pits beneath the West Parking Lot.

Appendix D - Soil Sample Collection Forms and Analytical Methods

Appendix D summarizes the sample collection protocol in which a total of 161 soil samples were collected during the drilling of 11 monitor wells and five test holes. Thirty-one of these samples were submitted to Analytical & Research Laboratory for analysis. All samples were collected in December 1982. The soil samples were submitted to Analytical & Research Laboratory for analyses.

Appendix E - Results of Chemical Analyses of Extracts from Soil Samples

Appendix E contains the laboratory analytical reports for 31 soil samples that were submitted to Analytical & Research Laboratory. Each soil sample was analyzed for the following parameters:

- Volatile Organic Compounds
- Trace Metals and Cyanide
- Organic Base/Neutral Compounds
- Organic Acid Compounds
- Oil/Grease and Jet Fuel

Appendix F - Water Sample Collection Forms and Analytical Methods

Appendix F provides the protocol used in the collection of groundwater samples from eight upper zone monitoring wells and one test hole. The water samples were analyzed for the following parameters:

- Volatile Organic Compounds
- Trace Metals and Cyanide
- Organic Base/Neutral Compounds
- Organic Acid Compounds
- Oil/Grease and Jet Fuel
- Common Ions

Groundwater samples were collected from the following monitor wells: HM-1; HM-2; HM-5; HM-6; HM-7; HM-8; HM-9; and HM-10. A groundwater sample was also collected from test hole TH-3.

Appendix G - Concentrations of Common Ions in Water Samples

Appendix G presents the common ion concentration of nine groundwater samples which were analyzed by Analytical & Research Laboratory.

Appendix H - Concentrations of Trace Metals and Cyanide in Water Samples

Appendix H contains the laboratory analytical reports for nine groundwater samples that were submitted to Analytical & Research Laboratory and analyzed for trace metals and cyanide.

Appendix I - Concentrations of Volatile Organic Compounds in Water Samples

Appendix I contains the laboratory analytical reports for nine groundwater samples that were submitted to Analytical & Research Laboratory and analyzed for volatile organic compounds.

Appendix J - Concentrations of Organic Base/Neutral Compounds in Water Samples

Appendix J contains the laboratory analytical reports for nine groundwater samples that were submitted to Analytical & Research Laboratory and analyzed for organic base/neutral compounds.

Appendix K - Concentrations of Organic Acid Compounds in Water Samples

Appendix K contains the laboratory analytical reports for nine groundwater samples that were submitted to Analytical & Research Laboratory and analyzed for organic acid compounds.

Appendix L - Concentrations of Oil/Grease and Jet Fuel in Water Samples

Appendix L contains the laboratory analytical reports for nine groundwater samples that were submitted to Analytical & Research Laboratory and analyzed for oil/grease and jet fuel compounds.

Title: Construction of Paluxy Monitor Well P-1
Author: Hargis & Montgomery
Doc No: AFP-01005
Submittal: April 1985

1. STUDY OBJECTIVES

In order to assess the hydrogeologic conditions in the Paluxy aquifer in the vicinity of the Die Yard a monitor well (designated P-1) was installed. Of primary concern was the quality of the groundwater within the Paluxy aquifer due to the questionable integrity of the Walnut Formation aquitard in that area. The groundwater within the Upper Zone aquifer was known from previous investigations to contain elevated levels of organic contaminants. This well was also installed to provide water level data to determine the vertical gradient between the upper zone and the Paluxy Aquifer. The site for well P-l was selected to be within the Plant boundary and as near as possible to the closest municipal well to determine the potential for contamination migration to the potable well.

2. STUDY ACCOMPLISHMENTS

Drilling was performed by Southwestern Laboratories, Inc. utilizing mud-rotary drilling to a total depth of 214 feet below land surface (bls). Samples of drill cuttings were collected during drilling operations and a lithologic log was compiled. Initially, a 15-inch surface borehole was drilled to the top of the Walnut Formation, and 10-inch blank steel casing was set and cemented to a depth of 37 feet bls to prevent contamination within the upper zone from migrating to the Paluxy Aquifer through the borehole. Following drilling equipment decontamination the borehole was flushed with fresh water and a 9-5/8-inch borehole was drilled to the top of the Paluxy Formation. A 6-5/8-inch blank steel casing was then set and cemented to a depth of 79 feet bls. Drilling equipment was again cleaned or replaced and the borehole was flushed with fresh water to prevent potential contamination of the Paluxy Formation. A 6-1/8-inch borehole was drilled to the apparent base of the Paluxy Formation, and 5-1/2-inch threaded schedule 80 PVC casing and screen was set to 208.5 feet bls. Three 20-foot sections of slotted PVC well screen were set opposite sandy zones within the Paluxy Formation. The well screen comprised 0.030-inch by 2-inch horizontal machine-cut slots, with six slots per round and 282 slots per foot.

Following installation, development of well P-l began with air-lift pumping for approximately 90 minutes until the discharge was clean and free of most suspended sediment. A single-phase, three-wire, two-horsepower Jacuzzi submersible pump was then installed with the pump in take set at 163 feet bls. Column pipe comprised threaded 1 7/8-inch galvanized steel pipe. A steel sanitary well seal with rubber gasket was placed at the top of the 6-5/8-inch casing. A 3/4-inch PVC sounding tube was installed adjacent to the column pipe and pump from land surface to a depth of 155 feet bls to provide access for water level measurements. The well was pumped for approximately one hour to continue development.

Pumping continued for seven hours and 10 minutes, and measurements of water level recovery began following the conclusion of pumping. Maximum water level drawdown during pumping was 11.03 feet. Average temperature and conductivity of the pumped water, measured in the field, were 21.5°C and 580 micro omhs per centimeter. A total of 13,900 gallons was pumped from the well at an average rate of 32.3 gallons per minute. Specific capacity of the well was calculated to be 2.9 gallons per minute per foot of drawdown. Static water level measured prior to pumping was 91.82 feet bls. Analysis of drawdown and recovery data collected during the pumping test indicates that, in the vicinity of well P-l, the Paluxy aquifer has a coefficient of transmissivity of about 24,000 gallons per day per foot. The permeability of the Paluxy aquifer is indicated to be about 200 gallons per day per square foot, or 9,800 feet per year.

At the conclusion of the pumping period, water samples were collected from the well discharge. All samples were immediately sealed and stored in ice. Two of the 20-milliliter glass vials were submitted to Brown & Caldwell, Pasadena, California, for determination of EPA priority pollutant volatile organic compounds. The remainder of the samples, together with blank samples, were submitted to Allied Analytical & Research Laboratories, Inc., Dallas, Texas, for determination of EPA priority pollutant organic compounds, common ions, trace metals, cyanide, and jet fuel.

3. DATA/INFORMATION DEVELOPED

Not applicable. This report only described installation and sampling procedures.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. INFORMATION IN IRPIMS

This data does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Environmental, Energy, and Resource Conservation Review
Author: JRB & Associates
Doc No: AFP-01008
Submittal: September 1983

1. STUDY OBJECTIVES

This report presents the results of an environmental and energy review, or a compliance audit performed throughout the AFP 4 facility. The report describes problems as they existed during the site visit and/or were reported to the Review Team. Corrections made soon after the initial site visit are generally not addressed within this report.

2. STUDY ACCOMPLISHMENTS

The audit addressed the following aspect of the plant operation:

- Assessment of the environmental management practices, including:
  - Hazardous Wastes
  - Air Emissions
  - Water Discharges
  - Other significant Environmental Activities
- Assessment and compliance with applicable local, state, and Federal laws and regulations.
- Assessment of potential environmental hazard areas.
- Development of recommendations to address areas of non-compliance and hazard areas.
- Development of DOD monitoring program for environmental compliance.
- Assessment of current energy use.
- Assessment of in-place energy program.
- Development of recommendations regarding energy and resource conservation opportunities.

3. DATA/INFORMATION DEVELOPED

Data developed during the audit was discussed as a narrative and was summarized in the form of the following recommendations.

4. RECOMMENDATIONS

Based on the findings of the survey, the following recommendations were made to improve environmental management at Plant 4:

- Upgrading of drum storage areas to include all required design features.
- Construct a new drum storage area, with emergency response capabilities.
- Inventory waste generation sources and nondesignated waste storage sites throughout the plant.
- Develop interim status documentation to comply with TDWR and RCRA regulations.
- upgrade waste treatment system to ensure adequate treatment capabilities for collected wastes.
- Conduct PCB investigation on all electrical equipment and dispose of PCB waste oils currently stored at the plant.
- Continue groundwater monitoring and remedial action studies to define extent of contamination from past environmental management practices.
- Upgrade emission sources to reduce emission levels to acceptable levels.

- Designate limited areas of intermediate waste drum areas in plant production areas to minimize the mislocation of wastes.
- Review drum management procedures to ensure proper collection, transport, and storage of wastes.
- Inventory USTs to identify possible sources of leaks.
- Update the hazardous waste status permit to reflect current General Dynamics activities.
- Notify state director of the change in facility status to reflect current drum storage situation.

The General Dynamics energy program was found to be excellent, as evidenced by the minimal increase in energy growth while increasing production output. Recommendations for improvements include:

- Installation of a superheater on DX air conditioning system.
- Install self power exit lights which save 100% of the energy used by existing incandescent or fluorescent exit lights.

A review of the information supplied by General Dynamics and a walk through evaluation of plant operations indicates that there is no resource recovery or recycling of generated wastes. Recommendations for further resource recovery include:

- Cleaning of recycled drums to prevent contamination of recoverable wastes by residuals.
- Waste segregation at point of generation.
- Improved tracking and labelling procedures from point of generation to point of off-site shipment.
- closing drums during use for accumulation and storage to prevent waste contamination with water.
- Separate storage of recoverable wastes from non-recoverable wastes.

5. STATUS OF STUDY

This study has been completed

6. STUDY SCHEDULE

The audit was performed in March 1983. The report was submitted in September in 1983.

7. INFORMATION IN IRPIMS

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Letter Report Seismic Refraction Survey
Author: D'Applonia
Number: AFP-1009
Submitted: December 1983

1. STUDY OBJECTIVES

The purpose of the seismic refraction study was to establish the depth and configuration of the near-surface Walnut Clay formation at the General Dynamics facility. This formation acts as the aquitard between the surficial aquifer and the Paluxy Aquifer. It was suspected that breaches in this formation were allowing contamination to pass between the aquifers.

2. STUDY ACCOMPLISHMENTS

A series of six seismic "lines" were shot. The source of the seismic waves was a weighted drop. The field data consist of a travel time observed at a location until interpreted by calibrate computer program.

3. STUDY DATA/INFORMATION

The seismic refraction survey identified a central depression, possibly a paleochannel , existing in the survey area. It was determined that the Walnut formation is breached or thinned to the point of where it is no longer functions as an aquiclude.

4. RECOMMENDATIONS

No recommendations were made in this report.

5. STUDY STATUS

The study was completed during October and November 1983.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Engineers notes on Radar Range and Die Yard Excavation
Author: Unknown
Number: AFP-1010
Submitted: January 1983

1. STUDY OBJECTIVES

This report documents on-site activities noted during a soil removal action.

2. STUDY ACCOMPLISHMENTS

Contaminated soil was removed during a remedial activity.

3. STUDY DATA/INFORMATION

The handwritten notes contain times of the beginning, shut down and restart times for an excavation at the Radar Range and Die-yard. Additionally, dates of sample collection and backfilling were recorded.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STUDY STATUS

Excavation activities were conducted December 1983 through February 1984.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information recorded in these notes has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Installation Restoration Program
Phase I - Records Search
Author: CH2M Hill
Doc No: AFP-01011
Submittal: August 1984

1. STUDY OBJECTIVES

The purpose of the investigation was to identify and evaluate suspected problems associated with past hazardous material disposal sites at the AF Plant facility. The records search included a detailed review of pertinent installation records, including Official Contract Records, agency contacts for documents relevant to the records search effort, and an onsite base visit conducted during May 1984. Activities conducted during the onsite base visit included interviews with past and present employees, ground tours, and a detailed search of relevant installation records. In cooperation with the investigation, the Public Affairs Office provided a press release announcing the study and requesting persons knowledgeable of past disposal practices at the installation to contact Air Force Plant 4.

2. STUDY ACCOMPLISHMENTS

Major findings of the records search activities were as follows:

1. The total quantity of waste oils, recoverable fuels, solvents, paint residues, and spent process chemicals generated at Air Force Plant 4 was estimated to be approximately 5,500 to 6,000 tons per year. This information was developed from interviews with General Dynamics personnel, previous reports, and monthly waste shipment records. The total waste quantities may have been higher in the past during periods of heavier contractor workload.
2. Major procedures for the disposal of the majority of industrial wastes in the past included a variety of methods, including: (1) burning and/or burial in onsite landfills, (2) burning in the fire department training areas, (3) contractor removal offsite, and (4) treatment through the waste disposal system.
3. Contamination assessment investigations have been in progress at Air Force Plant 4 since late 1982. Groundwater contamination has been confirmed in the vicinity of abandoned waste disposal sites. The detected contaminants were categorized as heavy metals and the organic priority pollutants, specifically volatile organic compounds such as the solvents trichloroethylene and 1,2-trans-dichloroethylene.
4. Remedial activities that have been implemented to date at Air Force Plant 4 include the excavation of contaminated soils and groundwater recovery and disposal in the area of some former waste oil pits. Contaminated soil has also been excavated in two areas (chrome pit and die yard pits) where former chromium sludge disposal pits were located.
5. Interviews with current and former employees and review of previous reports and aerial photographs resulted in the identification of 20 disposal or spill sites at Air Force Plant 4 which have been, or are presently in use.

3. DATA/INFORMATION DEVELOPED

1. Each of the twenty disposal sites was rated using the Hazard Assessment Rating Methodology. The scores ranged from a total of 51 points to 88 points, with an average total of 64 points.
2. Information obtained through the review of available reports, interviews with present and former employees, plant records, aerial photographs, and field observations indicates that hazardous wastes have been disposed of on Air Force Plant 4 property in the past.
3. No direct evidence was found to indicate that migration of hazardous contaminants beyond the Air Force Plant 4 boundary has occurred.

4. Indirect evidence indicates that migration of hazardous contaminants beyond the Air Force Plant 4 boundary has occurred in the past. Contaminated groundwater beneath the west employee parking lot was discovered in late 1982, and found to be seeping into a buried storm water pipe and subsequently discharging into Meandering Road Creek. This condition was eventually eliminated through remedial activities in the vicinity of the parking lot. Continued findings of metals and volatile organic compounds in water samples collected from Meandering Road Creek, adjacent to Air Force Plant 4, suggest that contaminated ground water from Air Force Plant 4 may be leaching into the creek.
5. Studies completed to date by General Dynamics have confirmed groundwater contamination in the Upper Zone over much of Air Force Plant 4 property. The Upper Zone ground water is not known to be used as a potable water source in the vicinity of Air Force Plant 4. A potential exists for contamination of the Paluxy Aquifer, a potable water source for the neighboring city of White Settlement, in those areas where the overlying confining bed separating the aquifer from the contaminated Upper Zone is absent. Contamination in the Paluxy Aquifer has been confirmed at one location east of the west employee parking lot, less than 100 feet east of the excavation of the former waste oil pits. However, the absence of contaminants in other Paluxy monitoring and production wells on and near Air Force Plant 4 property has indicated that contamination of this aquifer is not widespread. Additional Paluxy wells needed to better define the vertical and horizontal extent of contamination within the Paluxy Aquifer are currently being installed.
6. The presence of volatile organic compounds, including trichloroethylene (up to 4,000 ug/L) and 1,2-trans-dichloroethylene (13 to 1,800 ug/L) in Upper Zone monitor wells HM-ll and HM-31, located along the south property boundary, causes concern that migration of hazardous contaminants beyond the Air Force Plant 4 property may be occurring to the south. However, EPA monitor wells located approximately 700 to 800 feet further south have been free of these contaminants. The presence of volatile organic compounds, including trichloroethylene (10 to 500 ug/L) and 1,2-trans-dichloroethylene (120 to 10,000 ug/L) in upper zone monitor wells HM-21, 26, and 27, located near the west property line causes concern for potential contaminant migration beyond Air Force Plant 4 property to the west.
7. No evidence of significant environmental stress due to past disposal/spills of hazardous wastes was observed at Air Force Plant 4.
8. The potential exists for surface water migration of hazardous contaminants due to the proximity of identified sites to Meandering Road Creek and to Lake Worth. In addition, Upper Zone groundwater carrying dissolved contaminants may discharge to these surface waters.
9. The remaining site (Site 19, NARF Area) was not considered to present significant concern for adverse effects on health or the environment.

4. RECOMMENDATIONS

1. A program is needed to supplement on-going monitoring efforts at Air Force Plant 4. More specifically, monitoring, including soil borings and/or monitor wells, has been recommended at each of the 20 identified sites with the exception of one; the NARF Area (Site No. 19).
2. The priority for continued monitoring at Air Force Plant 4 is considered high in light of confirmed findings of groundwater contamination.
3. The specific details of the monitoring program, including exact locations of sampling points, should be finalized by the Phase II contractor.
4. Off-site wells, including the EPA monitor wells (EPA-l, 2, and 3), and the City of White Settlement wells (No. 1, 6, and 12), should be sampled at least semi-annually to detect possible contamination. Analysis should include volatile organic compounds.
5. Outfall No. 1 should be sampled and analyzed for volatile organic compounds to determine if this outfall could be the source of VOC contamination found by Carswell AFB in surface water downstream of the outfall discharge point.

6. The buried sanitary, storm, and industrial waste water lines that run parallel with the south property line and past monitor well HM-31 should be sampled and analyzed for VOCs to determine if a potential exists for contamination of HM-31 from contaminant migration through or along these lines. If VOCs are detected at levels that could explain the findings in HM-31, the respective pipeline(s) should be investigated for leaks and appropriate corrective actions taken.
7. Other IRP recommendations include: (1) locate abandoned wells on Air Force Plant 4 property and cap or plug each well, depending on their physical condition, and (2) sample the contents (if any) of three known inactive buried POL tanks, and based upon the analyses, recommend appropriate remedial actions (IRP Phase IV) be taken.

5. STATUS OF STUDY

This investigation has been completed.

6. STUDY SCHEDULE

The information was gathered during May 1984, the report was submitted in August 1984.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Conclusion and Recommendations for Completion of Phase II Investigation
Author: Hargis & Associates
Doc No: AFP-01012
Submittal: October 1984

1. STUDY OBJECTIVES

The objective of this report was to document those recommendations for actions which would facilitate completion of the Phase II assessment activities at Plant No. 4.
The results of the previous investigations were used to develop the recommendations for additional tasks. Briefly, the work which had been completed to date included:

- A detailed search of installation records which was conducted in 1984. The records search resulted in the identification of 20 disposal and spill sites at Air force Plant No. 4.
- Exploratory drilling of 33 Upper Zone monitor wells and four Paluxy Formation monitor wells (Hargis & Associates, Inc., 1984).
- Completion of a total of 25 test holes and the construction of 33 additional upper zone wells and four additional Paluxy Formation monitor wells.
- Completion of four off-site monitor wells constructed by the U.S. Environmental Protection Agency.
- Sampling and analysis of a monitor wells. Miscellaneous sites have also been sampled, including the creek, seep, and french drains (Hargis & Associates, Inc., 1984).

2. STUDY ACCOMPLISHMENTS

Not applicable. This report only recommended additional activities required.

3. DATA/INFORMATION DEVELOPED

Based on the results of the various drilling and testing activities performed as part of the Phase II investigation between July 1, 1983 and August 30, 1984, the following circumstances are concluded:

1. Chemical analyses of groundwater samples have confirmed Upper Zone groundwater contamination in the vicinity of Landfill No. 1, Landfill No. 3, FDTA No. 2, FDTA No. 5, Chrome Pit No. 3, the Die Yard Chemical Pits, Fuel Saturation Area No. 1, and the Wastewater Collection Basins.
2. Chemical analyses of groundwater samples also indicate some contamination of upper zone groundwater at Landfill No. 2, Landfill No. 4, and FDTA No. 3. The Upper Zone is not saturated with groundwater in the vicinity of FDTA No. 6. No groundwater contamination has been detected in the vicinity of the Former Fuel Storage Site.
3. Additional investigation is required to determine the chemical quality of groundwater in the Upper Zone in the vicinity of FDTA No. 4, Chrome Pit No. 1, Chrome Pit No. 2, Fuel Saturation Areas No.s 2 and 3, Solvent Lines, and the NARF Area (Figure 1).
4. Movement of groundwater in the Upper Zone is influenced by the topography of the underlying Goodland Formation and Walnut Limestone. Groundwater discharge occurs from the Upper Zone as it seeps along the outcrop of the Walnut Formation northwest of Bomber Plant Road near the western boundary of the Plant.
5. Upper Zone groundwater from the vicinity of the Chrome Waste Pit excavation moves northwest toward the Walnut Formation outcrop along the western boundary of the Plant. The Chrome Waste Pit excavation is located at or near an Upper Zone groundwater divide. Groundwater

from the vicinity of the Chrome Waste Pit excavation also moves southeast and east beneath the Process Building.

6. Upper Zone groundwater in the vicinity of the Die Yard Chemical Pits excavation also occurs near a groundwater divide. Upper Zone groundwater appears to move northeast toward the Process Building, and west and northwest beneath the Radar Range.
7. Upper Zone groundwater gradients in the vicinity of the Waste Oil Pits excavation are toward the west and northwest. The sediments which comprise the Upper Zone are thin and not saturated in some areas west of Bomber Plant Road. Some groundwater from the Upper Zone moves northeast through the poorly permeable Goodland and walnut Formation west of Bomber Plant Road.
8. Groundwater in the Upper Zone may also flow eastward from the Plant. Analysis of lithologic and geophysical data indicates that the Goodland Limestone and Walnut Formations which phoneme an aquitard beneath the Plant, have been deeply eroded along the eastern Plant boundary.
9. Vinyl chloride, trichloroethylene, and 1,2-trans-dichloroethylene have been detected in water samples collected from creek sampling sites C-2 and C-3. Water samples collected from site C-2 also contained 1,1,2,2-tetrachloroethene, chlorocyclohexanol, and dichlorocyclohexane. No organic compounds have been detected at creek sampling sites C-1 and C-4.
10. Analysis of lithologic and hydrologic data indicates that the Paluxy Formation comprises more than one aquifer. In the vicinity of monitor well sites P-5 and P-6, groundwater in the upper Paluxy Formation occurs under unconfined conditions. Groundwater in the middle Paluxy Formation occurs under confined or semi-confined conditions.
11. Priority volatile organic compounds have been-detected in groundwater samples collected from Paluxy Formation monitor wells P-4, P-5 (middle), P-6 (upper), and P-6 (middle). Analysis of water level elevation data indicates a southerly component in the hydraulic gradient in the Paluxy aquifers. Additional water level data are required to determine the direction of groundwater flow in the Paluxy Formation.

4. RECOMMENDATIONS

Based on the findings of the Phase II investigation as of August 30, 1984, and a review of the results of the Phase I Records Search, the following specific recommendations were made:

1. Construct and sample 19 additional monitor wells in the Upper Zone to define the limits of contaminated groundwater and to obtain water level and lithologic data. The following additional Upper Zone wells are recommended:

    a. Three monitor wells, located about 200 feet north, south, and east of well HM-51, to define the extent of contamination in the vicinity of well HM-51;
    b. One monitor well in the vicinity of FDTA No. 4, north of the North Employee Parking Area, to investigate possible contamination resulting from Fire Department Training Exercises.
    c. Two monitor wells east and north of the General Warehouse, to investigate potential groundwater contamination from Chrome Pit No. 1 and the Wastewater Collection Basins, and to determine groundwater elevations in the vicinity of the General Warehouse.
    d. One monitor well in the vicinity of Fuel Saturation Area No. 2, northwest of Building 176.
    e. One monitor well in the vicinity of Fuel Saturation Area No. 3, south of Building 142.
    f. Four monitor wells in the vicinity of the Solvent Lines, north and west of the Assembly Building.
    g. Five additional monitor wells in the East Parking Lot, to obtain additional lithologic data and to determine direction of upper zone groundwater movement.

2. Construct, test, and sample four additional Paluxy Formation monitor well clusters to define the limits of contaminated groundwater and to determine direction of movement of groundwater in

the Paluxy aquifers. Each cluster should consist of two wells, one completed in the upper Paluxy sand unit, the other completed in the middle Paluxy sand unit, as follows:

a. One cluster located in the West Parking Lot, about 600 feet south of the Waste Oil Pit excavation. Partially constructed monitor well P-7 should be completed as an upper Paluxy well, and an additional middle Paluxy monitor well should be constructed nearby. This suite will monitor groundwater quality-in the vicinity of the Waste Oil Pit excavations.
b. One cluster located west of the creek, approximately 600 feet northwest of the Waste Oil Pits excavation. These wells will define groundwater quality in the Paluxy aquifers up-gradient of the Plant.
c. Two clusters located in the East Parking Lot approximately 400 feet south of the Engineering Building and 600 feet northeast of the General Warehouse, respectively. These clusters will define the extent of contamination in the Paluxy aquifers, and provide geologic and water level data.

3. Continued collection and analysis of water samples from all Upper Zone and Paluxy monitor wells. Base/neutral and acid organic compounds have been deleted from the analysis schedule for wells where previous laboratory results indicate that these compounds are not present. Cyanide and selected trace metals have been deleted from the analysis schedule for wells where these constituents have not previously been detected. Jet fuel and oil/grease analyses are recommended for samples from wells where these constituents have been detected or are likely to be present. Upper Zone monitor wells HM-2, HM-8, HM-9, HM-12, HM-13, HM-14, HM-18, and HM-22 have an established history of no detectable priority organic compounds. These wells should be sampled annually. Other wells should be sampled quarterly until a chemical baseline is established.
4. Collect and analyze additional water samples from the creek which borders the west side of the Plant and from the seep north of the Radar Range. Water samples should be collected monthly at sampling sites C-1 through C-5, and should be analyzed for volatile organic compounds, base/neutral-acid organic compounds, arsenic, barium, beryllium, cadmium, chromium, iron, lead, manganese, mercury, nickel, selenium, oil/grease, and fuel hydrocarbons.
5. Review facility records and document facility history for the NARF Area. determine amounts and types of potentially hazardous materials disposed of including organic chemicals and radioactive materials. After reviewing available documents, determine whether investigation of subsurface conditions is necessary.

5. STATUS OF STUDY

The recommendations proposed in this report were used to formulate the work plan for additional Phase II activities. The work was eventually performed in 1985, and the report of findings was submitted in September of 1985.

6. STUDY SCHEDULE

This report was submitted in October 1984.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Phase II Investigation of Subsurface Conditions
Volume I
Author: Hargis & Montgomery
Doc No: AFP-01013
Submittal: September 1985

1. STUDY OBJECTIVES

The objectives of the Phase II investigation were as follows:

1. Determine the areal extent and direction of contaminant migration in the Upper Zone groundwater beneath the Plant.
2. Define the chemical quality of the Paluxy aquifer beneath the Plant.
3. Determine the direction, and rate of groundwater flow in the Paluxy beneath the Plant.
4. Define the hydrogeologic relationships of pertinent geologic units in the subsurface in the Plant area.
5. Evaluate the potential impact of historic waste disposal practices on nearby water resources in the Plant area.
6. Provide the basic data for evaluation and selection of remedial action alternatives.

2. STUDY ACCOMPLISHMENTS

Activities completed during the Phase II investigation included:

1. Construction of 84 Upper Zone monitor wells and 16 Paluxy Formation monitor wells within the Plant boundary.
2. Sampling and analysis of surface water, groundwater, and soil collected from the Plant and surrounding environs.
3. Sampling and analysis of water samples collected from City of White Settlement municipal water supply wells.
4. Collection and analysis of water samples from off-site upper zone monitor wells constructed by the U.S. Environmental Protection Agency (EPA).
5. Review of plant documents and aerial photographs relating to waste disposal practices and historic groundwater monitoring.
6. Analysis and interpretation of seismic refractions surveys conducted by D'Appolonia, Inc. (1983) for General Dynamics Corporation.
7. Analysis of geologic and hydrologic data, including construction of water level contour maps, structure contour maps, and analysis of aquifer test data. Field investigations by Hargis & Montgomery, Inc. (1984a, 1984b) and an installation records search by CH2M Hill (1984) have resulted in the identification of 20 disposal and spill sites at U. S. Air Force Plant No. 4 (the Plant) (Figure 1). Field investigations have resulted in the construction of 84 upper zone monitor wells and 16 Paluxy Formation monitor wells to investigate the impact of these identified disposal and groundwater quality.

3. DATA/INFORMATION DEVELOPED

Major conclusions reached during the Phase II investigation included the following:

1. Upper Zone groundwater contamination has been detected at 14 of the 20 unidentified disposal and spill sites. Groundwater within the Upper Zone moves downgradient from the recharge

areas toward discharge areas, and the contaminated Upper Zone groundwater is situated at distances as great as one-half mile from known source areas.

2. No contaminants have been detected in samples collected from monitor wells located at four of the identified disposal and spill sites. Because Upper Zone groundwater saturation is not present, no wells have been constructed at two of these sites.
3. The principal source of recharge to the Upper Zone system is precipitation. Additional sources of recharge may include leakage from buried water supply lines, sanitary sewers, and storm sewers. Sewers also serve as conduits for upper zone groundwater discharge. Upper Zone groundwater also discharges as seeps, springs, and as underflow along the western boundary of the plant. Upper Zone groundwater also leaves the Plant property by moving in an easterly direction beneath Grants Lane.
4. Upper Zone groundwater does not appear to move southward from the Plant property. No evidence of groundwater contamination has been detected in Upper Zone EPA wells constructed south of the plant.
5. The principal source of recharge to the Paluxy aquifer is Lake Worth. Water level elevation data indicates that recharge to the Paluxy may also occur from the creek located along the western plant boundary and from the Upper Zone where the Goodland/Walnut aquitard has been significantly eroded, or is missing entirely. The Goodland/Walnut aquitard is missing along the eastern boundary of the Plant property in the vicinity of well HM-82. In general, the direction of groundwater flow in the Paluxy aquifer is southeastward from Lake Worth.
6. Traces of organic solvents have been detected in Paluxy monitor wells P-4, P-5 (upper and middle), P-6 (upper and middle), P-7 (middle), and P-9 (upper). The source of these organic solvents is believed to be the Waste Oil Pits in the West Parking Lot.
7. Organic solvents have also been detected in samples collected from well P-8 (upper). The source of these contaminants is believed to be Upper Zone groundwater which enters the Paluxy Formation in those areas where the Goodland/Walnut aquitard is absent.
8. Low concentrations of organic solvents have been detected in samples collected from well P-10 (upper). Based on the direction of groundwater flow, it appears that the source of these contaminants may be from the area located to the north-northwest of well P-10 (upper).
9. Contaminants have not been detected in samples collected from the City of White Settlement municipal wells located south of the Plant.

4. RECOMMENDATIONS

No recommendations are presented in this volume.

5. STATUS OF STUDY

Additional assessment remedial activities have been initiated since the submittal of this report.

6. STUDY SCHEDULE

The field investigation was conducted in the early part of 1985, the report was submitted in September 1985.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Phase II Investigation of Subsurface Conditions
Volume II: Appendices A-E
Author: Hargis & Montgomery
Doc No: AFP-01014
Submitted: September 1985

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

Appendices A through E present various data collected during the Phase II investigation. The individual appendices contain the following information:

Appendix A:	Regional Well Inventory
Appendix B:	Lithologic Logs for Upper Zone Monitor Wells
Appendix C:	Lithologic Logs for Paluxy Formation Monitor Wells
Appendix D:	Schematic Construction Diagrams for Paluxy Wells and Plugged Water Supply Well
Appendix E:	Drawdown and Recovery Graphs for Paluxy Monitor Wells

Appendix A - Regional Well Inventory

Record search at then Texas Department of Water Resources indicates that there are more than 100 wells located within a two or three mile radius of the plant. The City of White Settlement maintains 9 wells, 2 of which produce groundwater from the Twin Mountain aquifer and 7 of which produce water from the Paluxy Aquifer. The closest White Settlement well (WSW-6) is located approximately 1,100 feet west of the plant. Well WSW-012 is located approximately 1,500 feet south of the plant.

The specifics for each well presented include well number, owner, completion date, well depth, diameter, screened interval, pumping capacity, and current use.

Appendix B - Lithologic Logs for Upper Zone Monitor Wells

A total of 82 monitor wells have been constructed at the Plant to assess subsurface conditions in the upper zone beneath abandoned waste disposal sites, burn pits, and the old site of a fuel storage tank. The monitor wells were installed to determine the horizontal extent of groundwater contamination in the Upper Zone and to collect lithologic data. The appendix contains lithologic logs for monitor wells HM-1 through HM-82, and EPA-1 through EPA-4.

Appendix C - Lithologic Logs for Paluxy Monitor Wells

This appendix contains the logs for 16 monitor wells installed within the Paluxy Aquifer. The monitor wells were installed to collect lithologic data, water level data, and to determine the vertical and horizontal extent of contamination in the Paluxy formation. Well clusters were created in order to compare water quality at differing depths in the same location. Wells screened within the Paluxy upper sand have been labelled with a 'U' following the well number. Wells installed within the middle of the Paluxy have are labelled with a 'M' following the well number (P-5M). This Appendix contains lithologic logs for Paluxy wells P-1 through P-10U, and 10M.

Appendix D - Schematic Construction Diagrams for Paluxy Wells and Plugged Water Supply Well

This Appendix contains the schematic diagrams for the Paluxy wells listed in Appendix C. A schematic diagram of a typical upper zone monitor well and the plugged water supply well are included. Schematic diagrams include the borehole diameter and depth; casing material, diameter, and depth; screened interval; screen length, material, diameter, and slot size; static water level; corresponding hydrogeologic unit; and surface well protection.

Appendix E - Drawdown and Recovery Graphs for Paluxy Monitor Wells

Appendix E contains drawdown and recovery graphs for the pump/recharge aquifer tests which were conducted on the Paluxy wells.

Title: Phase II Investigation of Subsurface Conditions
Volume III: Appendices F-G
Author: Hargis & Montgomery
Doc No: AFP-01015
Submitted: September 1985

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

The data presented in Appendices F-G are the analytical data for water samples collected during the Phase II investigation. The appendices include:

Appendix F: Concentrations of Common Ions in Water Samples
Appendix G: Concentrations of Trace Metals and Cyanide in Water Samples

Appendix F - Concentration of Common Ions in Water Samples

Appendix F contains the laboratory analytical reports for 107 water samples that were submitted to Analytical & Research Laboratory and analyzed for common ions. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Appendix G - Concentration of Trace Metals and Cyanide in Water Samples

Appendix G contains the laboratory analytical reports for 107 water samples that were submitted to Analytical & Research Laboratory and analyzed for common ions. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Title: Phase II Investigation of Subsurface Conditions
Volume IV: Appendices H-I
Author: Hargis & Montgomery
Doc No: AFP-01016
Submitted: September 1985

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

The data presented in appendices H and I are the analytical results for the water samples collected during the Phase II investigation. Specifically, the appendices include:

Appendix H:	Concentrations of Priority Volatile Organic Compounds in Water Samples
Appendix I:	Concentrations of EPA Priority Base/Neutral Organic Compounds in Water Samples

Appendix H - Concentration of Priority Volatile Organic Compounds in Water Samples

Appendix H contains the laboratory analytical reports for 107 water samples that were submitted to Analytical & Research Laboratory and analyzed for common ions. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Appendix I - Concentration of EPA Priority Base/Neutral Organic Compounds in Water Samples

Appendix I contains the laboratory analytical reports for 107 water samples that were submitted to Analytical & Research Laboratory and analyzed for common ions. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Title: Investigation of Subsurface Conditions
Phase I
Volume V: Appendices J-M
Author: Hargis & Montgomery
Doc No: AFP-01017
Submittal: September 1985

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

This document provides the analytical results from the groundwater and soil samples collected during the Phase I investigation. The data is contained in Appendices J through M and breakdowns as follows:

Appendix J:	Concentration of Priority Acid Organic Compounds in Water Samples
Appendix K:	Concentration of Oil/Grease and Fuel Hydrocarbons in Water Samples
Appendix L:	Concentration of Priority Pesticides and PCBs in Water Samples
Appendix M:	Concentrations of Nonpriority and Semiquantified Organic Compounds in Water Samples

Appendix J - Concentration of Priority Acid Organic Compounds in Water Samples

Appendix J contains the laboratory analytical reports for water samples that were submitted to Analytical & Research Laboratory and analyzed for Priority Acid Organic Compounds. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Appendix K - Concentration of Oil/Grease and Fuel Hydrocarbons in Water Samples

Appendix G contains the laboratory analytical reports for 107 water samples that were submitted to Analytical & Research Laboratory and analyzed for Oil/Grease and Fuel Hydrocarbons. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Appendix L - Concentration of Priority Pesticides and PCBs in Water Samples

Appendix J contains the laboratory analytical reports for water samples that were submitted to Analytical & Research Laboratory and analyzed for Priority Pesticides and PCBs. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Appendix M - Concentration of Nonpriority and Semiquantified Organic Compounds in Water Samples

Appendix G contains the laboratory analytical reports for 107 water samples that were submitted to Analytical & Research Laboratory and analyzed for Nonpriority and Semiquantified Organic Compounds. Eighty one of the samples were collected from upper zone monitor wells, 16 groundwater samples were collected from the Paluxy Aquifer, and ten water samples were collected from the creek and miscellaneous seeps.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume I - Final Draft
Author: Radian Corporation
Doc No: AFP-01018
Submittal: September 1985

1. STUDY OBJECTIVES

The objectives of the Phase II, Stage 1 investigation were to determine the impact to the environmental media resulting from the waste disposal practices at Carswell AFB. Twenty-two disposal or spill sites (seventeen sites at Carswell AFB and five sites at the Weapons Storage Area located west of Carswell AFB) were identified as potential hazardous waste sites during the Phase I studies for the Installation Restoration Program (IRP) in February 1984. Ten of the twenty-two sites were considered to present significant concern to the local environment.

Twelve sites of the twenty-two Phase I IRP sites were targeted for Phase II, Stage 1 studies, including:

Site #1 - Landfill 1
Site #3 - Landfill 3
Site #4 - Landfill 4
Site #5 - Landfill 5
Site #10 - Waste Burial Area
Site #11 - Fire Department Training Area 1
Site #12 - Fire Department Training Area 2
Site #13 - Flightline Drainage Ditch
Site #15 - Entomology Dry Well
Site #16 - Unnamed Stream
Site #17 - POL Tank Farm

Sites 1, 13, 15, 16, and 17 are located in the East Area. The remaining seven sites are located in the Flightline Area. The specific objectives for each of the target sites were to delineate the degree and extent of contamination, identify the environmental consequences of any migrating pollutants, and the to formulate recommendations regarding the need of any additional work.

2. STUDY ACCOMPLISHMENTS

The field program performed at each site involved a multi-phase investigation consisting of a variety tasks, including a geophysical survey, soil boring and monitor well installation, and soil and groundwater sampling. The manner in which each of these tasks were performed was as follows:

Geophysical Surveys: Geophysical surveys were performed in order to delineate define the boundaries of the waste-disposal areas at several sites. Several geophysical techniques were used during the investigation, including earth resistivity by direct current Schlumberger soundings (vertical electrical soundings - VES), magnetic and magnetic gradient surveying, and fixed frequency electromagnetic profiling (EMP) surveys at three different effective depths of exploration. Geophysical surveys were performed at Sites 1, 3, 4, 5, 10, 11, and 12.

Soil Borings/Soil Sampling: Soil borings were drilled using the hollow-stem drill method. The borings were performed in order to collect soil samples for determining the lithologic make-up of the individual sites and to determine the quality of the soil. Each boring was progressed to the

general depth of the water table. At those sites where the water table was at a significant depth below the surface, the borehole was created using the a drill rig and a hollow-stem auger. Samples were collected with a split-spoon sampler. In those areas where the water table was shallow, soil samples were collected with a hand-auger. Split-spoon samples were collected at Sites 1, 4, 5, 10, 11, 11, 13, 15, 17, and 18. Hand-auger samples were collected from Sites 11, 12, 13, and 16.

Monitor Well Installation/Groundwater Sampling: Monitor wells were installed in order to provide access to the groundwater within the Upper Zone and Paluxy aquifer for characterization and quality monitoring. The Upper Zone wells were installed using the hollow-stem method. Each of these wells were constructed with 2-inch diameter PVC screen and casing. The Paluxy wells were installed using the mud-rotary method. These wells were constructed with 5-inch diameter PVC screen and casing. Surface casing were used in the construction of these wells in order to isolate the water within the Paluxy from the Upper Zone. A total of sixteen Upper Zone wells and two Paluxy wells were installed in the Flightline Area (Sites 4, 5, 10, 11, and 12). Seven Upper Zone wells were installed at Sites 1 and 15 in the East Area.

Surface Water Sampling: Surface water samples for laboratory analysis were also collected from Sites 4, 5, 12, and 16.

3. DATA/INFORMATION DEVELOPED

The major findings at each of the targeted sites study are is summarized below.

Site #1 Landfill

The analytical results of the groundwater at Landfill 1 was inconclusive as a potential for contamination was identified but no significant contamination was detected.

Site #3 Landfill

The hydrogeologic investigation revealed significant levels of contamination in the upper zone north of the landfill. The study results showed that the Goodland/Walnut aquitard may be eroded along the east side of the AFB Plant 4 property to the point where its capability to inhibit the vertical exchange of groundwater between the Upper Zone and the Paluxy aquifer has been significantly reduced.

Site #4 Landfill 4

The analytical results indicated that the Upper Zone groundwater within the Upper Zone along the east side of the landfill contained elevated levels of halogenated organic compounds.

Site #5 Landfill 5

The groundwater within the Upper Zone showed elevated levels of halogenated organic compounds, including TCE, in both upgradient and downgradient directions of the landfill. The stream to the north of the landfill showed elevated levels of vinyl chloride.

Site #10 Waste Burial Area

The close proximity of the Waste Burial Area relative to landfills #4 and #5 indicated that the groundwater within the Upper Zone in that area was potentially impacted.

Site #11 Fire Training Area 1

Results of the Stage 1 investigation showed very low levels of organic compounds in the groundwater of the Upper Zone. TCE was also discovered in the soil samples collected from the training area.

Site #12 Fire Training Area 2

The analytical results indicated that the groundwater in the Upper Zone is impacted with halogenated and aromatic organic compounds. TCE concentrations in downgradient of the site were significantly higher than that measured onsite.

Site #16 Unnamed Stream

The results of the investigation at Site #16 showed significant organic contamination in the Upper Zone west of the inferred location of the french drain. Elevated levels of metals and some miscellaneous organic compounds were also detected.

Site #17 POL Tank Farm

The analytical results from groundwater samples collected from borings placed at the POL Tank Farm indicated that the Upper Zone is contaminated with organic compounds.

Site #15 Entomology Draw Well

No groundwater impacts were detected at the Entomology well.

Weapons Storage Area (WSA)

The investigation in the Weapons Storage Area did not include an analysis of the groundwater in the Upper Zone. Soil samples were collected for laboratory analysis from borings placed west of the Inspection Shop. Elevated levels of TCE were detected in some of those samples. A sample collected from the potable water supply well contained elevated levels of radium.

Site #13 Flightline Drainage Ditches

The analytical results of samples collected from the Flightline Drainage Ditch shoed that the soil have been affected by runoff from the flight line. The investigation did not assess the quality of the groundwater.

4. RECOMMENDATIONS

According to DOD criteria, investigation sites can be classified into one of the following categories:

Category I - No further action is required,
Category II- Requires additional monitoring or work to assess the extent of current or future contamination, or
Category III - Ready for remedial action.

The recommended classification for each of the targeted sites during the Stage 1 program, along with the suggested additional actions were as follows:

A. Category II Sites

Site 1. Landfill

- Collect groundwater samples for laboratory analysis from the four Upper Zone monitor wells.
- Investigate the condition and contents of metal drums stored south of the DPDO yard.
- Perform aquifer tests on selected upper zone wells in order to determine the hydraulic characteristics of the Upper Zone.

Site 3. Landfill

- Install two Upper Zone monitor wells so that the quality of the groundwater can be determined along the north side of the site.

Site 4. Landfill 4

- Install three Upper Zone monitor wells east and north of the landfill.
- Perform aquifer tests on selected Upper Zone wells.
- Collect groundwater samples the newly installed wells and from the Paluxy well.

Site 5. Landfill 5

- Install five Upper Zone monitor wells to the east, west, and south of the landfill in order to define water quality conditions downgradient of the site.
- Perform aquifer tests on selected Upper Zone wells.
- Collect groundwater samples from the existing Paluxy well.

Site 10. Waste Burial Area

- Combine the Waste Burial Area with Landfill No. 5 (Site #5) because of the close proximity. Additional work recommendations for Landfill #5 apply.

Site 11. Fire Training Area 1

- Collect groundwater samples on a regular basis from the two existing Upper Zone wells.

Site 12. Fire Training Area 2

- Install two Upper Zone wells north and east of the site in order to determine the down gradient water quality conditions.
- Conduct a series of soil borings in the vicinity of the fire training area in order to assess near-surface soil conditions.
- Resample existing monitor wells.
- Perform aquifer tests on selected wells.

Site 16. Unnamed Stream

- Install four Upper Zone wells in the vicinity of the old gasoline station and the Unnamed Stream in order to determine groundwater quality.
- Perform aquifer tests on selected Upper Zone wells.

Site 17. POL Tank Farm

- Install five Upper Zone monitor wells upgradient and down gradient of the POL Tank Farm in order to determine quality of the groundwater.
- Perform aquifer tests on selected Upper Zone wells.

Site 15. Entomology Dry Well

- Search for the dry well in order to collect a sample. If the well can not be located, then hand-augered soil borings should be performed in the probable location of the dry well in order to assess the impact to the soil and groundwater in that area.
- Water levels at the existing Upper Zone monitor wells should continue to be measured in order to determine the direction of groundwater flow.

Weapons Storage Area (WSA)

- Resample the potable supply well.
- Install three Upper Zone wells west of the Inspection Shop in order to determine the quality of the groundwater.

B. Category III Sites

Site 13. Flightline-Drainage Ditches

- Prior to corrective action, the ditch should be dredged to remove the contaminated. Install a concrete liner in the ditch.
- Repair the pipe which supplies fuel from the Fuel Systems Shop.
- Install an oil/water separator in the ditch above its discharge point into Farmers Branch.

5. STATUS OF STUDY

The scope of this investigation involved the initial on-site at twelve of the twenty-two site targeted for study during the Phase I investigation. The remaining ten sites were eventually addressed during additional activities of the Phase II investigation.

6. STUDY SCHEDULE

Authorization to proceed on the CAFB Phase II, Stage 1 program was given in September 1984. Field activities were started at the twelve sites targeted for this portion of the investigation in December 1984.

7. INFORMATION ON IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title:	Installation Restoration Program Phase II - Confirmation/Quantification Stage 1 Volume 2: Appendix A
Author:	Radian Corporation
Doc No:	AFP-01019
Submittal:	September 1985

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

Appendix A presents the raw laboratory analytical data for groundwater and soil samples collected during the Phase II investigation. The results are summarized in the main report, Installation Restoration Program, Phase II Confirmation/Quantification, Stage 1, Volume 1.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume III: Appendices B-L
Author: Radian Corporation
Doc No: AFP-01020
Submittal: September 1985

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

Appendices B-L provides data pertaining to the Phase II investigation. The appendices include:

Appendix B:	Definitions, Nomenclature, and Units
Appendix C:	Scope of Work
Appendix D:	Well Numbering System
Appendix E:	Well Logs
Appendix F:	Raw Field Data
Appendix G:	Sampling and Analytical Procedures
Appendix H:	Chain-of-Custody Forms
Appendix I:	References
Appendix J:	Biographies of Key Personnel
Appendix K:	Geophysical Tracings
Appendix L:	Safety Plan

Appendix B - Definitions, Nomenclature, and Units

Appendix B contains the definitions of 26 words and units which were used in the Phase II Confirmation/Quantification Report.

Appendix C - Scope of Work

Appendix C provides the Scope of Work for the investigation.

Appendix D - Well Numbering System

Appendix D provides the well numbering system utilized during the investigation.

Appendix E - Well Logs

Appendix E contains the lithologic logs from the wells installed during the investigation.

Appendix F - Raw Field Data

Appendix F contains the raw field data from the investigation, including the analytical results, the well sampling forms, and the development forms.

Appendix G - Sampling and Analytical Procedures

Appendix G contains the protocol used in the collection and analyses of samples.

Appendix H - Chain-of-Custody Forms

Appendix H contains the Chain-of-Custody form from the sample collection effort during the investigation.

Appendix I - References

Appendix I contains lists the references used during the investigation.

Appendix J - Biographies of key Personnel

Appendix J contains copies of the resumes of the personnel which participated in the investigation.

Appendix K - Geophysical Tracings

Appendix K provides the raw data generated during the geophysical surveys conducted during the investigation

Appendix L - Safety Plan

Appendix L provides a copy of the Health and Safety Plan used during the investigation.

Title: Results of the Soil and Groundwater Assessment
Proposed Systems Development Laboratory and Anechoic Chamber Buildings
Author: Hargis & Associates
Doc No: AFP-01022
Submittal: December 1985

1. STUDY OBJECTIVES

The objective of this investigation was to sample and analyze the shallow subsurface soils and groundwater in the vicinity of the subject building site.

2. STUDY ACCOMPLISHMENTS

As a result of the subsurface investigations, 24 soil borings and 3 monitor wells were installed. Soil borings SB-1 through SB-24 were drilled at the four proposed building locations. Soil cores were collected and examined visually for lithology and evidence of contamination. Soil cores were scanned for radioactivity and with a photo-ionization detector. If soil cores exhibited evidence of contamination by any of the screening techniques a second boring was advanced adjacent to the contaminated soil boring and a drive sample collected at the appropriate depth for laboratory analysis. Only one soil sample was submitted for laboratory analysis. The soil sample was analyzed for total fuel hydrocarbons and volatile and base/neutral organic compounds.

Three monitor wells, HM-83, HM-84, and HM-85, were installed to assess the upper zone groundwater quality. The wells were installed to depths ranging from 13 to 23 feet below surface. Water samples collected from the monitor wells and from SB-24 were submitted for laboratory analysis. The water sample collected form SB-24 was analyzed for oil/grease, total fuel hydrocarbons, volatile and base/neutral organic compounds. The water samples collected form the monitor wells were analyzed for the aforementioned parameters and acid organic compounds, gross alpha, beta and gamma radioactivity, trace metals and common ions.

3. DATA/INFORMATION DEVELOPED

The soil data collected indicates the following:

- Three of the twenty four soil borings drilled for this investigation exhibited evidence of contamination.
- Analytical results form the soil and groundwater samples collected from SB-23 and SB-24 confirmed the presence of fuel hydrocarbons in the subgrade material underlying the concrete in the Compass Rose vicinity.

The groundwater data collected indicates the following

- Samples collected form the upper zone groundwater monitor wells HM-83, HM-84, and HM-85 indicate that concentrations of volatile organic compounds are less than or slightly exceed concentrations currently being considered by EPA for drinking water
- The low concentrations of volatile organics observed in the monitor wells do indicate a disposal site in the area of the proposed construction

4. RECOMMENDATIONS

Recommendations for additional activities were not included in the report.

5. STUDY STATUS

Data collected during this investigation was used to for screening the proposed site of the Systems Development Laboratory and Anechoic Chamber Buildings.

6. STUDY SCHEDULE

The field investigation was conducted on October 22, 23, and 24, 1985. The report was submitted in December 1985.

7. IRPIMS STATUS

Information included in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Proposed 1986 Hydrologic Monitoring Plan
Author: Hargis & Montgomery
Doc No: AFP-01023
Submitted: January 1986

1. STUDY OBJECTIVES

The report describes the proposed plan and schedule for continued groundwater and surface water monitoring in the vicinity of Plant No. 4. This plans includes the monitoring of all onsite monitor wells, off-site wells constructed by the EPA, and surface water sampling sites. The plan also includes sampling of monitor wells under construction by the Army Corp of Engineers.

The monitoring plan was designed to maintain the continuity and integrity of the existing data base until remedial actions are initiated in areas where groundwater is contaminated, and to provide data during remedial actions to assess their effectiveness. The existing hydrologic data base for the Plant contains analytical results for approximately 1,500 water samples. Water level measurements have also been collected periodically for all wells.

The objectives of the monitor program included:

- Monitor water chemistry in areas of groundwater contamination, establish velocity and direction of contaminant migration, and establish baseline chemical data for monitoring of future remedial actions
- Monitor elevations of the groundwater surface to determine changes in the direction of groundwater flow and to delineate local effects of aquifer recharge and discharge
- Determine seasonal variations in water quality and water levels
- Continue to monitor the water quality of Meandering Road Creek to determine if contaminated groundwater from the upper zone has the potential to affect surface water quality

The plan included the frequency and schedule for groundwater and surface water monitoring at the following locations:

- Landfill Numbers 1, 2, 3, 4
- Fire Department Training Areas 2, 3, 5
- Chrome Pit Numbers 1, 2, 3
- Die Yard Chemical Pits
- Fuel Saturation Areas 1 and 2
- Solvent Lines
- Wastewater Collection Basins
- Miscellaneous Sites
- EPA and White Settlement Wells

2. STUDY ACCOMPLISHMENTS

No accomplishments were presented in this work plan.

3. DATA/INFORMATION DEVELOPED

This document presents the methodology for completing assessment activities.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

The proposed monitoring plan was approved and used for monitoring during 1986.

6. STUDY SCHEDULE

The proposed plan was submitted in January 1986.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Remedial Action Plan and Conceptual Documents
Fuel Saturation Area
Author: Intellus Corporation
Doc No: AFP-01025
Submittal: September 1986

1. STUDY OBJECTIVES

The IRP program is a 4-phased program. The fourth phase (Phase IV) addressed the remedial actions. The main objective of Phase IV remedial action efforts is to prepare a remedial action plan (RAP) that proposes a corrective action project to protect the public health and the environment from past releases of hazardous materials in a timely, cost-effective, and environmentally responsible manner. The remediation effort is divided into two stages - designated Phase IVA and IVB. Phase IVA is designed to select preferred remedial action and documents the selection in the RAP. The first stage, Phase IV-A, begins with the preparation of a Statement of Work (SOW) to conduct a Remedial Action Plan (RAP). The SOW identifies the contractor efforts necessary to conduct and document the RAP and to describe the selected remedial action. This effort can include provision of the basic data for evaluation and selection of remedial action alternatives.Review and approval of the RAP by the Air Force completes the first stage of Phase IV. Phase IV-B of the RAP, conducted as a separate effort from Phase IV-A, includes the design and construction of the remedial action as determined in this report.

The targets for the Phase IV investigation were IRP sites FSA 1 (Fuel Saturation Area 1) and FSA-2 (Fuel Saturation Area 2). The pipeline area between Buildings 31 and 96 at FSA-1 was excluded. Previous investigations indicated that if the contamination resulted from potential pipeline leaks, the leaks most probably occurred between Buildings 27 and 31. Therefore, the FSA 1 buried pipeline investigation is limited to that area beneath the pipeline between Buildings 27 and 31. FSA 3 is located just south of Building No. 142 in the Fuel Test Area. Buried fuel lines on the southern and eastern borders of FSA 3 may have leaked potentially contributing to contamination detected in the soil and groundwater.

2. STUDY ACCOMPLISHMENTS

Figure 1.5 portrays the methodology utilized by Intellus Corporation for preparing the Phase IV Remedial Action Plan for FSA 1 and FSA 3. As shown, the project was conducted in four steps: Screen Control Measures, Develop and Evaluate Detailed Alternatives, Select Preferred Alternatives, and Describe Preferred Alternative. This methodology follows the Air Force Installation Restoration Program Management Guidance, July, 1985.

In order to collect data necessary to formulate the RAP, Intellus Corporation undertook a site investigation at FSA-1 and FSA-3 to supplement the data accumulated in the previous Phase I ant II studies. The activities included in this investigation were the following:

1. An electromagnetic terrain conductivity study was conducted to provide insight into the areal extent of fuel saturation and to aid in siting cone penetrometer soundings and well locations. This technique provided an estimate of the volume of floating fuel located at the site.
2. A cone penetrometer investigation was conducted at the sites. The data collected assisted in establishing well locations, defining appropriate intervals for well screens, and establishing stratigraphic control at each site.
3. Six additional wells were installed at each site to obtain more detailed localized knowledge on geohydrologic properties of FSA 1 and FSA 3. Well installations were established to obtain the data detailed in the following paragraphs.
4. Water samples were collected from the new wells to determine pH, specific conductance~ temperature, total organic carbon (TOC), total petroleum hydrocarbon (TPH), and volatile

organic compounds. Groundwater contaminant concentrations are needed in determining the appropriate water treatment options in the remedial action plan.

5. Fluid levels in wells were measured to further define the local groundwater gradient and flow directions as well as the thickness of fuel floating on the groundwater.
6. Boring logs were collected in order to visually depict the stratigraphic character of the area. This was essential to further define contaminant movement at the site.
7. Aquifer tests were mate on two wells to estimate the transmissivity and storativity characteristics of the Upper Zone groundwater. FSA 1 is a fairly transmissive unit while FSA 3 showed low transmissivity. This data is necessary for the sizing of water control and treatment options in the RAP.

3. DATA/INFORMATION DEVELOPED

The findings of the Intellus investigation included:

Environmental Setting - FSA 1 contains basal laterally continuous sand and gravel under most of the site. The southern portion of FSA 1 is lithologically dominated by clay that changes to a dominant sand lithology to the north and west. Boring logs and cone penetrometer sounding data indicates a trend in which grain size increases to the north and, thus, relative permeability also increases to the north. Groundwater was encountered at 629.42 to 633.61 feet above mean sea level in FSA 1. The groundwater gradient trends to the north.

The FSA 3 Upper Zone lithology is predominantly clay with interbedded silt, sand and gravel. A laterally discontinuous basal sand is present under portions of FSA 3. Cone penetrometer sounding data and boring logs indicate a trend in which grain size increases to the northwest, and thus, relative permeability also increases to the northwest. The groundwater gradient trends to the north.

Nature and Extent of Contamination - Data derived during the Intellus Corporation field investigation further defined that jet fuel and the related dissolved constituents are present upgradient along the southern portion of the pipeline, and possibly extend under Building 14 and the transformer station.

The data also further defined the limits of the contaminated area upgradient from the east-west pipeline in FSA 3. The investigation also indicated that the contamination may exit the north side of FSA 3, which corresponds with the groundwater contour data and the base of Upper Zone contour data.

4. RECOMMENDATIONS

No recommendations were provided in this report.

5. STATUS OF STUDY

The information gathered during this investigation was used to formulate the work plan for the Remedial Investigation/Feasibility Study performed by Hargis & Associates in 1989.

6. STUDY SCHEDULE

The field investigation was performed in February 1986. The report of findings was submitted in August 1986.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Interim Report for Ten-Site Field Investigation
Author: Intellus Corporation
Doc No: AFP-01026
Submitted: November 1986

1. STUDY OBJECTIVES

Intellus Corporation presented an interim report on the field investigations being conducted at ten sites at the Plant No. 4. The ten sites were:

- Chrome Pits No. 1, 2, and 3
- Fire Department Training Areas (FDTA) No. 5 and 6
- Die Yard Chemical Pits
- Landfill No. 1
- Monitor Wells HM-38 and HM-51
- Fuel Saturation Area (FSA) No. 2

The field investigation was designed to accomplish the following

- Verify and quantify the aerial extent of contamination in the soil and groundwater in the Upper Zone aquifer.
- Assess hydrogeological characteristics of the upper zone including conductivity, transmissivity, storativity and hydraulic gradient
- Provide quantification of contaminant concentrations necessary to design, size, and cost remedial alternatives

2. STUDY ACCOMPLISHMENTS

The field investigation included the drilling of twelve soil borings, the installation of nine monitor wells (designated F212 - F221), the collection and analysis of soil and water samples for selected organics and metals, and the performance of aquifer tests.

3. DATA/INFORMATION DEVELOPED

The ten sites were evaluated in terms of metals and organic constituents. All of the sites were found to contain metals within the mean range concentrations of metals in natural soils in the United States. Organic concentrations varied from undetected to elevated concentrations. Four sites did not indicate any organic contamination. These were the Chrome Pits No. 1 and 2, FSA No. 2, and FDTA No. 6. Two sites that showed low levels of organic constituents were the Die Yard Chemical Pits and FDTA No. 5. The soils and groundwater near the Die Yard Chemical Pits contained relatively low levels of trichloroethylene (TCE). The groundwater at FDTA No. 5 indicated low levels of total petroleum hydrocarbons (TPH).

The area in the vicinity of Monitor Well HM-51 indicated moderate levels of TPH in the soil and groundwater. It is estimated that the volumes of contaminated soil and groundwater are 3,500 to 4,500 cubic yards and 50,000 gallons, respectively.

The three sites that contained relatively high levels of organic constituents were Chrome Pit No. 3, Landfill No.1, and the area in the vicinity of Monitor Well HM-38. Soil and groundwater samples in monitor well F-220 near Chrome Pit No. 3 contained 1,120 parts per billion (ppb) and 107,500 ppb of TCE, respectively. Soil and groundwater samples in Landfill No. 1 indicated 800 ppm and 900 ppm of

TPH and moderate levels of volatile organic compounds. The estimated volume of contaminated groundwater at this site is 11.9 to 17.0 million gallons. The analysis at Monitor Well HM-38 showed that the soil and groundwater contained 1950 ppb of trans-1,2-dichloroethylene and 638.00 ppb of methylene chloride, respectively. High levels (1500 parts per million) of Tph were also found in the soil at this site. The estimated volumes of contaminated soil and groundwater at HM-38 are 2,500 to 3,000 cubic yards and 6,500 to 8,000 gallons, respectively.

4. RECOMMENDATIONS

Remedial recommendations or recommendations for additional work were not included in this report.

5. STATUS OF STUDY

The data gathered during this investigation was used to formulate the remedial action plan submitted in January 1989.

6. STUDY SCHEDULE

Field investigations were conducted by Intellus Corporation and ERT between September 2 and 25, 1986. The report was submitted in November 1986.

7. INFORMATION IN IRPIMS?

Information presented in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Summary Report
Window Area Investigation
Author: Hargis & Associates
Doc No: AFP-01028
Submittal: April 1987

1. STUDY OBJECTIVES

The Window Area is located in the vicinity of the East Parking Lot of the General Dynamics facility. It is so-called because of the postulation that an area in the vicinity of the East Parking Lot may exist where the Walnut Formation is extremely thin or absent. H+A referred to this feature as the window area. Because of the limited thickness or absence of the Walnut Formation, groundwater in the Upper Zone may be in direct contact with the Upper Paluxy aquifer. To determine the potential for contaminant migration from the Upper Zone to the Upper Paluxy Formation in the vicinity of the window area, an investigation of geologic and hydrogeologic conditions in the general vicinity of the window area was performed. The specific objectives of this investigation were:

1) Obtain detailed lithologic logs of the upper zone, Walnut Formation, and Upper Paluxy Formation in the vicinity of the window area.
2) Attempt to further define the geologic and hydrogeologic conditions in the vicinity of the window area.
3) Determine water levels in monitor relationships between hydrogeologic units to provide additional data to aid in determining directions of groundwater flow and potential causes Upper Paluxy aquifer.
4) Further delineate the distribution of anomalous water levels in the of contamination in upper zone groundwater and the Upper Paluxy Formation.
5) Determine the potential for contaminant migration from the upper zone to the Upper Paluxy Formation in the vicinity of the window area.

2. STUDY ACCOMPLISHMENTS

Three groundwater monitor wells were installed adjacent to the window area, approximately one hundred feet south of monitor well HM-82. The three monitor wells were divided between the Upper Zone, the uppermost portion of the Upper Paluxy Formation, and the Upper Paluxy Formation. The monitor wells were designated as HM-86, P-14 Upper, and P-14US (Figure 1). Monitor well HM-86 was drilled with an 18-inch flight auger to a depth of 56 feet below land surface (bls). The well is completed with 30 feet of .010 slot size 4-inch PVC screen from 22 to 52 feet bls. The well is sand packed from the bottom to 14.5 feet bls with grade #9 sand. A one-foot bentonite seal was installed above the sand pack. Borehole cuttings were added to 2 feet bls followed by a cement surface seal. The well is completed and secured with an above-ground well vault. Monitor well HM-86 is equipped with a permanently installed one-third horsepower stainless steel Grundfos pump set at 45 feet bls.

Monitor well P-14US was drilled by mud rotary methods to a total depth of 70 feet bls. Continuous cores were collected from 53 to 70 feet bls. P14US was drilled to 60 feet bls with an 18-inch tricone drill bit. Eight and 5/8-inch steel conductor casing was cemented in place from land surface to 59.5 feet bls. The remainder of the borehole was drilled with a 10-3/4 inch tricone bit to a total depth of 70 feet bls. P-14US is completed with ten feet of .010 slot size 4-inch PVC screen from 60 to 70 feet bls. Centralizers are placed at 55, 35, and 5 feet bls. The well is sand packed with grade #9 sand up to 43.5 feet bls. A bentonite seal was installed above the sand pack to approximately 35 feet bls. A coarse grade #3 sand was used as backfill to 2 feet bls followed by a cement surface seal. The well is completed and secured with an above ground locking well vault. Monitor well P-14US is equipped with a 1.7-inch Triloc hand pump.

Monitor well P-14 Upper was drilled by flight auger and mud rotary methods. An 18-inch flight auger bit was used to drill to the top of the Walnut Formation at 53 feet bls. P-14 Upper was then drilled with mud rotary techniques to 75 feet bls with a 10-5/8-inch tricone bit. Eight and 5/8 inch steel conductor casing was cemented into place at 74.5 feet bls. The remainder of the borehole was drilled with a 6-5/8-inch tricone bit to a total depth of 85 feet bls. Continuous cores were collected from 53 to 85 feet bls. P-14 Upper is completed with ten feet of .010 slot size 4-inch PVC screen from 75 to 85 feet bls. Centralizers are placed at 75, 45, and S feet bls. The well is sand packed with a grade #9 sand from 67.8 to 85 feet bls. A bentonite seal was installed above the sand pack to approximately 44.5 feet bls. A backfill of grade #3 sand was installed to 2 feet bls followed by a cement surface seal. The well is completed and secured with an above ground locking well vault. Monitor well P-14 Upper is not equipped with a pump.

3. DATA/INFORMATION DEVELOPED

The lithologic logs from wells constructed for this investigation suggest that the Upper Paluxy Formation consists of two sand units separated by a clay or shale layer (Figure 2). Lithologic logs of core samples collected from monitor wells P-14 Upper and P-14US identified three lithologic units in the upper 22 feet of the Paluxy Formation. The uppermost unit is a clayey sandstone approximately 9 feet thick at P-14U. Underlying the uppermost clayey sandstone unit is a layer of silty claystone approximately 5 feet thick. The lower unit is approximately 8 feet thick and is a relatively clean, very fine grained sandstone.

The logs indicate that an ancient stream may have eroded through the Walnut Formation and into the Upper Paluxy Formation. In this area, the Upper Zone alluvium may have been deposited directly on the Paluxy Formation. The window area is thought to be located adjacent to Grants Lane in the general vicinity of monitor well HM-67 and well HM-82. The exact limits of the window area remain unknown.

Lithologic data also suggest that the Walnut Formation was deposited on a very uniform surface on top of the Paluxy Formation. The elevation of this surface ranges from 584 to 586 feet above mean sea level in the vicinity of the Plant. Soil boring data from 8A4C-84 and 8A-107 drilled by the ACOE (1986) indicate that the Walnut Formation was encountered at refusal. The elevations at which auger refusal occurred, as noted in the logs from the ACOE borings, are similar to elevations which top of the Upper Paluxy Formation. Therefore, far north as ACOE boring 8A4C-84 but probably well HM-71.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

Information gathered during this study was utilized to formulate the work plan for the Remedial Investigation/Feasibility Study submitted by Hargis & Associates in August 1987.

6. STUDY SCHEDULE

The field investigation was performed in November 1986. The report of findings was submitted in April 1987.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Assessment Report (Draft)
Landfill No. 3
Author: Intellus Corporation
Doc No: AFP-01029
Submittal: June 1987

1. STUDY OBJECTIVES

The Landfill No. 3 assessment report was prepared under Plant Services Contract No. 5161 with Air Force Plant No. 4, Fort Worth, Texas. The report utilizes data collected during Phase I, II, and IV Installation Restoration Program (IRP) investigations and sampling campaigns to evaluate the potential impacts of groundwater contaminant migration form Landfill No. 3 and the potential need of remedial action or interim control measures prior to the completion of the Complete Site Remedial Action Plan.

The objectives of this study included:

- Evaluate the nature and extent of groundwater contaminant migration from Landfill No. 3 and identify areas potentially requiring additional evaluation
- Evaluate the fate of three significant organic contaminants in soil, water, and air and their resulting aquatic and human health effects
- Evaluate the potential need for development of remedial actions or interim control measures prior to completion of the Complete Site Remedial Action Plan

2. STUDY ACCOMPLISHMENTS

No field activities were completed during this investigation. All data presented was collected during previous investigations.

3. DATA/INFORMATION DEVELOPED

Groundwater migration from the Landfill No. 3 area may follow one or more of the pathways described below:

- Groundwater seepage from the east bank of Meandering Road Creek with evaporation loss and/or flow into the Creek
- Groundwater flow through the upper zone and weathered or fractured Upper Walnut Formation directly into the Creek
- Vertical flow down through fractures in the Walnut Formation to the Upper Paluxy Formation

Groundwater seepage from the east bank of Meandering Road Creek with evaporation loss and/or flow into the creek is the most likely migrational pathway. The groundwater flow from Landfill No. 3 is expected to be very small because of the limited recharge area and the generally low hydraulic conductivity.

Vertical groundwater flow downward into the Upper Paluxy Formation is expected to the minimal. The Walnut Formation generally precludes the vertical flow into this formation. The low concentrations of trichloroethylene (TCE) identified in monitor well P-22U may be attributed to the off-site sources or potentially limited vertical migration through the Walnut Formation.

Volatilization of toluene, benzene and TCE from the aquatic environment to the atmosphere followed by oxidative destruction is the dominant environmental fate process. The half-life for volatilization of these

compounds from the aquatic environment ranges from a few hours to a few days. In addition, biodegradation in soil and water can be an important environmental fate process.

4. RECOMMENDATIONS

Based on the data current with the completion of the assessment, it was recommended that a line of soil gas sampling points be established along the toe of the landfill. The survey would extend from the known seep at the south end of the site to a point between creek sampling stations C-3 and C-2. The results of the survey will be used in conjunction with current groundwater monitoring data to determine if the installation of a groundwater collection system is required. The groundwater collection system, if installed, will preclude groundwater migration to Meandering Road Creek from Landfill No. 3. A second soil gas survey, approximately 6 to 12 months following the initial survey, is recommended. The second survey , conducted in the selected areas along the creek, would be used to determine if any additional contaminant migration toward the creek is occurring.

An additional well, installed within the Upper Paluxy at the southern end of the landfill, is recommended. The purpose of the new well will be to determine if Upper paluxy contaminant concentrations in a down gradient direction from Well P-22U are increasing, decreasing, or not present. All data acquired during the recommended investigations will be utilized in the Complete Site Remedial Action Plan development.

5. STATUS OF STUDY

The study is complete.

6. STUDY SCHEDULE

The investigation was conducted in the first part of 1987, the reported was submitted in June 1987.

7. INFORMATION IN IRPIMS?

Information presented in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Proposed 1988 Hydrologic Monitoring Plan
Author: Hargis & Associates
Doc No: AFP-01031
Submittal: December 1987

1. STUDY OBJECTIVES

This hydrologic monitoring plan provides the recommended schedule for continued groundwater and surface water monitoring in the vicinity of Plant No. 4. The plan includes recommendations for monitoring groundwater quality from all on-site monitor wells, off-site monitor wells constructed by the U.S. Environmental Protection Agency (EPA) and municipal drinking water wells. The plan also includes sampling selected surface water sites. Water level and water quality data have been monitoring plan is primarily designed collected since 1982. The proposed plan is based on data collected from May 1986 through September 1987.

The proposed monitoring plan is designed to maintain the continuity and integrity of the existing water quality and water level data base. The data base will be used in evaluating and formulating remedial action plans and will aid in monitoring remedial actions. Continuous monitoring is necessary to provide data before, during, and after remedial actions to assess effectiveness. Due to changing hydrogeologic conditions and potential remedial actions, the monitoring plan should be modified as necessary throughout the year to satisfy changing monitoring requirements. Continuous monitoring allows further understanding of the hydrogeology of the site and provides data with which to eventually evaluate the efficiency of remedial actions.

The objectives of the hydrogeologic monitoring plan are as follows:

1. Maintain the continuity and integrity of the database.
2. Monitor groundwater chemistry in selected areas.
3. Establish water quality baselines for newly constructed wells.
4. Monitor changes in established baseline water quality data.
5. Continue to regularly monitor the quality of surface water in Meandering Road Creek.
6. Monitor groundwater level elevations to determine changes in the direction of groundwater flow.
7. Determine the areas where groundwater level elevation fluctuations are outside established norms of seasonal variability.
8. Establish baseline data for eventual development of a water budget for the site.

2. STUDY ACCOMPLISHMENTS

Twenty-three new wells were constructed in the vicinity of the Plant during September and October, 1987. Two of the new wells are dry. Water quality monitoring is being conducted at the remaining eighteen wells during routine sampling rounds in November and December. Pending analysis of the results of this sampling, these wells will be integrated into the hydrologic monitoring plan. A proposed amendment to this plan will be forwarded to all concerned parties for comments regarding the proposed sampling frequency and analytical methodologies for the new wells.

As has been the practice in the past, all new wells are sampled for full priority pollutant scans at least once. The full scans and initial baseline water quality data, from two to four additional sampling events are evaluated to determine the sampling schedule. Analytical methodologies and sampling frequencies are selected based on the criteria of: 1) the chemicals of interest at specific wells; 2) well location in relation to potential source areas, and; 3) reductions in the scope of analytical work to specific target defensible chemicals or "fingerprints." As a result, most wells are eventually routinely analyzed for volatile organic chemicals by EPA Method 624.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

As a result of the U.S. Air Force IRP program, seven sites at the Plant have been formally recommended as requiring no further action. These sites are Landfill 2, Landfill 4, FDTA No. 3, Former Fuel Lines, NARF Area, and FDTA No. 4. Routine water quality monitoring activities in the vicinity of these seven sites recommended to be reduced in both scope and frequency. Approximately one-half of the monitor wells which were installed to monitor the seven sites have been deleted from the proposed water quality monitoring plan for 1988. The remaining wells are sufficient to monitor these sites on a routine annual basis.

5. STATUS OF STUDY

The proposed plan was used as a guide for monitoring throughout 1988.

6. STUDY SCHEDULE

The proposed plan is based on data collected from May 1986 through September 1987. The plan was submitted in December 1987.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 2: Appendix A-1
Author: Radian Corporation
Doc No: AFP-01032
Submittal: December 1987

This report contains appendices only and is a supporting document for the Phase II - Confirmation/Quantification, Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Appendix A1 contains the laboratory analytical reports submitted by Radian Analytical Services. The data has been compiled in Appendix A1 as "batches" of samples which were submitted and logged in the same time frame. Volume 2, Volume 3, and Volume 4, Appendix A1 contain Tables A.1-1, A.1-3, and A.1-5, respectively, which are sequential listings of the reports contained in that volume by batch number and Tables A.1-2, A.1-4, and A.1-6, respectively, which are sample log and cross-reference table. These tables serve as sample log and cross-references well numbers, OEHL numbers and the RAS work order numbers under which the results are located in Appendix E (Document Number AFP-01038).

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 3: Appendix A-1
Author: Radian Corporation
Doc No: AFP-01033
Submitted: December 1987

This report contains appendices only and is a supporting document for the Phase II - Confirmation/Quantification, Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Appendix A-1 contains the laboratory analytical reports submitted by Radian Analytical Services. The data has been compiled in Appendix A-1 as "batches" of samples which were submitted and logged in the same time frame. Volume 2, Volume 3, and Volume 4, Appendix A-1 contain Tables A.1-1, A.1-3, and A.1-5, respectively, which are sequential listings of the reports contained in that volume by batch number and Tables A.1-2, A.1-4, and A.1-6, respectively, which are sample log and cross-reference table. These tables serve as sample log and cross-references well numbers, OEHL numbers and the RAS work order numbers under which the results are located Appendix E (Document No. AFP-01038).

Title:	Installation Restoration Program Phase II - Confirmation/Quantification Stage 1 Volume 4: Appendix A1
Author:	Radian Corporation
Number:	AFP-1034
Submittal:	December 1987

This report contains appendices only and is a supporting document for the Phase II - Confirmation/Quantification, Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Appendix A1, included in Volumes 2, 3 and 4, contains the laboratory analytical reports submitted by Radian Analytical Services. The data has been compiled in Appendix A1 as "batches" of samples which were submitted and logged in the same time frame. Volume 2, Volume 3, and Volume 4, Appendix A1 contain Tables A.1-1, A.1-3, and A.1-5, respectively, which are sequential listings of the reports contained in that volume by batch number and Tables A.1-2, A.1-4, and A.1-6, respectively, which are sample log and cross-reference table. These tables serve as sample log and cross-references well numbers, OEHL numbers and the RAS work order numbers under which the results are located Appendix E (Document Number AFP-01038).

Title:	Installation Restoration Program Phase II - Confirmation/Quantification Stage 1 Volume 5: Appendix A2
Author:	Radian Corporation
Doc No:	AFP-01035
Submittal:	December 1987

This report contains appendices only and is a supporting document for the Phase II - Confirmation/Quantification, Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Appendix A2 contains all QA/QC reports for water analyses (organized by work number) submitted by Radian analytical Services. Also included are summary tables (A.2-1 through A.2-9) of the QC reports. QA/QC data in Appendix A2 is for the water sample analyses reported in Appendix A1 (Volumes 2,3, and 4).

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 6: Appendix A-2
Author: Radian Corporation
Number: AFP-1036
Submitted: December 1987

This report contains appendices and is a support document to the main body of the report (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Appendix A2 contains all QA/QC reports for water laboratory analyses (organized by work number) submitted by Radian analytical Services. Also included are summary tables (A.2-1 through A.2-9) of the QC reports. QA/QC data in Appendix A2 is for the water sample analyses reported in Appendix A1 (Document Numbers AFP-01032, AFP-01033, AFP-01034)).

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 7: Appendices A3 and A4
Author: Radian Corporation
Doc No: AFP-01037
Submitted: December 1987

This report contains appendices only and is a supporting document for the Phase II - Confirmation/Quantification, Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

This volume contains:
Appendix A3: Soil Analytical Data
Appendix A4: Soil Quality Assurance/Quality Control Data

Appendix A3 - Soil Analytical Data

Appendix A3 contains the analytical report for the soil analyses completed during the Phase II field investigation. The soil analytical data was submitted by Radian Analytical Services.

Appendix A4 - Soil Quality Assurance/Quality Control Data

Appendix A4 contains all QA/QC reports for soil analyses submitted by Radian analytical Services. QA/QC data in Appendix A4 is for the soil sample analyses reported in Appendix A3 of the Phase II - Confirmation/Quantification, Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041).

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 8: Appendices B-E
Author: Radian Corporation
Number: AFP-1038
Submittal: December 1987

This report contains appendices and is a support document for the main body of the report (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Volume 8 includes the following Appendices:

- Appendix B - Definitions, Nomenclatures and Units
- Appendix C - Statement of Work
- Appendix D - Well Numbering System
- Appendix E - Lithologic Logs, Soil Boring Logs, Well Completion Logs

Appendix B - Definition, Nomenclature, and Units

Appendix B contains the all acronyms, definitions, and units which were utilized in the Phase II - confirmation/Quantification Report.

Appendix C - Statement of Work

The overall objective of the Phase II investigation was to define the magnitude, extent, direction and rate of movement of identified contaminants. The propose of this investigation is to conduct a contaminant source investigation at Air Force Plant 4 to determine the following:

- To determine the presence or absence of contamination within specified areas of the field survey
- To determine the potential for contaminant migration in the various environmental media
- Top determine the extent/magnitude of contamination of Air Force Plant 4 property
- To determine potential environmental consequences and health risks of migrating contaminants based on state or federal standards for these contaminants.

The Phase II Investigation consisted of the following:

- Installation of 23 boreholes (maximum) for a total of 1220 linear feet with soil samples collected for laboratory analysis
- Installation of 14 monitor wells for a total of 930 linear feet.
- Subsurface investigations and groundwater sampling will be completed at the following Disposal Sites:
  - Site 1: Landfill 1
  - Site 3: Landfill 3
  - Site 12: Chrome Waste Pit
  - Site 17: Former Fuel Storage Area
  - Site 2: Landfill 2
  - Site 4: Landfill 4
  - Zone 1: Die Pits, Chrome Pit 2, and Fire Department Training Area 5
  - Site 15: Fuel Saturation Area 2 (FSA 2)
  - Site 20: Wastewater Collection Basin

- Site 16: Fuel Saturation Area 3 (FSA 3)
- Site 7: Fire Department Training Area 4 (FDTA 4)
- Site 18: Solvent Lines
- Site 10: Chrome Pit 1
- Site 5: Fire Department Training Area 1 (FDTA 1)
- Site 14: Fuel Saturation Area 1 (FSA 1)
- Ambient Monitoring
- East Parking Lot
- Fuel Storage Tank
- Lake Worth Monitor Wells
- Nuclear Aerospace Research Facility
- Fuel Test Area, Bldg. 21

Exact tasks are outlined in Appendix C.

Included in this appendix are monitor well and soil boring location maps, analytical guidelines (QA/QC and acceptable parameters), decontamination guidelines and standard operations of procedure.

Appendix D - Well Numbering System

Appendix D contains a list of monitor wells, both upper zone and Paluxy, that have been installed at Air Force Plant No.4. Included in this appendix is a description of the well numbering system, including definition of well numbers. The following definitions of well numbering are listed in Appendix D:

- HM - Upper Zone monitor wells installed by Hargis & Montgomery, Hargis & Associates or Radian Corporation
- F - Represents upper zone monitor wells installed by Intellus
- P - Monitor wells drilled in the Paluxy Formation are denoted by the prefix P before the number, in most cases the number is followed by a U or M denoting the Upper Paluxy and Middle Paluxy respectively.

Appendix E - Lithologic Logs, Soil Boring Logs, Well Completion Logs

- Lithologic Logs for SB-1 through SB-12, HM-100 through HM-108, and P-20M through P-23U
- Soil Boring Completion Logs for SB-1 through SB-12
- Well Completion Logs for HM-100 through HM-108 and P-20M through P-23U

Title: Installation Restoration Program
Phase II
Confirmation/Quantification
Stage 1
Volume 9: Appendices F-K
Author: Radian Corporation
Doc No: AFP-01039
Submitted: December 1987

This report contains appendices and is a support document for the main body of the report (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Volume 9 contains Appendices F through K of the final report (Document Number 1041). The information provided in the individual appendices are as follows:

- Appendix F - Field Investigation Quality Control Plan
  - Quality Assurance/Quality Control Program for Radian Analytical Services
- Appendix G - References
- Appendix H - Biographies of Key Personnel
- Appendix I - Terrain Conductivity Study
  - Shallow Soil Gas Study
- Appendix J - Health and Safety Plan
- Appendix K - Technical Operations Plan

Appendix F - Field Investigation Quality Control Plan
Quality Assurance/Quality Control Program for Radian Analytical Services

The field investigation quality control plan is included in the Technical Operations Plan, Appendix K. Appendix F includes the Quality Assurance/Quality Control protocols for the Radian Analytical Services. The basic quality control program includes procedures for sample handling, calibration, spiking and replicate analyses, analysis of QC test samples, equipment maintenance, and supplies control. The procedures were integrated with USACE additional requirements including spiking studies, analysis of replicate samples, linearity determinations and stability studies. The Quality Assurance program consists of frequent submission of blind QA samples, duplicates, and spiked sample splits. Also included are personnel training, analytical methodologies, sample control procedures, data handling, and equipment maintenance and calibrations.

Appendix G - References

Appendix G contains references for material used and/or cited in the Phase II field investigation or Confirmation/Quantification Report

Appendix H - Biographies of Key Personnel

Appendix H contains the resumes of Radian personnel who participated during the Phase II Investigation.

Appendix I - Terrain Conductivity Study
- Shallow Soil Gas Study

Terrain Conductivity Study

Radian utilized the services of a subcontractor, Delta Geophysical Services, to accomplish the terrain conductivity surveys at Air Force Plant 4. Appendix I contains an edited report of the subcontractor. The report was edited to present only those results dealing with activities requested by the statement of work (Appendix C, Document Number AFP-01038). Geophysical recommendations or conclusions that went beyond those actions requested in the scope or that were not consistent with the results of direct drilling and geological exploration in the study areas were disregarded.

The purpose of the geophysical surveys was to define the areas of waste disposal, determine if plumes of contaminated groundwater are present and to provide guidance on the selection of monitor well sites. A total of three locations (sites 2, 3, and 5) were surveyed. These locations correspond to landfills and fire department training areas. Interpretation of the data is included in Volume I, IRP - Phase II Confirmation/Quantification Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041).

Shallow Soil Gas Study

Radian utilized the services of a subcontractor, Tracer Research Corporation, to complete the Shallow Soil Gas Investigation of the U.S. Air Force Plant #4. Appendix I contains an draft report of the subcontractor. Interpretation of the data is included in Volume I, IRP -Phase II Confirmation/Quantification Stage 1, Final Report for Air Force Plant 4, Fort Worth, Texas (Document Number AFP-01041).

Appendix J - Health and Safety Plan

The Health and Safety Plan completed for the Phase II field investigation is included in Technical Operation (Appendix K). The document describes the health and safety procedures that was enforced for the Phase II - Stage 1 investigation at Air Force Plant 4. All Radian employees and subcontractors were required to follow the plan.

Appendix K - Technical Operations Plan

Appendix K contains the detailed procedure for all technical operations for the Phase II field investigation. Technical Operations Plan was submitted for approval on January 10, 1986. The following items are described in detail in the Technical Operations Plan:

- Site Descriptions and Field Activities
- Field Program Coordination
  - Health and Safety Plan
  - Sampling Quality Control Plan
  - Subcontractor Requirements
- Operation of Field Equipment
  - Air Monitoring Equipment
  - Physical Properties Instrumentation
- Field Team Organization and Responsibilities
  - Organization
  - Responsibilities
  - Training

- Site Investigations
  - Geophysical and Soil Gas Surveys
  - Drilling and Sampling
  - Waste Handling and Decontamination Procedures
  - Drilling Safety
  - Monitor Well Construction and Completion
  - Well Development
- Sample and Data Acquisition
  - Groundwater Level Measurements
  - Surveying of Wells
  - Purging and On-Site Analysis
  - Sampling and Laboratory Analysis
  - Split Sample Procedures
- Work Zones and Decontamination Procedures
  - Zone 1, Zone 2, and Zone 3 Descriptions
  - Personnel Decontamination
  - Equipment Decontamination
- Sample Control and Data Management
  - Sample Numbering Format
  - Sample Identification Documents
  - Sampling Handling and Shipment
  - Data Reduction and Reporting
  - Data Validation

The Technical Operations Plan contains the schedule, Statement of Work, Health and Safety Plan, and Quality Control Plan.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 10: Appendix L
Author: Radian Corporation
Doc No: AFP-01040
Submittal: December 1987

This report contains appendices and is a support document for the main body of the report (Document Number AFP-01041). No objectives, procedures or recommendations are a part of this volume.

Appendix L includes analytical data from the previous and current studies performed by Hargis & Associates for General Dynamics.

Title: Installation Restoration Program Phase II - Confirmation/Quantification Stage 1, Volume I - Report Text
Author: Radian Corporation
Doc No.: AFP-01041
Submitted: December 1989

1. STUDY OBJECTIVES

A contaminant source investigation at AFP 4 was conducted to determine the following:

- the presence or absence of contamination within the specified areas of the field survey
- if contamination exists, the potential for migration in the various environmental media
- the extent/magnitude of contamination on AFP 4 property
- the potential consequences and health risks of migrating contaminants, based on state or federal standards for these contaminants

The full scope of work covering this investigation is presented in Appendix C, Volume 8 (Document Number AFP-01038) of the submittal.

2. STUDY ACCOMPLISHMENTS

The following summarizes the field activities that were completed during this investigation. Groundwater samples were collected from monitoring wells at all disposal and topic sites. New upper zone monitor wells were installed at the following former disposal sites:

- Former Fuel Storage Facility
- Landfill No. 4
- Wastewater Collection Basins
- Fire Department Training Area No. 3
- Solvent Lines
- Chrome Pit No 1
- Jet Engine Test Stand

Paluxy monitor wells were installed at the following sites:

- Landfill No. 3
- Landfill No. 2
- Landfill No. 4
- Install near Lake Worth

Terrain conductivity surveys were completed at Landfill Nos. 3 and 2 and Fire Department Training Area 2 to determine site lithology and to attempt to determine if a conductive groundwater plume was present. Soil borings were completed at Fuel Saturation Area 2, fire Department Training Area 6, Fuel Saturation Area 1, NARF, and Jet Engine Stand.

3. STUDY DATA/INFORMATION

Hydrogeologic data collected during this investigation consisted of water-level measurements at existing and new upper zone and Paluxy monitor wells. Groundwater flow in the Paluxy is generally to the southeast at AFP 4. Potentiometric surface maps of both upper and middle members of the Paluxy Formation support earlier interpretations of the potentiometric surface and groundwater flow.

Organic compounds were detected in groundwater samples collected from monitoring wells within the former disposal at AFP 4. Organic contamination, consisting primarily of trichloroethene (TCE), trans-1,2,-DCE, and vinyl chloride, was detected at the following disposal sites:

- Site 1, Landfill No.1
- Site 3, Landfill No.3
- Site 12, Chrome Pit 3
- Zone 1
- Site 20, Wastewater Collection Basin
- Site 16, Fuel Saturation Area 3
- Site 10, Chrome Pit 1
- Site 5, Fire Department Training Area 2
- East Parking Lot

Chemical compounds and the respective concentrations are listed in tabular form in this report.

Contaminants were not detected in groundwater samples collected from the following sites:

- Site 17, Former Fuel Storage Area
- Site 9, Fire Department Training Area 6
- Site 6, Fire Department Training Area 3
- Site 18, Solvent Lines
- Jet Engine Test Stand
- Fuel Storage Tank
- Lake Worth monitor well

Raw analytical data can be found in Volumes 2, 3, and 4 (Document Numbers AFP-01032, AFP-01033 and AFP-01034) of this report.

4. RECOMMENDATIONS

The following recommendations were made as a result of this investigation:

Category I - No Further IRP Activities

The following sites were investigated during this and previous studies and found to currently contain little or no hazardous material or potential for contamination. On the basis of this information, no further action is recommended for:

- Site 17, Former Fuel Storage Site
- Site 2, Landfill No. 2
- Site 4, Landfill No. 4
- Site 6, FDTA 3
- Site 7, FDTA 4
- Site 18, Solvent Lines
- NARF Area
- Jet Engine Test Stand, Building 21

Category II - Additional Phase II Effort

Site 15, Fuel Saturation Area 2, was studied during this program but insufficient data exists to fully characterize the extent of contamination. Additional Phase II investigation activities, including the

construction and sampling of two, down gradient, upper zone monitor wells to define the extent of groundwater contamination was recommended.

Category III - Ready for Phase IV Actions

The following sites were investigated during this and previous studies and found to currently contain various levels of hazardous material and contamination. All these well-characterized sites were recommended to be released for Phase IV planning:

- Site 1, Landfill No. 1
- Site 3, Landfill No. 3
- Site 12, Chrome Pit 3
- Zone 1
- Site 20, Wastewater Collection Basins
- Site 10, Chrome Pit 1
- Site 16, Fuel Saturation Area 3
- Site 9, FDTA 6
- Site 5, FDTA 2
- Site 14, Fuel Saturation Area 1

It was also recommended that individual groundwater monitoring wells at the plant should be considered for a plant wide continued monitoring program.

5. STUDY STATUS

The study was initiated in November 1985 and was concluded in August 1986.

6. STUDY SCHEDULE

This study has been concluded.

7. IRPIMS STATUS

Information presented in this report has not been entered into IRPIMS

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Installation Restoration Program
Phase II - Confirmation/Quanitification
Stage 2
Quality Assurance Project Plan
Author: Radian Corporation
Doc No: AFP-01042
Submittal: January 1988

1. STUDY OBJECTIVES

The Quality Assurance Project Plan contains the quality assurance/quality control (QA/QC) protocols for the Preliminary Assessment/site Investigation and Remedial Investigation/Feasibility Studies. The basic quality control program includes procedures and guidelines for sample handling, analysis, laboratory quality control, performance and system audits. The quality assurance program includes procedures and guidelines for QA blank samples, duplicates, personnel training, field methods, measurements, data reduction, equipment calibration, sampling, and decontamination procedures.

2. STUDY ACCOMPLISHMENTS

The Quality Assurance Project Plan establishes the proper QA/QC for the study.

3. DATA/INFORMATION DEVELOPED

No data developed. The Quality Assurance Project Plan presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

Recommendations were not included in the Quality Assurance Project Plan.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in the Quality Assurance Project Plan has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: U.S. Air Force Underground Storage Tank Program Evaluation
Analysis of USTs
Volume III: Appendix F
Author: Hargis & Associates
Doc No: AFP-1045
Submittal: June 1989

1. STUDY OBJECTIVES

The purpose of the Underground Storage Tank Evaluation was to determine the status of UST compliance at the installation relative to federal and local UST regulations. The UST evaluation was conducted on the USTs located at AFP 4.

2. STUDY ACCOMPLISHMENTS

The study completed the following:

- Clarification of Texas State, Tarrant County, and Fort Worth Regulations
- Tank Data Summary
- Budgetary Initiatives
- Summary of State and Local UST Regulations
- Regulatory Compliance
- Analysis of Leaks, Spills, and Overfill Incidents

3. DATA/INFORMATION DEVELOPED

Currently existing and removed USTs at AFP No. 4 include 25 subject to Federal Subtitle I and 13 excluded or deferred from Subtitle I regulations. The state of Texas published proposed UST regulations which were scheduled to be finalized in May 1989. Twenty-four USTs currently exist at AFP No. 4. An additional 14 were removed from the ground. Of the USTs which currently exist at the site, 21 are currently in use and 3 have been taken out of use. The 21 USTs currently in use include 10 which contain petroleum, one which contains a hazardous substance and 10 which are exempt from federal Subtitle I and from proposed Texas state UST regulations.

The petroleum and hazardous substance USTs currently in use are subject to Federal Subtitle I regulations and will be subject to Texas UST regulations when finalized. Release detection monitoring must begin at the currently used petroleum and hazardous substance USTs according to the schedule established in the Federal Subtitle I and Texas UST regulations. Release detection monitoring must be provided at seven of the USTs by December 22, 1989, at to more by December 22, 1990, and at the last by December 22, 1993, per Federal Subtitle I requirements. Piping release detection monitoring at all of these USTs which have pressurized piping is required by December 22, 1990.

Per federal Subtitle I, corrosion is required by December 22, 1988, for all steel tanks and piping which do not already have some form of corrosion protection. Texas UST regulations will require field installed cathodic protection on all steel tanks by December 22, 1998. Spill and overfill equipment must be installed by December 22, 1998, at all active petroleum and hazardous USTs. Secondary containment and interstitial monitoring is required by december 22, 1998 on all active USTs containing hazardous substances.

The 14 USTs which have been removed from the ground at AFP No. 4 include 12 which contained petroleum and two which contained hazardous substances. All tanks were removed prior to federal

Subtitle I regulations. Following the removal of the USTs, soil samples indicated contamination at 6 of the former UST locations. Four contamination incidents involved petroleum product and two involved hazardous substances. no soil was removed. Current Subtitle I and proposed Texas state UST regulations reserve the right of the state implementing agency to require corrective action at sites where USTs were removed before the effective date of federal UST regulations.

Included in the report is tabulated information on leaks, spills and overfill incidents, tank data summary, budgetary initiatives, regulatory compliance,and state and local UST regulations.

4. RECOMMENDATIONS

The following are recommended to bring AFP No. 4 into regulatory compliance:

- Notify Texas Water Commission and Texas State UST Office of contamination of soils under removed USTs
- Adapt the AFP No. 4 UST program to the finalized Texas regulations for petroleum and hazardous substance USTs
- Prepare a closure schedule for those USTs the GOCO will permanently close
- Provide leak detection for USTs which will not be permanently closed prior to respective release detection deadlines
- Follow closure guidelines in subtitle I or final Texas regulations for petroleum and hazardous substance USTs depending on the date the USTs are removed and the effective date of final Texas regulations
- Prepare upgrading program for USTs which continue in use

5. STATUS OF STUDY

The study has been completed.

6. STUDY SCHEDULE

The report was submitted in June 1989.

7. IRPIMS STATUS

The information and data presented in this report has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Industrial Hygiene Assessment of Organic Solvents at General Dynamics Plant Fort Worth, Texas
Author: Clayton Environmental Consultants, Ltd.
Doc No: AFP-1046
Submitted: August 28, 1989

1. STUDY OBJECTIVES

The objective of the study was to determine the amount of potential human exposure to organic solvents during subsurface investigations at AFP 4. The report includes air monitoring, air sample analysis, and safety recommendations.

2. STUDY ACCOMPLISHMENTS

The industrial hygiene assessment quantified and characterized the health risks due to the exposure to organic solvents.

3. STUDY DATA/INFORMATION

The report includes air sample analysis, summary of standards and guidelines, work practice descriptions and respirator protection recommendations.

4. RECOMMENDATIONS

Respirator recommendations include the type, (supplied or air purifying), cartridge types, and ambient air levels required for each type of respirator.

5. STUDY STATUS

The industrial hygiene assessment was completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information included in the industrial hygiene assessment has not been entered into the IRPIMS.

8. DISCREPANCIES

Not Applicable

Title: Environmental Assessment
Advanced Materials Development Laboratory Site
Author: Hargis & Associates
Doc No: AFP-01047
Submittal: October 1989

1. STUDY OBJECTIVES

This report is a summary of the environmental assessment performed by Hargis & Associates at the proposed Advanced Materials Development Laboratory (AMDL) site at U.S. Air Force Plant No. 4 (AFP4) Fort Worth, Texas. The report was prepared for General Dynamics Corporation, Fort Worth Division pursuant to Plant Services Contract No. 6554.

The proposed AMDL site is located in the southwestern portion of AFP4 on the Radar Range. A portion of the AMDL site overlies former Landfill No. 2. The objectives of this investigation are to:

- Delineate the extent of potential soil contamination in the vicinity of the proposed AMDL
- Identify areas of soil contamination that may require remediation prior to constructing the AMDL facility.

2. STUDY ACCOMPLISHMENTS

Seven soil borings were drilled in the vicinity of the proposed AMDL site during the investigation (RR-1 through RR-7). Soil borings were advanced to the water table utilizing a 6-1/4 inch outside diameter (SIC) hollow stem augers. Soil samples were collected at 5 feet interval (minimal) utilizing a California Split Spoon Sampler and were submitted for laboratory analysis. Soil samples submitted for analyses were analyzed for metals and volatile organic compounds.

3. DATA/INFORMATION DEVELOPED

The following data and information was collected during this study:

- Depth to groundwater in the vicinity of the AMDL site ranges form approximately 21 to 37 feet below surface.
- Geologic material in the vicinity of the ADML site is comprised of fill and alluvium consisting of construction rubble, clay, silty, sand and gravel mixture
- Metals were not detected at concentrations exceeding established cleanup levels for each respective metal.
- TPH was not detected in the six soil samples analyzed for TPH
- Toluene was the only VOC detected
- Toluene was only detected in one soil sample at a concentration well below health-based cleanup levels
- The concentrations of metals and VOCs detected during this investigation do not appear to represent areas of contamination
- No areas were identified that require soil remediation in the area of the proposed AMDL facility

4. RECOMMENDATIONS

Based on the conclusions of this investigation, the following are recommended:

- No further assessment is recommended of Landfill No. 2 for the construction of the AMDL facility
- Based on the results of this investigation, the no action alternative should be retained for Landfill No. 2
- General Dynamics should initiate the process of obtaining closure for Landfill No. 2

5. STUDY STATUS

The study was completed.

6. STUDY SCHEDULE

The field investigation was conducted on September 20 and 21, 1989.

7. IRPIMS STATUS

The information contained in this report has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Preliminary Assessment/Site Investigation
Remedial Investigation/Feasibility Studies
Quality Assurance Project Plan
Volume III
Author: U.S. Department of Energy
Number: AFP-1048
Submittal: August 1990

1. STUDY OBJECTIVES

The Quality Assurance Project Plan contains the quality assurance/quality control (QA/QC) protocols for the Preliminary Assessment/Site Investigation and Remedial Investigation/Feasibility Studies. The basic quality control program includes procedures and guidelines for sample handling, analysis, laboratory quality control, performance and system audits. The quality assurance program includes procedures and guidelines for QA blank samples, duplicates, personnel training, field methods, measurements, data reduction, equipment calibration, sampling, and decontamination procedures.

2. STUDY ACCOMPLISHMENTS

The Quality Assurance Project Plan establishes the proper QA/QC for the study.

3. DATA/INFORMATION DEVELOPED

No data developed. The Quality Assurance Project Plan presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

Recommendations were not included in the Quality Assurance Project Plan.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in the Quality Assurance Project Plan has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: Preliminary Assessment/Site Investigation
Remedial Investigation/Feasibility Studies
Volume IV: Health and Safety Plan
Author: U.S. Department of Energy
Doc No: AFP-01049
Submitted: August 1990

1. STUDY OBJECTIVES

The purpose of this Health and Safety Plan is to assign UNC site personnel health and safety responsibilities, to prescribe mandatory operating procedures and to establish personnel protective equipment requirements for job, work, or activity, for alternative and contingency work items, for emergency response, and for spill cleanup and abatement. This plan is to be used for all Remedial Investigation/Feasibility Study (RI/FS) operations at Air Force Plant 4 (AFP 4) including but not limited to monitoring well drilling and construction, soil boring and sampling, and groundwater sampling.

2. STUDY ACCOMPLISHMENTS

The Health and Safety Plan establishes the health and safety procedures for the RI/FS.

3. DATA/INFORMATION DEVELOPED

No data developed. This document presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

Recommendations were not included in the Health and Safety Plan.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in the Health and Safety Plan has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies were noted in this report.

Title: **Preliminary Water Quality Monitoring Plan for FY1991**
Author: **Geotech, Inc.**
Doc No: **AFP-01054**
Submitted: **October 1990**

1. STUDY OBJECTIVES

This annual hydrologic monitoring plan provides the recommended schedule for continued groundwater and surface water monitoring in the vicinity of Air Force Plant No. 4 (AFP 4). The objectives of the hydrologic monitoring plan are as follows:

- Maintain the continuity and integrity of the database
- Monitor groundwater chemistry in selected areas
- Establish water quality baselines
- Monitor changes in water quality to evaluate potential contaminant migration
- Monitor the quality of surface water in Meandering Road Creek
- Monitor groundwater level elevations to determine changes in the direction of groundwater flow

2. STUDY ACCOMPLISHMENTS

The report describes water sampling locations and sampling protocol for the 1991 water Quality Sampling program.

3. DATA/INFORMATION DEVELOPED

The Work Plan contains a detailed description of the following:

- Monitoring Scope
  - Boundary Wells
  - Hazardous Waste Site
  - Paluxy Wells
  - Surface Water Quality
  - Proposed Additional Wells
- Groundwater Sampling Equipment
  - Groundwater Sampling Equipment
  - Groundwater Sampling Equipment Decontamination Procedures
  - Sampling Procedures and Protocols
- Waste Management
- Field Quality Assurance and Quality Control
  - Field Quality Assurance
  - Sample Control
  - Document Control
  - Field Quality Control
- Laboratory Analyses
  - Volatile Organic Compound Target List
  - Semi-Volatile Organic Compound Target list
  - Chromate
  - Total Petroleum Hydrocarbons
  - Oil/Grease
- Laboratory Quality Control

- Data Management
- Logistics and Schedule
- Health and Safety
- Deliverables

4. RECOMMENDATIONS

The following monitoring recommendations are the result of an extensive evaluation of previous monitoring activities at AFP 4. On the basis of the evaluation, monitoring wells were placed in the following categories:

- Priority I: The minimum wells recommended for monitoring to satisfy the monitoring plan objectives
- Priority II: Wells that can be used in the future to satisfy monitoring plan objectives
- Priority III: Lower priority wells that maybe monitored in the future only if conditions warrant

The remaining wells were not considered for continued monitoring for various reasons and many have been recommended for abandonment. Abandonment recommendations were also prioritized as follows:

- Priority I: Contaminated wells that pose a serious risk to the Paluxy Aquifer or off-site receptors due to poor well design or construction.
- Priority II: Contaminated wells that are poorly constructed but do not presently pose a significant risk to the Paluxy aquifer or off-site receptors.
- Priority III: Poorly constructed well that are not presently contaminated but could present a significant risk in the future to contaminant migration.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information contain in this work plan has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Stage 2 Site Characterization Report - Flightline Area
Author: Radian Corporation
Doc No: AFP-01055
Submittal: November 1990

1. STUDY OBJECTIVES

The purpose of this study was to determine the degree of impact to the environmental media in the Flightline Area so that a remedial action plan could be designed for implementation. The Flightline Area includes six distinct sites that were identified as potential sources of contaminants in previous IRP studies. The six sites are:

* LF03 - Landfill 3;
* LF04 - Landfill 4;
* LF05 - Landfill 5;
* WP07 - Waste Burial Area;
* FT08 - Fire Department Training Area 1; and
* FT09 - Fire Department Training Area 2.

Previous IRP studies documented impacts to both the soil and groundwater, including trichloroethene (TCE) and chromium, in the Flightline Area. The previous investigations were limited to only that groundwater within the Upper Zone. Multiple sources were thought to be responsible for the contamination. The existing monitoring network was determined to be inadequate to delineate the relative contributions from these other sources. This investigation was designed to address those areas where gaps in the soil and groundwater quality data existed and to provide additional hydrogeologic data for Upper Zone in the Flightline Area.

2. STUDY ACCOMPLISHMENTS

The investigation called for the performance of four major field tasks, including the drilling of soil borings for soil sample collection, the installation of monitor wells in order to provide access to the groundwater in the Upper Zone, a comprehensive soil and groundwater sample effort, and the collection of samples from numerous surface water bodies.

3. DATA/INFORMATION DEVELOPED

The main findings of the investigation with respect to the nature and extent of groundwater contamination were:

1. Concentrations of TCE and vinyl chloride exceed federal primary drinking water standards in Upper Zone monitor wells in the Flightline Area.

2. Multiple sources, including sites LF04, LF05, FT09, and Air force Plant 4, have been postulated for the various organic contaminant plumes which occur in the Flightline Area.

3. Some downgradient migration of the plume apex and a decrease in total TCE concentration may have occurred since the monitor will network was last sampled. Continued monitoring will be necessary to verify this trend.

4. The extreme western edge of the Flightline Area TCE plume is as yet still undefined, but high levels of TCE and other contaminants detected in wells far upgradient of any known source areas strongly supports the existence of a significant upgradient source, possibly Air Force Plant 4.

5. The extreme eastern limit of the TCE contaminant plume in the Upper Zone is also undefined.

6. The vertical extent of contamination in the Flightline Area corresponds to the upper surface of the underlying Goodland/Walnut aquitard. Previous sampling of the two Paluxy Aquifer monitor wells have not revealed any contamination.

7. It is probable that no heavy metal contamination exists in the Upper Zone Aquifer of the Flightline Area, as no concentrations exceeding federal drinking water standards were reported in the dissolved metal analyses.

8. Both TCE and vinyl chloride were found in excess of federal standards in the surface water samples collected.

9. Based upon the similarity between groundwater and surface water TCE concentrations, the tributary to Farmers Branch appears to be a zone of ground-water discharge.

10. A pronounced similarity between surface water and ground-water quality indicators supports the existence of zones of communication between the two water systems.

4. RECOMMENDATIONS

No recommendations were made in this report.

5. STATUS OF STUDY

The findings of this report were used to formulate a remedial action plan. Following a feasibility study in 1988, the remediation plan was submitted and approved in 1991.

6. STUDY SCHEDULE

Stage I of Phase II investigation was performed in 1986. Based on the findings of that study, Stage 2 was designed to addressed the additional assessment and remediation work. Stage 2 investigation was performed in 1990. The report was submitted in November 1990.

7. IRPIMS STATUS

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Groundwater Quality Monitoring Report (Final)
Author: Chem-Nuclear Geotech, Inc.
Doc No: AFP-01057
Submitted: January 1992

1. STUDY OBJECTIVES

The objectives of the water quality monitoring program at AFP 4 were to:

* Provide baseline data on quality of surface water and groundwater in the vicinity of AFP 4
* Monitor changes in water quality over time in order to evaluate potential migration of contaminants and ensure protection of public health and the environment
* Detect threats to water quality as early as possible so that corrective actions can be taken

2. STUDY ACCOMPLISHMENTS

All monitor wells were sampled for volatile organic compounds, additionally selected samples were analyzed for semi-volatile organic compounds, total metals, total chromium, total petroleum hydrocarbons, and/or oil and grease.

3. DATA/INFORMATION DEVELOPED

The study includes the results of the February 1990 to March 1991 water quality monitoring analytical results. Analytical results, monitoring well sampling frequency and analytical parameters have been tabulated. Included in the tables ar the following:

- Definition of analytical parameters
- Summary of Analytical Data
- Summary of Semi-Volatile Data
- Summary of Inorganic Data
- Summary of Petroleum Data
- Summary of Oil/Grease Data
- Sampling Locations Where Volatile Organic Compounds Exceed Maximum Levels
- Comparison of VOC Concentrations from Pumps and Bailers
- Recommended quarterly Water Sampling at AFP 4

Included in the report appendices (appendices listed by same Document Number) are the following:

- Summary of Volatile Organic Compounds in Water Through March 1991 (Volume 2 and 3)
- Semi-volatile Organic Compounds in Water Through March 1991 (Volume 4)
- Inorganics in Water Through March 1991 (Volume 5)
- Oil and Grease in Water through March 1991 (Volume 5)
- Total Petroleum Hydrocarbons in Water Through March 1991 (Volume 5)

Included in the report is a discussion on the comparison of pumps verse bailer sampling results.

4. RECOMMENDATIONS

The monitoring report contains the following recommendations for continued monitoring:

- Collect VOC and semi-VOC samples quarterly from the creek adjacent to the landfill
- Collect VOC and total petroleum hydrocarbon samples quarterly from the Outfall area
- Collect samples from any seeps along the Walnut outcrop that have an oily sheen
- Collect samples from the Window Area and the bedrock channel area for VOCs on a quarterly basis
- Collect samples from Paluxy wells located in the Window Area for VOCs and semi-VOCs
- Collect semi-VOC samples from areas associated with fuel spills
- Removal of submersible pumps

5. STUDY STATUS

Groundwater monitoring continues on a quarterly basis.

6. STUDY SCHEDULE

Groundwater sampling was performed from February 1990 to March 1991. The results were submitted in march 1991.

7. IRPIMS STATUS

The information contained in this report has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Water Quality Data
May 1985 through May 1985
Volume I: Appendices A-H
Author: Hargis & Montgomery
Number: AFP-3001
Submittal: August 1986

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

This report provides the laboratory water quality data collected at U.S. Air Force Plant No. 4 from May 1986 through May 1987. The data is divided be Appendices A through H, specifically include the following:

Appendix A:	Results of Analyses for Common Ion Constituents in Water Samples
Appendix B:	Results of Analyses for Trace Metals in Water Samples
Appendix C:	Results of Analyses for EPA Priority Volatile Organic Compounds in Water Samples collected from Monitor Wells
Appendix D:	Concentration of Base/Neutral Organic Compounds in Water Samples collected from Monitor Wells
Appendix E:	Results of Analyses for EPA Priority Acid Organic Compounds in Water Samples collected from Monitor Wells
Appendix F:	Concentration of Nonpriority and Semiqualified Organic Compounds in Water Samples
Appendix G:	Concentration of Oil/Grease and Fuel Hydrocarbons in Water Samples
Appendix H:	Results of Analyses for EPA Priority Pesticide Components in Water Samples

Title: Water Quality Data
May 1986 through May 1987
Volume I: Appendices A-C
Author: Hargis & Montgomery
Doc No: AFP-03002
Submittal: August 1987

This report contains appendices only. No objectives, procedures or recommendations are a part of this volume.

This document provides the laboratory water quality data collected at U.S. Air Force Plant No. 4 from May 1986 through May 1987. Specifically, the Appendices include the following information:

Appendix A:	Results of Analyses for Common Ion Constituents in Water Samples
Appendix B:	Trace Metals in Water Samples
Appendix C:	Results of Analyses for EPA Priority Volatile Organic Compounds in Water Samples

Title: Water Quality Data
May 1986 through May 1987
Volume II: Appendices D-G
Author: Hargis & Montgomery
Doc No: AFP-3003
Submittal: August 1987

This report contains appendices only. No objectives, procedures or recommendations are a part of this volume.

This document provides the laboratory water quality data collected at U.S. Air Force Plant No. 4 from May 1986 through May 1987. Specifically, Appendices D-G contain the following information:

Appendix D:	Base/Neutral Organic Compounds in Water Samples
Appendix E:	Acid Organic Compounds in Water Samples
Appendix F:	Concentration of Nonpriority and Semiquantified Organic Compounds in Water Samples
Appendix G:	Concentration of Oil/Grease and Fuel Hydrocarbons Compounds in Water Samples

Title: Remedial Investigation/Feasibility Study
Work Plan (Final)
Volume I
Author: Hargis & Associates
Doc No: AFP-3004
Submittal: January 1989

1. STUDY OBJECTIVES

This Final Draft Work Plan outlines the procedures for performing a Remedial Investigation and Feasibility Study (RI/FS) at U.S. Air Force Plant No. 4, Fort Worth, Texas.

The objectives of the RI/FS for Air Force Plant 4 (AFP 4) are to:

* Define the physical characteristics at AFP 4.
* Delineate sources of contamination.
* Characterize the nature, extent, and range of concentrations of specific compounds.
* Define the potential pathways of contaminant migration at AFP 4.
* Determine the receptors of contaminants potentially migrating from AFP 4.
* Evaluate the risks and hazards to the environment and public health resulting from contamination the AFP 4.
* Integrate the FS with RI activities to ensure that all remedial alternatives are developed, screened, and evaluated in a systematic manner.
* Identify appropriate cleanup criteria.
* Provide a quantitative basis for selection of an effective remedial alternative.
* Evaluate alternative remedial actions.
* Develop and evaluate remedial alternatives with respect to technical, environmental, public health, and cost considerations.
* Perform a detailed analysis of remedial alternatives that are technically feasible and provide the necessary protection of public health and the environment in a cost effective manner.
* Determine which remedial alternatives are best suited for potential and existing hazards at AFP 4.
* Prepare a conceptual design for the preferred remedial alternative(s).

2. STUDY ACCOMPLISHMENTS

The Work Plan contains the detailed Scope of Work for the RI and FS.

The Scope of Work for the RI included the following:

* Preliminary Activities
  - Evaluation of new data and modification of RI tasks
  - Evaluation of Tank Inventory and pipelines
  - Updating the Health and Safety Plan
  - Development of a Community Relations Plan
  - Determination of background metals concentration in soil
* Study Area Characterization
  - Remedial Investigations of Area 1 through Area 8
* Treatability Investigations
* Data Management
* Baseline Risk Assessment
  - Contaminant identification

- Exposure assessment
- Toxicity assessment
- Risk characterization

* RI Report Requirements

The Scope of Work for the FS included the following:

* Evaluation of Applicable Technologies and Processes
  - Development of remedial action plan objectives
  - Grouping of major remedial areas
  - Identification, evaluation, screening of remedial technologies and process options
* Remedial Development and Initial Screening
  - Development of preliminary remedial alternatives
  - Initial remedial alternative screening
* Detailed Analysis Alternatives
  - Short and Long term effectiveness
  - Reduction of Toxicity, Mobility, and Volume
  - Implementability and Cost
  - Compliance with ARARs
  - Overall Human Health and Environmental Impact Analysis
  - Regulatory and Community Acceptance
* Comparative Analysis of Alternatives
* Feasibility Study Report Requirements

Additionally, the Work Plan contained the following background material:

* Site Location, Status, and History
* Regional Setting
* Regional Geology
* Local Geology
* Hydrogeology
* Site Background
* Nature and Extent of Contamination
* Initial Evaluation of Pathways and Receptors
* Data Requirements

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

The Draft Final Work Plan does not contain recommendations.

5. STUDY STATUS

The RI/FS is ongoing.

6. IRPIMS STATUS

Information contained in the Draft Work Plan has not been entered into IRPIMS.

7. DISCREPANCIES

No discrepancies noted.

Title: Remedial Investigation/Feasibility Study
Work Plan Volume II: Appendices C-I
Author: Hargis & Associates
Number: AFP-3005
Submittal: January 1989

This report contains appendices only and is a supporting document for the Final Draft Work Plan - Remedial Investigation/Feasibility Study (Document Number AFP-03004). No objectives or recommendations are a part of this volume. This report contains the supporting data for the Final Draft Work Plan of the Remedial Investigation/Feasibility Study. Specifically, the Appendices C-I include:

Appendix C:	Quality Assurance Project Plan
Appendix D:	Health and Safety Plan
Appendix E:	Summary of Basic Data
Appendix F:	Inventory of Underground Tanks
Appendix G:	Summary of Soil Samples and Analyses
Appendix H:	Evaluation of Background Metals and Cyanide in Water Samples
Appendix J:	Monthly Status Report

Appendix C - Quality Assurance Project Plan

Appendix C contains the Quality Assurance Project Plan that was prepared for the Remedial Investigation tasks being conducted at the U.S. Air Force Plant No. 4. The objective of the Quality Assurance Project Plan is to ensure that data resulting from the remedial investigation are of sufficient quantity and adequate supply to support the feasibility study. Quality Control procedures are outlined in this document to ensure that data collected are precise, accurate, complete, and representative. Quality Assurance procedures are outlined in this document to ensure reliability of monitoring and measurement data.

Appendix D - Health and Safety Plan

Appendix D contains the Health and Safety Plan which established the responsibilities, protective measures, safe work practices and emergency procedures so that personnel can safely perform Remedial Investigation/Feasibility Study (RI/FS) work at and in the vicinity of U.S. Air Force Plant 4. All RI/FS personnel working at Air Force Plant 4 was required to read and comply with the Health and Safety Plan. The Health and Safety Plan established safety precaution to ensure that other on-site personnel are not exposed to hazards.

Appendix E - Summary of Basic Data

Appendix E contains monitoring well and soil boring data. Appendix E contains the following data for upper zone and Paluxy monitor wells:

- Water level data for January 1988
- Base of Upper Zone Elevation

Additionally, the upper zone saturated thickness for the upper zone monitor wells are listed.

Soil borings are listed with range and station locations. The base of the upper zone elevation n for each soil boring is also listed.

Appendix F - Inventory of Underground Tanks

Appendix F contains a list of the USTs located at Air Force Plant 4.

Appendix G - Summary of Soil Samples and Analyses

Appendix G contains tabulated summaries of analyses for soil samples collected in Area 1, Area 2, Area 3 and Area 4. Additionally, Appendix G contains a tabulated summary of soil samples and analyses from the following prior field investigations:

- Phase I Investigation of Subsurface Conditions
- Results of Soil and Groundwater Assessment for the Proposed Systems Development Lab
- Draft Interim Report for Ten-Site Investigation
- Installation Restoration Program Phase II, Confirmation/Quantification

Appendix H - Evaluation of Background Metals and Cyanide in Water Samples

Appendix H contains a report completed by Hargis & Associates to determine, by statistics, the background concentration of metals and cyanide in groundwater. The findings of the report were utilized as the preliminary screening method to compare onsite inorganic concentrations detected in groundwater to the estimated background concentrations for inorganic constituents. The report contains detailed information on the statistical approach, upper zone groundwater,and Paluxy aquifer groundwater.

Appendix J - Monthly Status Report

Appendix J contains the Monthly Status Report Format, including specific requirements on budgeting, schedule, and personnel.

Title: Remedial Investigation/Feasibility Study
Work Plan (Final) Volume II: Figures
Author: Hargis & Associates
Doc No: AFP-03006
Submittal: January 1989

This report contains figures only and is a supporting document for the Final Work Plan - Remedial Investigation/Feasibility Study. No objectives, procedures or recommendations are a part of this volume. This report contains the figures for the Final Draft Work Plan Remedial Investigation and Feasibility Study, Air Force Plant No. 4 (Document AFP-03004). Specifically, the following illustrations are included in Volume III:

- Fig.1 - Location of AFP 4, Fort Worth, Texas
- Fig.2 - Location of Potential Disposal and Spill Sites
- Fig.3 - Sampling Locations
- Fig.4 - Surface Topography
- Fig.5 - Elevation Contours, Base Upper Zone
- Fig.6 - Water Level Contours
- Fig.7 - Saturated Thickness Upper Zone
- Fig.8 - Groundwater Flow, Upper Zone
- Fig.9 - Water Level Contours, Paluxy Aquifer
- Fig.10 - Groundwater Flow, Upper Paluxy Aquifer
- Fig.11 - Groundwater Flow, Middle Paluxy Aquifer
- Fig.12a-c - Metals and Cyanide, Upper Zone
- Fig.13a-c - Volatile Organic Compounds, Upper Zone
- Fig.14a-c - Fuel-Related Organic Compounds, Upper Zone
- Fig.15a-c - Semivolatile Organic Compounds, Upper Zone
- Fig.16a-c - Total Volatile Organic Compounds, Upper Zone
- Fig.17a-c - Total Fuel-Related Hydrocarbons, Upper Zone
- Fig.18a-c - Total Semivolatile Organic Compounds, Upper Zone
- Fig.19a-c - Metals, Cyanide, and Organic Compounds, Upper Sand Unit
- Fig.20a-c - Metals, Cyanide, and Organic Compounds, paluxy Aquifers
- Fig.21 - Location of Areas 1 - 4, Upper Zone
- Fig.22 - Location of Area 5, Upper Sand Unit
- Fig.23 - Location of Area 6 and 7, Upper Paluxy Aquifer
- Fig.24 - Location of Area 8, Middle Paluxy Aquifer
- Fig.25 - Location of Remedial Investigation Activities, Area 1
- Fig.26 - Location of Remedial Investigation Activities, Area 2
- Fig.27 - Location of Remedial Investigation Activities, Area 3
- Fig.28 - Location of Remedial Investigation Activities, Area 4
- Fig.29 - Location of Remedial Investigation Activities, Area 5
- Fig.30 - Location of Remedial Investigation Activities, Area 6
- Fig.31 - Location of Remedial Investigation Activities, Area 7
- Fig.32 - Location of Remedial Investigation Activities, Area 8

Title: Water Quality Data
May 1987 through January 1989
Volume II: Appendices B-G
Author: Hargis & Associates
Doc No: AFP-03008
Submitted: April 1989

This report contains appendices only. No objectives, procedures or recommendations are a part of this volume.

Volume II, Appendices B-G contain laboratory analytical data for water samples collected from Air Force Plant No. 4 from May 1987 through January 1989. Specifically Appendices B-G includes:

- Appendix B - Results of Analyses for Base/Neutral Organic Compounds
- Appendix C - Results of Analysis for Acid Organic Compounds
- Appendix D - Results of Analyses for Common Ion Constituents
- Appendix E - Results of Analyses for Trace Metals
- Appendix F - Semiquantified Result of Analyses for Organic Compounds
- Appendix G - Results of Analyses for Oil/Grease and Total Fuel Hydrocarbons

Title: Draft Annual Hydrologic Monitoring Plan
September 1989 through September 1990
Author: Hargis & Associates
Doc No: AFP-03009
Submittal: July 1989

1. STUDY OBJECTIVES

This annual hydrologic monitoring plan provided the schedule for continued sampling of groundwater and surface water in the vicinity of U.S. Air Force Plant No. 4. The objectives of the hydrologic monitoring program are to:

* Provide baseline water quality and water level data for evaluation of effectiveness of remedial measures
* Provide data required to perform preliminary screening of potential remedial alternatives
* Monitor changes in groundwater quality and water levels to evaluate potential migration of contaminants in groundwater
* Monitor the volume and quality of surface water in Meandering Road Creek.

2. STUDY ACCOMPLISHMENTS

The study established sampling points, analytical schedule and sampling frequency. The included appendices of the Annual Hydrologic Monitoring Plan presented the Sampling Quality Control Procedures, Health and Safety Plan, and Index to Sampling Stations.

3. DATA/INFORMATION DEVELOPED

Sampling Quality Control Procedures:
The Sampling Quality Control Procedure describes the field measurement and water sample collection procedures and quality assurance/quality control procedures to be followed at U.S. Air Force plant 4 during monitoring activities.

Health and Safety Plan:
The Health and Safety Plan established the responsibilities, protective measures, safe work practices, and emergency procedures so that Hargis & Associates personnel could safely perform hydrologic monitoring in the vicinity of the General Dynamics facility located in Fort Worth, Texas. This Health and Safety plan supersedes the Health and Safety Plan Submitted with prior hydrologic monitoring plans.

4. RECOMMENDATIONS

No recommendations other than the presentation of the plan were presented.

5. STATUS OF STUDY

The plan was utilized for hydrologic monitoring in 1990.

6. STUDY SCHEDULE

The field investigation was completed by September 1990.

7. IRPIMS STATUS?

Information has not been entered into IRPMIS.

8. DISCREPANCIES

No discrepancies noted.

Title: Draft Annual Hydrologic Monitoring Plan
September 1989 through September 1990
Author: Hargis & Associates
Doc No: AFP-03009
Submittal: July 1989

1. STUDY OBJECTIVES

This annual hydrologic monitoring plan provided the schedule for continued sampling of groundwater and surface water in the vicinity of U.S. Air Force Plant No. 4. The objectives of the hydrologic monitoring program are to:

* Provide baseline water quality and water level data for evaluation of effectiveness of remedial measures
* Provide data required to perform preliminary screening of potential remedial alternatives
* Monitor changes in groundwater quality and water levels to evaluate potential migration of contaminants in groundwater
* Monitor the volume and quality of surface water in Meandering Road Creek.

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The study established sampling points, analytical schedule and sampling frequency. The included appendices of the Annual Hydrologic Monitoring Plan presented the Sampling Quality Control Procedures, Health and Safety Plan, and Index to Sampling Stations.

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Sampling Quality Control Procedures:
The Sampling Quality Control Procedure describes the field measurement and water sample collection procedures and quality assurance/quality control procedures to be followed at U.S. Air Force plant 4 during monitoring activities.

Health and Safety Plan:
The Health and Safety Plan established the responsibilities, protective measures, safe work practices, and emergency procedures so that Hargis & Associates personnel could safely perform hydrologic monitoring in the vicinity of the General Dynamics facility located in Fort Worth, Texas. This Health and Safety plan supersedes the Health and Safety Plan Submitted with prior hydrologic monitoring plans.

4. RECOMMENDATIONS

No recommendations other than the presentation of the plan were presented.

5. STATUS OF STUDY

The plan was utilized for hydrologic monitoring in 1990.

6. STUDY SCHEDULE

The field investigation was completed by September 1990.

7. IRPIMS STATUS

Information has not been entered into IRPMIS.

8. DISCREPANCIES

No discrepancies noted.

Title: Summary of Interim Remedial Investigations
January 1987 to April 1989
Volume I: Text, Tables and Illustrations
Author: Hargis & Associates
Doc No: AFP-03010
Submittal: July 1989

1. STUDY OBJECTIVES

This report summarizes interim remedial investigation activities at U.S. Air Force Plant 4 (AFP 4). Interim remedial investigations have focused on the groundwater conditions in the Paluxy aquifers beneath the west side of AFP 4 and the upper zone and upper Paluxy Formation beneath the east side of AFP 4.

The objectives of the interim remedial investigations were to:

- Further define the geologic and hydrogeologic conditions at AFP 4 and the western portion of CAFB
- Provide additional data to determine the directions of groundwater flow and potential causes of anomalous water levels in the upper Paluxy Formation
- Further delineate the distributions of contaminants in the upper zone and Paluxy Formation groundwater
- Determine the potential for groundwater to migrate from the upper zone into the upper Paluxy Formation

2. STUDY ACCOMPLISHMENTS

East Side Investigation:

Seventy-seven soil borings were completed and 31 upper zone monitor wells were installed on the east side of AFP 4 prior to the completion of this investigation. The following is a detailed summary of upper zone subsurface exploration activities:

- Soil borings RSB-1 to RSB-15 and upper zone monitor wells HM-87 to HM-97 were installed in the East Parking Lot and flight line in October 1987
- Soil borings RSB-16 to RSB-33 and upper zone monitor wells HM-98, HM-99, HM-110, HM-111, HM-112 and HM-113 were installed in the western flight line area in March 1988
- Soil borings RSB-34 to RSB-66 were installed in the eastern flight line area in December 1988
- Upper zone monitor wells HM-114 to HM-127 were installed in the eastern flight line area in January and February 1989

Nine upper sand unit and 12 upper Paluxy formation monitor wells were installed and four existing Paluxy formation monitor wells were reconstructed since June 1987. The following is a detailed summary of Paluxy Formation subsurface exploration activities:

- Paluxy monitor well P-8U was reconstructed in July 1987. The new Paluxy wells resulting from activity are P-8US and P-8UN.
- Paluxy monitor wells P-11US and P-13US were constructed in September 1987.
- Paluxy monitor wells P-15US, P-15U, P-16US, and P-17US were constructed in October 1987.
- Paluxy monitor wells P-5U, P-9U and P-12U were abandoned, new Paluxy wells installed within the abandoned boreholes were P-5US, P-9US and P-12US. Additionally Paluxy monitor wells P-5UN and P-9UN were constructed.

- Paluxy monitor wells P-12UN, P-18US, and P-19US were constructed in March 1988.

Results of the east side interim remedial investigations comprise lithologic, geophysical, hydrogeologic, and water quality data collected during field operations conducted on the east side of AFP 4.

West Side Investigation:

During the period of January 1987 to April 1988, three exploratory soil borings and seven Paluxy monitor wells were installed on the west side of AFP 4. The following is a summary of Paluxy Formation subsurface exploration activities:

- Middle Paluxy monitor well P-22M was constructed in October 1987
- Three pairs of Paluxy monitor wells, each with a accompanying exploratory boring, were installed in three separate locations. Prior to the installation of the monitor wells, downhole geophysics were utilized to define separate hydrologic units in the exploratory soil borings.
- Monitor wells P-24U and P-24M were installed north of Landfill No.3
- Monitor wells P-25U and P-25M were installed downgradient of Landfill No.1 and No.3
- Monitor wells P-26U and P-26M were installed on the south side of AFP 4 near the former railroad gate
- Monitor Well P-1 was abandoned

Results of the west side interim remedial investigations comprise lithologic, geophysical, hydrogeologic, and water quality data collected during field operations conducted on the east side of AFP 4.

3. STUDY DATA/INFORMATION

Based on analysis of geologic, hydrologic, and water quality data obtained during the interim remedial investigations at AFP 4, the following are concluded:

East Side:

- Basal sand and gravel deposits in the upper zone are potential pathways for contaminant migration
- In general, groundwater in the upper zone the east side of the Main Assembly Building flows to the east
- Chromium, trans-1,2-DCE, and TCE are the most commonly detected contaminants in the upper zone groundwater on the east side of AFP 4
- The distribution of chromium, trans-1,2-DCE, and TCE in the upper zone is influenced by the direction of groundwater flow and the erosional channel in the Walnut Formation
- The extent of total chromium contamination in the upper zone has been defined in the area of Grants Lane. The extent of trans-1,2-DCE and TCE has not been defined on the area east of Grants Lane.
- The source of contaminants detected in the upper zone groundwater has not been determined but appears to originate from the southern portion of the Assembly Building and Parts Plant. Former Chrome Pit No.1 and 2 and the wastewater collection basins maybe the source of the contaminants
- Contaminants detected in the monitor wells constructed on CAFB by Radian originate from a different source than the contaminants migrating from AFP 4.
- The Walnut Formation is thin and maybe absent below the East Parking Lot along Grants Lane. The potential exists for hydraulic communication between the upper zone and the uppermost Paluxy Formation in this area

- The primary source of recharge to the Paluxy upper sand unit appears to be vertical leakage from the overlying upper zone in the vicinity of Grants Lane where the Walnut Formation is thin or absent.
- Trans-1,2-DCE and TCE were the only contaminants detected in water samples collected from the upper Paluxy unit
- The upper Paluxy Aquifer is unconfined
- Lake Worth is the principal source of recharge in the upper paluxy aquifer in the vicinity of AFP 4.
- The extent of TCE contamination in the upper Paluxy aquifer on the east side of AFP4 has been delineated

West Side:

- The Walnut Formation is an aquitard between the upper zone and the upper Paluxy aquifer
- The potential exists for hydraulic communication between surface water in Meandering Creek and the upper Paluxy aquifer
- The Paluxy upper sand unit is absent on the west side of AFP 4.
- The upper Paluxy aquifer is confined on the west side of AFP 4.
- Lake Worth is the principal source of recharge to the upper Paluxy aquifer
- The concentration of contaminants detected in the upper paluxy aquifer are generally less than those detected in the upper zone. TCE, DCE and vinyl chloride are the most commonly detected VOCs in the upper Paluxy aquifer groundwater
- The extent of the upper Paluxy aquifer contamination is approximately defined
- Contaminants detected in water samples collected from the upper Paluxy groundwater aquifer on the west side of AFP 4 appear to have migrated from the overlying upper zone
- The direction of groundwater flow in the middle Paluxy aquifer is to the southeast
- The concentrations of contaminants detected in the middle Paluxy aquifer are generally less than those detected in the upper Paluxy zone. Trans-1,2-DCE was the most commonly detected VOC in middle Paluxy aquifer water samples
- The approximate extent of middle Paluxy aquifer contamination has been defined
- The source of contaminants in the middle Paluxy aquifer appears to be vertical leakage from the overlying upper Paluxy aquifer

4. RECOMMENDATIONS

Results in the interim remedial investigations indicate that additional data are required to evaluate remedial alternatives at AFP 4.

East Side

Based on the results of the interim remedial investigations conducted during this study, the following additional investigations are recommended for the east side of AFP 4:

- Conduct 10 aquifer tests in upper zone monitor wells to collect data required to estimate upper zone hydrologic parameters
- Install and sample 12 upper zone monitor wells in the southern portion, east side, and east of Grant's Lane to determine the extent of contamination in the upper zone groundwater
- Sample all CAFB upper zone monitor wells constructed by Radian in the area southeast of the runways once for VOCs concurrently with all other monitor wells
- Conduct five aquifer tests in the upper sand unit monitor wells to collect the data required to estimate upper sand unit hydrologic parameters
- Drill and complete geophysical logs on 12 exploratory soil borings to the base of the upper Paluxy Formation

- Conduct three aquifer tests in the middle Paluxy aquifer wells to collect data required to estimate the middle Paluxy aquifer hydrologic parameters
- Construct and sample nine upper sand unit monitor wells to define the extent of contamination in the upper sand unit

West Side

Based on the results of the interim remedial investigations conducted during this study, the following additional investigations are recommended for the west side of AFP 4:

- Drill nine soil borings spaced 200 feet apart in the Meandering Road Creek bed to delineate areas where the Walnut Formation is thin or absent
- Drill and geophysically log three exploratory soil borings to the base of the Paluxy Formation
- Conduct aquifer tests in the upper and middle Paluxy aquifer to collect data to approximate Paluxy aquifer hydrologic parameters

5. STUDY STATUS

The study was conducted from January 1987 to April 1989.

6. STUDY SCHEDULE

This investigation has been completed.

7. IRPMIS STATUS

Information presented in this report has not been entered into the IRPMIS.

8. DISCREPANCY

This investigation concludes that the extent of TCE contamination has been defined. However, based on review of all data, it appears that TCE contamination exists in the deepest of the wells installed and therefore the vertical extent of the contamination needs to be further defined.

Title: Summary of Interim Remedial Investigations
January 1987 to April 1989
Volume II: Appendices A-F
Author: Hargis & Associates
Doc No: AFP-3011
Submittal: July 1989

This report contains appendices and is a support document only. No objectives, procedures or recommendations are a part of this volume.

This report contains the subsurface data for the Summary of Interim Remedial Investigations, January 1987 to April 1989, Air Force Plant No. 4 (Document Number AFP-03010). Specifically, the Appendices A-F include:

Appendix A:	Lithologic Logs for Soil Borings
Appendix B:	Lithologic Logs for Upper Zone Monitor Wells
Appendix C:	Seismic Study, General Dynamics, Fort Worth Division, Window Area
Appendix D:	On-Site Analysis of Water from Boreholes Drilled in Carswell Air Force Base, Fort Worth, Texas
Appendix E:	Lithologic Logs for Paluxy Monitor Wells
Appendix F:	Monitor Well Construction Diagrams

Appendix A - Lithologic Logs for Soil Borings

Appendix A contains the lithologic logs for soil borings RSB-1 through RSB-67, and P-24EB through P-26EB.

Appendix B - Lithologic Logs for Upper Zone Monitor Wells

Appendix B contains the lithologic logs for upper zone monitor wells HM-87 through HM-127.

Appendix C - Seismic Study, Window Area

Hargis & Associates subcontracted the seismic study on the Window Area to Dr. H.C. Clark. Appendix C contains a copy of the subcontractor, report . The data is summarized in the Summary Interim Remediation report.

Appendix D - GC Analysis Results

Appendix D contains the laboratory analytical reports for on-site water sample analysis. The analysis consisted of automated headspace gas chromatography performed by Microseeps Limited. The report is a copy of Microseeps Ltd. final report. Included in the report is a description of QA/QC procedures, sample collection and preparation, analytical methods summary, standards and calibration summary.

Appendix E - Lithologic Logs for Paluxy Monitor Wells

Appendix E contains the lithologic logs for Paluxy monitor wells P-5UN, P-8UN, P-9UN, P-11Us, P-12UN, P-13US, P-15U, P-15US through P-19US, P-22M, P-24M, P-24U, P-25M, P-25U, P-26M, and P-26U.

Appendix F - Monitor Well Construction Diagrams

Appendix F contains schematic monitoring well construction diagrams of a typical upper zone monitor well and the Paluxy monitor wells listed in Appendix E.

Title: Summary of Interim Remedial Investigations
January 1987 to April 1989
Volume III: Appendices G-L
Author: Hargis & Associates
Doc No: AFP-03012
Submittal: July 1989

This report contains appendices and is a support document only. No objectives, procedures or recommendations are a part of this volume.

This report contains the subsurface data for the Summary of Interim Remedial Investigations, January 1987 to April 1989, Air Force Plant No. 4. Specifically, the Appendices G-L include:

Appendix G:	Results of Analyses for EPA Priority Volatile Organic Compounds
Appendix H:	Results of Analyses for Base/Neutral Organic Compounds
Appendix I:	Results of Analyses for Acid Organic Compounds
Appendix J:	Results of Analyses for Trace Metals
Appendix K:	Results of Analyses for Oil/Grease and Total Fuel Hydrocarbons
Appendix L:	Results of Analyses for Common Ion Constituents

Title: Annual Hydrologic Monitor Plan
Author: Hargis & Associates
Doc No: AFP-03013
Submittal: January 1989

1. STUDY OBJECTIVES

This annual hydrologic monitoring plan provides the recommended schedule for continued groundwater and surface water monitoring in the vicinity of Plant No. 4. The plan includes recommendations for monitoring groundwater quality from on-site monitor wells, off-site monitor wells constructed by the U.S. Environmental Protection Agency (EPA) and municipal-drinking water wells. The plan also includes recommendations for sampling selected surface water sites

Water level and water quality data have been monitoring plan is primarily designed collected since 1982. The proposed monitoring plan is designed to maintain the continuity and integrity of the existing water quality and water level data base. The data base will be used in evaluating and formulating remedial action plans and will aid in monitoring remedial actions. Periodic monitoring is necessary to provide data before, during, and after remedial actions to assess effectiveness. Due to changing hydrogeologic conditions and potential remedial actions, the monitoring plan should be modified as necessary throughout the year to satisfy changing monitoring requirements.

The objectives of the hydrogeologic monitoring plan are as follows:

* Maintain the continuity and integrity of the database.
* Monitor groundwater chemistry in selected areas.
* Establish water quality baselines for newly constructed wells.
* Monitor changes in water quality to evaluate potential contaminant migration.
* Monitor the quality of surface water in Meandering Road Creek.
* Monitor groundwater level elevations to determine changes in the direction of groundwater flow.
* Delineate areas where groundwater level fluctuations exceed established norms of seasonal variability.

2. STUDY ACCOMPLISHMENTS

Groundwater samples from new wells are sampled for full priority pollutant scans and common ion constituents at least once. Baseline water quality is established by analyzing for detected priority pollutants two to four additional times. The full scan and initial baseline water quality data are evaluated to determine the sampling schedule. Analytical methodologies and sampling frequencies are selected based on the criteria of:

1) the chemicals of interest at specific wells;
2) well location in relation to potential source areas, and;
3) reductions in the scope of analytical work to specific target defensible chemicals or "fingerprints."

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

As a result of the U.S. Air Force IRP program, seven sites at the Plant have been formally recommended as requiring no further action. These sites are Landfill 2, Landfill 4, FDTA No. 3, Former Fuel Storage Sites, Solvent Lines, NARF Area, and FDTA No. 4. Recommended routine water quality monitoring in the vicinity of these seven sites has been reduced in both scope and frequency. Approximately one-half of the monitor wells which were installed to monitor the seven sites have been deleted from the proposed water quality monitoring plan. The remaining wells are sufficient to monitor these sites on a routine annual basis. All wells will be used for monthly water level measurements.

5. STATUS OF STUDY

The proposed plan was used as a guide for monitoring throughout 1989.

6. STUDY SCHEDULE

The study was completed by 1990.

7. IRPIMS STATUS

The information included in this report has not been entered in IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Water Sampling Manual (Preliminary Draft)
Author: Hargis & Associates
Doc No: AFP-03014
Submittal: July 1989

1. STUDY OBJECTIVES

The purpose of this manual is to establish methods and procedures for the sampling of groundwater wells and surface sampling water sites, including well site procedures, health and safety considerations, and contingency plans. The scope of this document is limited to the proposed monitoring activities described in the Annual Hydrologic Monitoring Plan prepared for AFP4 (Document Number AFP-03013).

The objectives of the hydrologic sampling program are to:

- Provide the hydrologic data required to determine the need for alternative remedial measures
- Maintain the continuity and integrity of the water quality and water level data base
- Determine baseline water quality conditions for new monitor wells
- Monitor water quality in selected areas
- Monitor changes in water quality that may indicate chemical constituent migration
- Monitor changes in water quality in areas potentially affected by remedial activities
- Monitor groundwater elevations to determine changes in directions of groundwater flow
- Determine effects of industrial operations on hydrologic conditions
- Monitor the volume and quality of surface water in Meandering Road Creek

2. STUDY ACCOMPLISHMENTS

This sampling manual has been prepared for the water quality monitoring program for the AFP 4. The purpose of this manual is to establish methods and procedures for the sampling of groundwater and surface water.

This manual covers the following:

- Site description and scope of work summary for monitoring activities
- Objectives of sampling program
- Methods of measurement , sample collection procedures, required equipment, and contingency plans for field measurements, sample collection and custody documentation
- Specific sampling site procedures
- Health and Safety considerations, including safety procedures, requirements for levels of protection at each well site, and emergency response plans
- Reporting requirements for data obtained during monitoring activities

The manual contains specific information concerning the aforementioned information

3. DATA/INFORMATION DEVELOPED

No information or data was included in the Manual.

4. RECOMMENDATIONS

Recommendations were not included in this Manual.

5. PROJECT STATUS

This document supports ongoing sampling activities.

6. STUDY SCHEDULE

The monitoring program is ongoing.

7. IRPIMS STATUS

The information included in the Manual has not been entered into IRPIMS

8. DISCREPANCIES

No discrepancies noted.

Title: Collection and Analyses of Soil Samples
Author: Versar, Inc.
Doc No: AFP-03015
Submittal: January 1990

1. STUDY OBJECTIVES

The objective of the subsurface investigation was to determine the horizontal and vertical extent of soils contamination in the Chrome Pit Area and surrounding the Chrome Pit No. 3 Excavation.

2. STUDY ACCOMPLISHMENTS

Eleven soil borings were completed in the proximity of the Chrome Pit No. 3. The soil borings were advanced to approximately 10 feet bls utilizing a 3-1/4 inch inside diameter hollow stem auger. Soil samples were collected continuously utilizing 4 feet long split spoon samplers. A composite soil sample from the split spoon samplers for each soil boring was submitted for laboratory analysis. The soil samples were analyzed for the following parameters:

- Volatiles (EPA Method 8240)
- Total Extractable Halogens (EPA Method SW-846)
- CLP Metals (including Arsenic)

3. DATA/INFORMATION DEVELOPED

None of the samples contained high concentrations of toxic organic or inorganics. One sample contained 72.5 parts per million of EOX indicating that a halogenated compound was present but at a low level. The report contains soil boring logs, raw analytical data, quality assurance results, and field methods that were followed during the subsurface investigation.

4. RECOMMENDATIONS

No recommendations were included in this report.

5. STUDY STATUS

No information available regarding any additional work related to this study.

6. STUDY SCHEDULE

The study was conducted during December 1989. The report was submitted in January 1990.

7. IRPIMS STATUS

Information contained in this report has not been entered into IRPIMS.

Title: Preliminary Assessment/Site Investigation
Remedial Investigation/Feasibility Studies
Volume II: Final Analysis and Sampling Plan
Author: U.S. Department of Energy
Doc No: AFP-03018
Submitted: August 1990

1. STUDY OBJECTIVES

The purpose of this document is to outline a plan for the field sampling and laboratory analysis to be performed in support of Remedial Investigation/Feasibility Studies (RI/FS) at Air Force Plant No. 4 (AFP 4) located near Fort Worth, Texas. Included in this plan are activities to be performed as Preliminary Assessment/Site Inspection (PA/SI). This sampling and analysis plan is intended to be a guide that incorporates specific rationale and objectives for each sampling and analysis activity, sampling protocols and procedures, analytical protocols and procedures, data and document management, and data evaluation and interpretation. Also included are logistics and schedule for the RI/FS.

The document describes in detail the field investigation activities in areas at AFP 4, known or suspected to contain hazardous waste contamination, that require additional information on the type(s) and extent of contaminants that may pose a threat to human health or the environment. These sites are identified in the Work Plan Volume I (Document Number 3019) that accompanies this plan. This plan addressed the sampling objectives, designs and procedures for each area. Figures are included that show the proposed sampling locations.

Results of the field investigation outlined in this document will be used in the evaluation of:

- the presence or absence and relative concentrations of reported or suspected contaminants at the waste sites
- the vertical and lateral extent of contamination
- the potential pathways for the migration of contaminant within the environment

Based on these results, remedial action alternatives can be evaluated and public health assessments and feasibility studies can be completed.

2. STUDY ACCOMPLISHMENTS

The Work plan outlines a plan for the field sampling and laboratory analysis to be performed in support of Remedial Investigation/Feasibility Studies (RI/FS) at Air Force Plant No. 4 (AFP 4) located near Fort Worth, Texas.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

Recommendations were not included in the Work Plan.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in the Work Plan has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: **Preliminary Assessment/Site Investigation**
Remedial Investigation/Feasibility Studies
Volume I: Work Plan
Author: **U.S. Department of Energy**
Doc No: **AFP-03019**
Submitted: **August 1990**

1. STUDY OBJECTIVES

This work plan outlines the activities designed to bring previously identified waste disposal and spill sites at U.S. Air Force Plant No. 4 (AFP 4), Fort Worth, Texas, into compliance with environmental laws and regulations promulgated by the U.S. Government and the State of Texas. This work was performed in support of the Aeronautic Systems Division of U.S> Air Force Systems Command. The locations identified during the Air Force Installation Restoration Program (IRP) are as follows:

- Landfill No. 1 (Site 1)
- Landfill No. 2 (Site 2)
- Landfill No. 3 (Site 3)
- Landfill No. 4 (Site 4)
- Fire Department Training Area No. 2 (Site 5)
- Fire Department Training Area No. 3 (Site 6)
- Fire Department Training Area No. 4 (Site 7)
- Fire Department Training Area No. 5 (Site 8)
- Fire Department Training Area No. 6 (Site 9)
- Chrome Pit No. 1 (Site 10)
- Chrome Pit No. 2 (Site 11)
- Chrome Pit No. 3 (Site 12)
- Die Yard Chemical Pits (Site 13)
- Fuel Saturation Area No.1 (Site 14)
- Fuel Saturation Area No.2 (Site 15)
- Fuel Saturation Area No.3 (Site 16)
- Former Fuel Storage Site (Site 17)
- Solvent Lines (Site 18)
- Nuclear Aerospace Research Facility (Site 19)
- Waste Water Collection Basins (Site 20)
- Jet Engine Test Stand (Site 21)

In addition to the above sites, the following study areas have been added as a result of a review of previous data and records and from on-site observations:

- Assembly Building/Parts Plant Perimeter
- East Parking Lot/Flight Line
- Underground Storage Tanks 19, 20, 24A, 24B, 25A, and 30 (removed)

Following an extensive review of data generated during previous investigations, this Work Plan proposes the following to ensure that there is no risk to human health and to ensure compliance with federal and state laws:

- Lateral and vertical limits of contamination at each site be determined
- "Pathway" or mechanisms through which contamination might effect humans or the natural environment be identified
- Assessments of risk or harm to health, safety, public welfare, and the environment form current conditions at AFP 4 be prepared

- If warranted by the conditions at AFP 4, a range of alternatives to reduce or eliminate the possible effects of contamination on humans or the natural environment be developed, screened, or evaluated

2. STUDY ACCOMPLISHMENTS

The Work Plan describes former disposal and spill sites that will be investigated during the RI/FS and PA/SI at Air Force Plant No. 4 (AFP 4) located near Fort Worth, Texas.

3. DATA/INFORMATION DEVELOPED

Volume I of the Work Plan contains the following information:

- Site Background including History and Previous Investigations
- Environmental Setting, Physiography, Meteorology
- Geologic Setting
- Hydrologic Setting
- Surface Water
- Conceptual Site Model and Sources of Contaminants
- Evaluation of Contaminant Pathways
- Objectives and Rationale for the Preliminary Assessment/Site Inspection (PA/SI)
- Objectives and Rationale for Remedial Investigation Studies at the aforementioned disposal or spill sites
- PA/SI and RI/FS Work Task Breakdown
- Proposed Schedule

Included in Volume I appendices are the Community Relations Plan and the EPA Region I and Texas Water Commission Preliminary ARARS.

4. RECOMMENDATIONS

Recommendations were not included in the Volume I of the Work Plan.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been competed.

7. IRPIMS STATUS

The information included in the Work Plan has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: IRP Coordination Letter
Author: Various USAF Personnel
Doc No: AFP-03020
Submitted: April 1984

1. STUDY OBJECTIVES

No objectives presented.

2. STUDY ACCOMPLISHMENTS

This document presents various letters concerning the investigations as supporting documentation.

3. STUDY DATA/INFORMATION

The IRP coordination letter contains various letters from USAF personnel endorsing the combination of CAFB and AFP 4 IRP Phase II . Included in the letter is a IRP schedule.

4. RECOMMENDATIONS

USAF personnel recommended to combine IRP Phase II work for CAFB and AFP 4.

5. STUDY STATUS

This document does not cover an individual study.

6. STUDY SCHEDULE

This document does not cover an individual study.

7. IRPIMS STATUS

Information contained in these letters has not been entered into the IRPIMS.

8. DISCREPANCIES

Not applicable

Title: Investigation of Disposal/Cleanup Activities, Waste Disposal Project West Parking Lot
Author: U.S. EPA
Doc No: AFP-07001
Submittal: December 1983

1. STUDY OBJECTIVES

In late October 1983, based on information received by EPA Headquarters, the NEIC was directed to initiate a criminal investigation into the certain allegations regarding the waste disposal and cleanup practices at Plant No. 4. Specifically, the allegation was that hazardous waste materials removed from the west parking lot excavation had not been completely removed nor disposed of properly.

To determine the validity of this allegation, discussions were initiated on November 2 with EPA-Region VI and Plant No. 4 officials. On November 3 additional information was related to a Region VI staff member by the excavation contractor (Chemical Waste Management, Inc. (CWMI)) employee who was the project officer during the excavation and cleanup activity for the west parking lot. Essentially the new information indicated that significant areas of contamination, including partially exposed drums in one excavation wall, had not been removed and that to preclude the detection of these areas (the contaminated areas were reported to be clearly visible in the excavation walls) a deliberate attempt was made to cover up/or disguise the contaminated areas from EPA officials.

Based on these circumstances, additional interviews were held with key GD and USAF officials directly involved with the west parking lot project. In addition, NEIC reviewed extensive Regional files on Plant No. 4 in order to: a) become familiar with the technical information on which the area to be excavated was based; b) determine the relationship, if any, of the disposal and cleanup activities to the allegations raised; and c) became familiar with the overall contaminated site identification and remedial measures being employed or proposed at Plant No. 4.

2. STUDY ACCOMPLISHMENTS

The major findings of the investigation were:

1. CWMI was the successful bidder of the three contractors who bid the project. On July 1, 1983, they were awarded a $1,227,601.30 contract to remove an estimated 10,700 cubic yards of solid materials, as well as any associated liquids, and to install a collection system within the excavated area. The excavating commenced on July 8 and was completed about August 1. GD and USAF officials who visited the site routinely recalled seeing a few deteriorated and punctured drums, parts of drums, and other debris (e.g., scrap lumber) but could not recall any drums being imbedded in the south wall or any wall when the excavation was completed. Photographs taken of the excavation show discolored areas and what appears to be debris in the walls but no drums are visible. Some individuals related that a GD official suggested fly ash be sprayed on the barrels and discolored areas to disguise or make them less noticeable.

2. All solid material was designated for the CWMI facility at Carlyss, La. (EPA ID No. LAD 000777201). Liquids pumped fran the site were originally designated for deep well disposal at CWMI's Corpus Christi, Texas site. However, because of objections raised by a State senator for the Corpus Christi area, CWMI decided to send all liquids to its Port Arthur, Texas facility (EPA ID No. IXD 000838896). CWMI subcontracted the transportation of the solids and liquids to Sprint Waste Disposal Co. Inc. (EPA ID No. I0 980624274) who subcontracted with five other transporters for the liquid waste disposal, all of which have EPA ID numbers.

A review of the manifest files showed that 723 loads of solids had been removed and transported to the CWMI facility at Carlyss, Louisiana. Selected manifests (about 20) from the 723 on file showed that a copy of the signed manifest had been returned by the disposal facility. Two manifests (Louisiana and Texas) were required for each shipment. There is a discrepancy on the load quantities noted on the manifests. One Texas manifest indicates a unit measure of cubic yards/truck whereas the Louisiana manifest for the same shipment shows the quantity as tons. A telephone conversation with Majors Madrid and Lussier indicated the volume of yd^3 per truck is used to calculate the total solids removed, and that 1 yd3 is considered to be approximately 1 ton.

Fifty-seven tank loads of liquid wastes were removed from the site for a total of approximately 180,000 gallons. A review of the files indicated a signed copy of the manifest had been returned to GD by the disposal facility (i.e., CWMI, Port Arthur, Texas). Some minor discrepancies were noted on these manifests. For example, the Port Arthur facility has several TDWR permit numbers W160 covers deep well operations; 39102-2 covers a landfill operation. These two numbers plus the Number 39102-1 were intermixed on the manifests. The manifests reviewed at GD indicated that all waste loads leaving the west parking lot site arrived at their designated disposal facility. NEIC, however, did not conduct inspections at the disposal facilities to determine the method of disposal of the wastes after they were received.

3. Soil samples were collected from the walls when the excavation was considered complete to determine if any contamination remained. A series of grab samples were collected by the project officer from selected areas of each wall and then were composited into one sample for each wall. These samples were sent to Allied Analytic and Research laboratories (Allied), Dallas, Texas for selected organic analysis and EP toxicity (Appendix B). (Note: Allied is a subsidiary of CWMI but was operating and does operate under separate contract to GD for analytical work). Composite soil samples were collected from all walls when the excavation was completed and analyzed for selected organics and EP toxicity. The north wall sample did not pass the EP toxicity test and was resampled, according to an AEPRO official, after more material was removed. This sample passed the EP toxicity test but showed a 20-fold increase in TCE (27,992 ug/L versus 1,437 ug/l). A third soil sample was apparently collected but only the EP toxicity test was performed, which it passed. The first sampling of the walls we observed by representatives of GD and Allied. The analytical results for this sampling and other sampling performed during the excavation were not provided to these CWMI officials.

4. When the excavation was considered complete, members of the Technical Review Committee were requested to inspect the site and attend a meeting regarding site closure (i.e., placement of the collection system, backfill, and blacktop). Representatives from EPA-Region VI, TAR, GD and USAF were present for the inspection tour and a meeting. Approval to close the site was subsequently granted by TAR officials.

3. DATA/INFORMATION DEVELOPED

The NEIC concludes that there is no merit to the allegations. Specifically:

1. In regard to the extent of the cleanup activity for the west parking lot project, discussions with GD, AF and TAR officials did not substantiate the allegations. It was determined that shipment of these materials (drums) with the excavated soil would not be considered a violation of Texas hazardous waste regulations. With regards to any failure to completely remove these materials, given the prior use of the area before the parking lot this was not considered a problem and as mentioned above, any contamination left within the walls would be controlled through the operation of the parking lot collection system. With regards to efforts to disguise any remaining materials, GD officials flatly denied that anyone had been directed to spray the walls of the excavation with fly ash to cover up areas of contamination, drums or for any other reason. Given the technical basis for the excavation

and the collection system installed, any contamination in the area surrounding the excavated area should, if the system is operated as recommended, be controlled. Criteria, however, needs to be established (i,e., contaminant levels in the collection system) that trigger pumping the system.

2. In regard to the disposal of waste solids and liquids no indication of illegal disposal activity was found. The generator, General Dynamics, had 723 manifests for solid loads and 57 manifests for liquid loads leaving the site. Although there are some discrepancies in the information contained on the manifests (e.g., designation of truck volumes are different between Texas and Louisiana; DOT proper shipping names; and State ID numbers for disposal facilities), the generator had received signed copies of the manifests from the respective disposal facilities indicating that all waste loads had been received. NEIC did not conduct an inspection st either facility to cross check the manifest and determine the disposition of the waste after it was received.

3. It is unclear what criteria GD used in determining if the excavation had gone far enough. Composite soil samples were collected from all walls when the excavation was completed and analyzed for selected organics and EP toxicity. The north wall sample did not pass the EP toxicity test and was resampled, according to an AEPRO after more material was removed. This sample passed the EP toxicity test but showed a 20-fold increase in TCE (27,992 ug/L versus 1,437 ug/l). A third soil sample was apparently collected but only the EP toxicity test was performed, which it passed. GD officials indicated they would attempt to clarify this matter and provide the information to AEPRO officials.

4. RECOMMENDATIONS

The following recommendations were made by the NEIC:

1. A comprehensive plan of action outlining the entire groundwater/subsurface pollution investigation/remedial needs at Plant No. 4 is required so that the remedial objectives performance standards (e.g., "how clean is clean"?) and verification and monitoring procedures are understood by those with the responsibility for reviewing USAF/GD activities.

2. Procedures for monitoring the 31 Upper Zone wells, four Paluxy wells, the French Drain, and the parking lot collection system are not well documented. Consistent well purging and sampling procedures are especially important for volatile organic compounds. The use of inconsistent methods jeopardizes the integrity of samples collected for these analysis. Specific procedures need to be established for the Plant No. 4 monitoring specifying frequencies, parameters, etc.

3. Further investigation of the four Paluxy wells on Plant No. 4 is required. me well construction features preclude isolating zones within the Paluxy from contamination moving between the zones or because of the dilution effects preclude determining if Paluxy wells other than P-4 show contamination.

5. STATUS OF STUDY

Information not available regarding any actions toward the recommended changes.

6. STUDY SCHEDULE

Investigation conducted during the latter part of 1983, report submitted in December 1983.

7. IRPIMS STATUS?

No.

8. DISCREPANCIES

No discrepancies noted.

Title: Results of Chemical Analysis of Liquid Samples Various Sites
Author: Corps of Engineers, Southwestern Division Laboratory
Number: AFP-X01
Submitted: January 1993

1. STUDY OBJECTIVES

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation only.

2. STUDY ACCOMPLISHMENTS

Samples were analyzed and this document presents the results.

3. STUDY DATA/INFORMATION

This letter contains the laboratory analytical data as submitted by Southwestern Division Laboratory, Corp of Engineers. The analytical results are for 14 water samples. Twelve of the water samples were collected from six monitor wells (2 apiece). The monitor wells were sampled on two consecutive days. The following monitor wells were sampled HM-70, HM-87, HM-88, HM-89, F-218, and F-219. Additionally, a trip blank, was submitted for each day of sampling were submitted for chemical analysis. The samples were analyzed for volatile organic compounds utilizing EPA Method 8240.

4. RECOMMENDATIONS

No recommendations are presented in this document.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Quarterly Monitoring Program
Quarterly Letter Report
Author: Jacobs Engineering Group, Inc.
Doc No: AFP-X4
Submitted: June 1992

1. STUDY OBJECTIVES

The objectives of quarterly sampling at AFP4 are to:

- Monitor changes in groundwater quality over time in the Upper Zone and Paluxy Aquifers
- Monitor and map contaminant plumes
- Assess the potential for movement of plumes across Air Force facility boundaries
- Monitor changes in groundwater levels
- Check for monitor free product thickness in wells where it occurs
- Monitor off-site water quality by collecting groundwater and surface water samples from municipal water supply wells, streams, and other locations
- Try to detect possible contaminants entering surface water seeps from the Upper Zone

2. STUDY ACCOMPLISHMENTS

The report contains the sampling results from the third quarter sampling round completed during April 20 and April 30, 1991 at AFP4.

3. STUDY DATA/INFORMATION

The report contains the laboratory analytical results for the third sampling round completed during April 20 through 30, 1991. Included in this report is the following information:

- Semi-VOC, Oil/Grease and TPH Results
- Metals Results
- Volatile Organic compound Results

The following information is included in tabulated form:

- Summary of Third Quarter Field Parameters
- Third quarter analytical Suite
- Preliminary analytical results
- Comparison of analytical results form the first three quarters
- Proposed sampling locations for the fourth Quarter

Semi-VOCs were not detected in any of the groundwater samples analyzed. Of all metals analyzed, only barium was detected; however, the barium concentration was below MCLs. VOCs were detected in the Middle Paluxy and Upper Paluxy Wells , Upper Zone Wells, and surface water sampling locations.

4. RECOMMENDATIONS

The following recommendations were included in the report:

- Modify the design of the proposed water treatment system at AFP4 to allow the treatment of purge water from quarterly monitoring activities
- Obtain a water tight cover to seal the outer casing at P-12M and prevent surface water filtration
- It is requested that the Air Force consider BCAs recommendation to remove the fourth stage charcoal trap from their GC/MS instrumentation
- Sampling from specified Upper and Middle Paluxy Wells
- Sampling from Upper Zone Monitor wells located at the East and West Flightline, East Parking Lot, Radar Range, an south Boundary
- Sampling selected surface water locations at CAFB/AFP4

5. STUDY STATUS

Groundwater monitoring at the facility is continuing.

6. STUDY SCHEDULE

The groundwater sampling was completed April 20 through April 30, 1991.

7. IRPIMS STATUS

The information contained in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Final Construction Quality Control Plan
Subsurface Barrier Wall Installation
Landfill No.3
Author: International Technology Corporation
Doc No: AFP-X05
Submitted: March 1993

1. STUDY OBJECTIVES

The Construction Quality Plan (CQP) presents the overall quality control program to be implemented for construction of a slurry wall and groundwater extraction system at Landfill No. 3, Plant 4 in fort worth, Texas.

2. STUDY ACCOMPLISHMENTS

The CQP identified personnel, objectives, procedures, and forms necessary to fulfill the quality control function.

3. STUDY DATA/INFORMATION

The CQP presents, in detail, the quality control program concerning the following major tasks of the project

- Extraction well installation
- Mobilization and site setup
- Stormwater drainage pipe relocation
- Slurry Wall installation
- Storage area construction for spoils
- Equipment Decontamination
- Site Restoration

4. RECOMMENDATIONS

Recommendations are not included in this report.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information presented in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Final Sampling and Analysis Plan
Subsurface Barrier Wall Installation
Landfill No.3
Author: International Technology Corporation
Doc No: AFP-X06
Submitted: March 1993

1. STUDY OBJECTIVES

The Sampling Analysis Plan (SAP) covers all project issues relating to field procedures and quality assurance/quality control (QA/QC) procedures to be implemented for construction of a slurry wall and groundwater extraction system at Landfill No. 3, Plant 4 in fort worth, Texas. The SAP is divided into two separate parts, the Field Sampling Plan (FSP) and the Quality Assurance Plan (QAP).

The objectives for the FSP include the work plan for a geophysical program, a geotechnical program, and a geotechnical/hydrologic testing program that will be completed prior and during slurry wall installation.

Objective of the HSP is to provide a mechanism for the establishment of safe working conditions at the site.

2. STUDY ACCOMPLISHMENTS

The SAP establishes QA/QC procedures for the continued investigation at Landfill No. 3. The SAP is presented in two separate parts, the Field Sampling Plan and the Quality Assurance Plan.

The FSP includes the procedures necessary for the investigation of Landfill No.3, installation of the hydraulic barrier, and installation of a groundwater extraction system.

The HSP establishes the work practices necessary to help ensure protection of IT personnel and subcontractors during the Groundwater Remedial Action for the Landfill No. 3 Area of Air force plant No. 4 in Fort Worth, Texas.

3. STUDY DATA/INFORMATION

The FSP presents, in detail, the following field procedures for the continuing investigation at Landfill No. 3.

- Project team organization
- Field objectives and approach
- Field procedures
- Chain of custody, sample storage, and shipment
- Field parameter guidelines
- Equipment decontamination procedures
- Geophysical investigation procedures and guidelines
- Geotechnical investigation procedures and guidelines
- Hydrogeologic investigation
- Slurry wall installation
- Extraction well field installation

The HSP presents, in detail, the following health and safety topics:

Personnel responsibilities

- Job hazard analysis
- Hazard control program
- Personnel protective equipment
- Site control
- Decontamination Rules
- Site Monitoring
- Employee training
- Medical surveillance
- Emergency procedures

4. RECOMMENDATIONS

Recommendations are not included in this report.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information presented in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Draft Final Preliminary Assessment/Site Inspection and Remedial Investigation Report, Air Force Plant No. 4, Fort Worth, Texas, Volume I
Author: Chem-Nuclear Geotech, Inc
Doc No: AFP-X07
Submitted: December 1992

1. STUDY OBJECTIVE

The purpose of the Preliminary Assessment/Site Inspection (PA/SI) was to delineate possible contaminant source areas beneath the Assembly Building/Parts Plant and investigate the locations of previously removed underground storage tanks. The purpose of the Remedial Investigation (RI) was to characterize the nature and extent of contamination at Air Force Plant 4 (AFP 4) and to assess the risk to human health and the environment associated with the contamination. The results of the RI and the risk assessment provide the basis for an assessment of appropriate remedial actions that will be presented in a Feasibility Study. PA/SI/RI activities were undertaken in accordance with the Work Plan submitted by Geotech in August 1990 (AFP 4 document numbers 03018 and 03019).

2. STUDY ACCOMPLISHMENTS

Site characterization activities were implemented in three phases. Phase I included a review of existing data and preparation of planning documents. Phase II activities included soil gas surveys which provided the initial screening of sites and a guide subsequent surface and subsurface investigations. Phase III included the installation of soil borings and monitoring wells and the collection of groundwater, surface water, lake sediment, stream sediment, air and ecological samples.

Existing data were reviewed during Phase I and used to prepare planning documents in support of PA/SI and RI/FS activities at AFP 4. The planning documents prepared by Geotech included the Work Plan, Sampling and Analysis Plan, Quality Assurance Project Plan, and Health and Safety Plan. These documents were reviewed by the Aeronautical Systems Center, EPA Region VI, and TWC and approved in October 1990.

Phase II soil gas investigations were conducted in 1990 around the perimeter of the Assembly Building/Parts Plant and Fuel Saturation Areas No. 1, No. 2 and No. 3. Two analytical techniques were used to analyze soil gas samples, gas chromatography/mass spectroscopy (GC/MS) and specified indicator detectors.

Phase III field activities began in early February 1990 and continued through mid-May 1992. A total of 168 soil borings were drilled and 43 monitoring wells were installed. Thirty eight monitor wells were installed within the alluvial aquifer (also referred to as the upper zone) and five wells were installed within the Paluxy Formation. Four off-site locations were sampled to assess if contaminants originating from AFP 4 are migrating across the facility boundary. The new monitor wells and 5 existing wells were sampled were sampled in two rounds during September and October 1991. Groundwater elevations were collected from 199 AFP 4 well that were accessible during the September 1991 sampling round. Single well aquifer test (slug Tests) were conducted at 32 AFP 4 monitor wells.

Surface water samples were collected from 11 locations on Meandering Road Creek and 9 locations on Lake Worth. Stream sediment samples were collected from 7 surface water locations. Lake sediment samples were collected from 22 locations, three from each surface water sample location and four from intermediate locations. One surface water sample was collected from Farmer's Branch, a small tributary of the West Fork of the Trinity River.

Tissues samples from mosquito fish netted from five locations along Lake Worth and Meandering Road Creek were analyzed. Toxicity tests were conducted on surface water samples collected from three locations in creeks up-gradient of Lake Worth to assess the effects of the water on living organisms. Two sampling sites

were located on Meandering Road Creek (one up gradient and one down gradient of several waste disposal sites). The third sampling site was located on Live Oak Creek and represents background lake conditions.

Air samples were collected form two locations; one at AFP 4 and the other approximately 0.75 miles west of the facility. Sampling was conducted during a 14-week period beginning in mid-February.

3. STUDY DATA/INFORMATION

The hydrogeologic system at AFP 4 consists of three primary components; the upper zone flow system, the Walnut Formation aquitard and the Paluxy Formation Aquifer. The upper zone flow system is the uppermost groundwater unit and is characterized by water table conditions, hydraulic conductivities ranging from 10^{-6} to 10^{-1} centimeters per second (cm/sec), and a major groundwater divide extending north to south beneath the Assembly Building/Parts Plant. Discharge for the upper zone occurs as seepage to Meandering Road Creek for groundwater flowing west and as base flow to the West Fork of the Trinity River and Farmer's Branch for groundwater flowing east. Discharge from the upper zone to the Paluxy Formation Aquifer occurs in the Window Area beneath the east parking lot. The term Window Area refers to the area where the Goodland Limestone and Walnut Formation Aquitard is thin (and possibly absent) because of past deep erosion of the bedrock caused by former channels of the West Fork of the Trinity River. Elsewhere the Goodland Limestone and Walnut Formation form a relatively thick, commonly 30 feet or greater aquitard with a hydraulic conductivity ranging from 10^{-11} to 10^{-9} cm/sec.

The Paluxy Formation Aquifer, which is approximately 160 feet thick, is a major source of municipal water for the community of White Settlement and elsewhere in Tarrant county. Discharge from the Paluxy Formation Aquifer occurs as withdrawals from pumping wells and base flow into the western portions of Lake Worth and Eagle Mountain Lake.

Site characterizations performed at AFP 4 indicate that groundwater contamination consisting of VOCs, some semivolatile organic compounds (semi-VOCs) and inorganic compounds. The most prevalent VOC is trichloroethene (TCE) and to a lesser extent 1,1-trichloroethane (TCA). Also common in groundwater are the environmental degradation byproducts of these compound including cis-, and trans-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride. Other organic solvent compounds such as methylene chloride; acetone; and the fuel related compounds benzene, toluene, ethyl-benzene, and xylene were also detected in various concentrations. Semi-vocs detected in groundwater have included 1,2 dichlorobenzene, 1,4-dichlorobenzene, naphthalene, 2-methylnapthalene and 2,4-dimethylphenol.

Highest concentrations of groundwater contamination occur near the source areas. The east parking lot plume originates at the south-central and west-central parts of AFP 4 and extends in an easterly direction to beyond the property line, onto CAFB. The extent an shape of the plume is controlled by the presence of a buried paleochannel that cuts through the Goodland Limestone and into the Walnut Formation. The West Plume originates near Landfill No.1 and the west part of FSA-1 and extends in a westerly direction toward Meandering Road Creek. The North Plume consists of moderately elevated concentrations of solvent compounds adjacent to the Jet Engine Test Stand.

Contamination introduced to the Paluxy Formation primarily through vertical leakage from the upper zone flow system in the vicinity of the east parking lot window area. Estimates to the volumetric flux into the Paluxy Formation range from 1 to several hundred cubic feet per day. Because the uppermost Paluxy Formation is variably saturated within AFP 4, vertical migration of contamination to the fully saturated portions of the Paluxy Formation is a function of the unsaturated hydraulic conductivity. Little contamination has migrated to the fully saturated portions of the Paluxy Formation because the unsaturated hydraulic conductivity is relatively low.

Chromium is the most prevalent inorganic priority pollutant detected above maximum contaminant level MCL) in samples collected from upper zone groundwater. Limited detections of six other priority pollutant

in upper zone groundwater (Antimony, arsenic, cadmium, lead, nickel, and thallium) slightly exceed their respective MCLs. Aluminum, manganese, and iron frequently exceed secondary drinking water standards.

Surface water contamination in the vicinity of AFP 4 is primarily associated with Meandering Road Creek. The most significant contamination identified in the creek results from elevated concentrations of VOCs. The primary VOCs of concern included TCE, cis-1,2-DCE, 1,2-DCE and vinyl chloride. Discharge of contaminated upper zone groundwater into the creek id the mostly source of VOC contamination. Lower concentrations of other contaminants, including semi-VOCs, total petroleum hydrocarbons, and oil/grease, were reported as isolated occurrences in the creek during the RI.

Only one analyte, carbon disulfide, was detected in the water samples collected from Lake Worth. Carbon disulfide was detected in samples collected from three locations along the northern boundary of AFP 4. The magnitude of the concentrations reported and the distribution of sampling sites suggest that sources for the contamination are probably not related but located near the points of sample collection.

TCE is the most prevalent VOC in soils. Widespread occurrence of this compound, at relatively low concentrations, is associated with saturated soils under the south end of the Assembly Building, the East Parking Lot area and as least as far as Runway No. 130 North. TPH and petroleum related semi-VOCS were detected in Fuel Saturation Areas and Landfill Nos. 1 and 4. Inorganic soil contamination is characterized by the presence of antimony, cadmium, chromium, copper, lead, silver, zinc at concentrations greater than the natural background.

Results of ambient air monitoring program conducted at AFP 4 indicated that plant activities are contributing significant quantities if four VOCs to the air when compared to the respective off-site concentration measured. Maximum on-site concentrations of dichlorodifluoromethane, Freon 113, 1,1,1-trichloroethane, and trichloroethene, ranged from 4 to 14 times greater than maximum off-site concentrations. Additionally the results of the program indicated that the activities at AFP 4 do not contribute significant quantities of particulate in the air.

A total of 37 chemicals of potential concern for the risk assessment were identified in the samples collected from AFP 4. The chemicals were most frequently found in soils followed by groundwater, air and surface water. The complete future exposure pathways are: ingestion of groundwater from White Settlement production wells by future residents, inhalation of and dermal contact with organic compounds in groundwater by future residents during showering, and ingestion and dermal contact with contaminated soil by AFP 4 personnel.

Exposure point concentrations in soil and air were based on concentrations measured at the site. Future groundwater concentrations were estimated using a conservative analytical groundwater transport model. A cross-media transfer equation was used to calculate concentrations of volatile chemicals in the air during and after showering and a simple dilution model was used to derive exposure point concentrations in surface water.

The most significant carcinogenic risks for the exposure scenarios examined in this risk assessment range from $1x10^{-4}$ to $1x10^{-3}$. This occurred from the future ingestion of groundwater from the White Settlement production wells and the future inhalation of volatile compounds during showering with groundwater form White Settlement production wells. TCE is the only chemical that contributes this risk.

For noncarcinogens, the Hazard Index is 2.6 for current land use and 1.1 for future land use. Chromium (assuming 100 percent hexavalent) is the major contributor associated with current land use and 1,2-DCE is the dominant contributor to future land risks.

An ecological risk assessment conduct at AFP 4 concluded that the current risk conditions do not present a significant risk to the integrity of the aquatic communities in Lake Worth. However, effluent with toxic

levels of contaminants are entering the Meandering Road Creek and bioaccumulation of polynuclear aromatic hydrocarbons is occurring in fish populations at the site.

4. STUDY RECOMMENDATIONS

Five areas have been identified where additional information may be necessary to accurately quantify the total extent of soils contamination if soils remediation is required based on the FS

- Define total extent of TPH contamination at Fire Department Training Area 2
- Define total extent of soil contamination at the Die Yard Chemical Pit
- Define total extent of TPH contamination at Fuel Storage Area 3
- Define total extent of soil contamination at the Jet Engine Test Stand and UST-25A

It is recommended that further RI activities be completed to resolve the following gaps in data. The most significant gap in groundwater data is the lack of data defining the down gradient limit of the East Parking Lot Plume. Additional gaps are present in the southwestern portions of the East Parking Lot Plume and West Plume Areas. The transient distributions of TCE in the East Parking Lot can not be defined solely on the basis of samples collected during RI or previous investigations.

5. STUDY STATUS

The RI was conducted from October 1990 to May 1992.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information presented in this report has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Groundwater Resources for Fort Worth and Vicinity, Texas
Author: George and Rose
Number: AFP-11001
Submitted: September 1942

1. STUDY OBJECTIVES

This report was not commissioned as a part of the contamination assessment activities but has been entered into the Administrative Record to provide background information on the area. The objectives of the report were to determine specific information of available groundwater resources prior to the estimated increase in population and industry in the Fort Worth area.

2. STUDY ACCOMPLISHMENTS

During the study information including well location, water level measurements, pump test information and chemical character of water from the aquifer systems.

3. STUDY DATA/INFORMATION

The following information is included in this report:

- Lithologic Logs for Wells
- Common ion analytical results
- Pump test results
- Well location
- Water volume used

4. RECOMMENDATIONS

No recommendations have been presented in this document.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

Information included in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

P/WORTH/AFP-VOL2.SUM.53
01/24/94

Title: Variations in the Specific Yield in the Outcrop of the Carrizo Sand in South Texas as Estimated by Seismic Refraction
Author: Duffin and Elder
Number: AFP-11005
Submitted: April 1979

1. STUDY OBJECTIVES

This report was not commissioned as a part of the contamination assessment activities but has been entered into the Administrative Record to provide background information on the area. The objectives of the report were to obtain estimated lateral variations in total porosity and specific yield in the Carrizo Sand outcrop in South Texas for refinement of data to be used in the Carrizo Aquifer computer model.

The general scope of the investigation included the following:

- Seismic refraction surveys were made on the Carrizo outcrop to determine lateral variations in the compressional wave velocities in the unweathered and unsaturated zone
- These compressional wave velocities were used to estimate the total velocities were used to estimate total porosity was used to estimate the total porosity in the saturated zone
- The total porosity was used to estimate the specific yield of the saturated material through the use of empirical relationships

2. STUDY ACCOMPLISHMENTS

Seismic soundings were made at 84 sites, situated along 20 profiles, on the outcrop of the Carrizo Sand in south Texas. The soundings were made to estimate lateral variations in the aquifer's total porosity.

3. STUDY DATA/INFORMATION

Compressional wave velocities in the upper unsaturated portion of the aquifer were determined by the refraction soundings. Empirical relationships were used to estimate total porosity values from the compressional wave velocity. Estimated specific yields were derived from the estimated total porosities. The porosity values obtained by these empirical methods agree closely with laboratory porosity determinations from core samples taken from seven of the 84 seismic sounding sites.

All of the averaged values for specific yield fall within the range usually specified for unconfined aquifers. The higher specific yield values are found east of the Frio river and range from 26 to 32 percent. West of the Frio River the specific yield values ranged from 18 to 24 percent.

4. RECOMMENDATIONS

Recommendations were not included in this study.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information in this report has not been entered into IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 2
Work Plan (Draft)
Author: Radian Corporation
Doc No: CAFB-2
Submittal: January 1988

1. STUDY OBJECTIVES

The Installation Restoration Program (IRP), Phase II, Stage 2 investigation at Carswell AFB will involve a series of field activities to collect environmental data at selected sites. The data collected will be used to determine the need for, and type of, remedial action for contaminated areas that pose a risk to public health or the environment. These activities will proceed in unison at the various sites.

2. STUDY ACCOMPLISHMENTS

Thirteen sites were targeted for the Phase II, Stage 2 investigation. These sites included:

* Site 1 - Landfill 1
* Site 3 - Landfill 3
* Site 4 - Landfill 4
* Site 5 - Landfill 5
* Site 10 - Waste Burial Area
* Site 11 - Fire Department Training Area 1
* Site 12 - Fire Department Training Area 2
* Site 13 - Flightline Drainage Ditch
* Site 15 - Entomology Dry Well
* Site 16 - Unnamed Stream
* Site 17 - POL Tank Farm
* Site WSA - Weapons Storage Area
* Site BSS - Base Service Station

The thirteen sites were to be individually investigated as single operable units. The field program called for one or more of the following tasks to be performed:

* Drilling of borings in order to collect soil samples for definition of site lithology, and the determination of the degree of contaminant impact through chemical analysis.
* Installation of monitor wells to provide access to the groundwater within the Upper Zone aquifer. Groundwater samples will be collected for laboratory analysis. At some of the sites monitor wells will be installed to greater depths in order to determine the quality of the groundwater in the deeper Paluxy aquifer.
* Collection of surface soil and water samples for laboratory analysis.
* Determine the hydraulic characteristics of the various aquifers in the study areas through the analysis of water level and conductivity test data.

All drilling and sampling operations were to be supervised by a registered geologist or hydrogeologist.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

Recommendations concerning methodology for additional assessment activities are presented in this document.

5. STATUS OF STUDY

The work plan was utilized in the performance of the Stage 2 field investigation in 1990. The report of the findings was submitted in November 1990. Information not available as to status regarding any actions towards further assessment or remedial actions.

6. STUDY SCHEDULE

The Stage 2 investigation was performed in 1990.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Stage I - Weapons Storage Area
Author: Radian Corporation
Doc No: CAFB-066
Submittal: December 1988

1. STUDY OBJECTIVES

The investigation was designed to determine the extent of impact to the environment resulting from the reported release of fuel oil from an underground storage tank (UST) at the Weapons Storage Area (WSA), located approximately five miles west of the CAFB. The field investigation consisted of the drilling of 10 shallow borings in order to collect soil for laboratory analysis. The samples were analyzed for the concentration of petroleum hydrocarbons and volatile organic compounds. The elevation of the groundwater at each boring location was measured so that the configuration of the potentiometric surface of the shallow Upper Zone aquifer could be determined.

2. STUDY ACCOMPLISHMENTS

Ten boreholes were drilled to a maximum depth of 10 feet below the land surface (bls). Drilling revealed that the upper part of the subsurface in the study area was comprised of a thin zone of clayey soil underlain by dense, fossiliferous limestone. The UST pit itself was filled with backfill material. Because the target depths were relatively shallow, groundwater was not encountered at any boring location during the investigation. It was estimated that groundwater was situated at depths ranging from 50 to 60 feet bls.

Results of the chemical analyses of soil indicated the presence of petroleum hydrocarbons. The impacted soil was limited to the backfill material within the UST pit. The maximum concentration of petroleum hydrocarbons detected within any sample was 1,300 μ/g. Volatile organic compounds were detected in two soil samples collected from the UST pit. These compounds included 1,1,2,2 tetrachloroethane, 4-methyl-2-pentane, methyl ethyl ketone, xylene, and methylene chloride.

3. DATA/INFORMATION DEVELOPED

Observations made during the field investigation, including presence of the dense fossiliferous limestone at a relatively shallow depth, the absence of any migration enhancement agent with the relatively deep water table, and the failure to detect any petroleum hydrocarbons outside of the UST pit, suggested that the extent of impact resulting from the fuel release was limited to the borders of the backfill material of the UST pit. Based on these circumstances it was concluded that there was no petroleum hydrocarbon compounds either at the surface or in the subsurface materials.

4. RECOMMENDATIONS

Because petroleum hydrocarbon impacts were limited to the backfill of the UST pit, it was recommended that the tank should be removed along with all of the backfill material. The excavated soil was to be replaced with clean backfill. During excavation operations, particular attention was to be paid to the base of the pit to ensure that the water table was indeed deeper than the base of the pit. Soil samples were to be collected for laboratory analysis from the sides and base of the pit to verify that all of the impacted material was removed.

5. STATUS OF STUDY

The findings of this report were used to formulate a remedial action plan. Following a feasibility study, the remediation plan was submitted 1991.

6. STUDY SCHEDULE

The Stage field investigation was performed in 1988, the report of findings was submitted in December 1988.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Work Plan
Landfill No. 6 (SWMU No. 62) - Final Draft
Author: U.S. Army Corps of Engineers, Fort Worth District
Doc No: CAFB-67
Submittal: April 1992

1. STUDY OBJECTIVES

The work plan is designed to act as a guideline during the performance of a remedial investigation at Landfill No. 6 (SWMU No. 62).

The data provided by a 1990 investigation was used to formulate the work plan. Samples were collected in the 1990 field program and analyzed for volatile (organic and inorganic), metal species (for filter and unfiltered samples) in order to evaluate total dissolved metals (period April to May 1990). The organic and inorganic exceeds the EPA primary drinking water standards. Based on the 1990 volatile organic compound analytical results, the abandoned gasoline station does not appear to be contributing appreciable organic contamination to the shallow groundwater system. Any contaminants in the groundwater would be expected to move hydraulically downgradient, eventually entering the Oil/Water Separator and the unnamed stream or Farmers Branch itself where the initially low concentrations would be further diluted. No metals were detected above MCLs in the shallow groundwater system.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

In order to determine the current conditions at the sites and assess the likely environmental impact of past releases, it will be necessary to perform the following site exploration activities.

* Conduct a magnetometer survey of the complete area to identify the possibility of buried waste drums. This survey will not only show extent ut also aid in proper placement of monitoring wells.
* Locate five exploratory borings to determine the potentiometric values and groundwater direction. The borings will also provide subsurface soil information. The exploratory boreholes may qualify for the placement of monitoring wells.
* Install three Upper Zone groundwater monitoring wells near the site, and one background well in order to assess the degree of groundwater contamination. The four wells will be installed with long screens extending above the water table to intercept floating hydrocarbon product (if any).
* Conduct two rounds of groundwater sampling and analyze for general water quality parameters, petroleum hydrocarbons, metals and volatile organic compounds.

Groundwater Testing Parameters

* Volatile Organics: Benzene, Toluene, Ethylbenzene, Xylene
* Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Silver, and Zinc
* Oil & Grease
* Total Petroleum Hydrocarbons
* EPA Method 8240
* EPA Method 8240
* EPA Method 7060
* EPA Method 6010
* EPA Method 7471
* EPA Method 7740
* EPA Method 9071
* EPA Method 418.1

Hydrogeologic Assessment

The purpose of the hydrogeologic assessment is to develop a complete understanding of the groundwater system on-and off-base by integrating the available data from earlier investigations and by conducting additional field studies to fill data gaps or provide additional detail where necessary. Specific purposes of this evaluation include: developing a better understanding of on-and off-base groundwater flow; relationships between saturated zones; extent and migration of contamination plumes; seasonal changes in water levels and flow. Results of this study will form the framework of the evaluation of groundwater impacts, qualitative risk assessment, and remedial action alternatives. The information developed in the detailed site characterization of individual contamination areas will form an integral part of the data used in this task.

The hydrogeologic assessment will draw on the results of all previous groundwater investigations conducted at Carswell AFB. In addition to those sources, previous studies will now be updated with any regional and area studies by federal, state, and local agencies and other published and unpublished information will be used.

1) Geophysical Surveys. Magnetometer surveys will be performed at SWMU 64. of the total magnetic field and magnetic gradient will be taken at appropriate locations using an EDA PPM 500 proton magnetometer (or equivalent).

2) Subsurface Soil Surveys. No boreholes will be drilled for this investigation. The existing monitoring wells will be utilized to provide the chemical data. Air monitoring during all well drilling and soil boring work will be accomplished with an organic vapor analyzer utilizing a photoionization detector (PID) or flame ionization detector (FID) to identify the presence of potentially hazardous and/or toxic vapors or gases. The air monitoring results will be noted in the boring logs. If soil encountered during well drilling is suspected to be hazardous because of abnormal discoloration, odor or air monitoring levels, the drill soil cuttings will be containerized in new, unused drums. A different drum will be used for each boring where soil encountered is suspected to be hazardous. The field log will reflect the boring logs depth(s) from which the suspected contaminated soil cuttings were collected. Composite drill cutting samples will be obtained for chemical analysis in accordance with the EPA publication SW-846, per Table I of Appendix B.

3) Monitoring Wells. The objective of the investigation at Carswell AFB is to define the presence, magnitude, direction, rate and extent of movement of any identified contaminants. To accomplish this task, four monitoring wells will be installed.

The field team will use a hollow-stem auger rig to drill the upper zone monitoring wells. This method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for formation samples. The hollow-stem auger can be used as a temporary casing to prevent the borehole from caving during drilling and completion of test wells. For the depths and geology involved, this drilling method will provide fast, efficient performance at a relatively low operating cost.

Each new monitoring well will be developed as soon as practical after completion. The monitoring wells will be developed by a submersible pump, and/or bailer. Monitoring well development will continue until the discharge water is clear and free of sediment to the fullest extent possible. All water during development will be collected and disposed of through an existing oil/water separator connected to a base sanitary sewer. The development water production (rates), pH, specific conductances and water temperature will be measured. These data will be included in the final report.

Following the completion of drilling operations, each well will be screened above and below the water table surface with a minimum of 10 feet and maximum of 35 feet of screen. The screen will consist of 4-inch diameter PVC casing with up to 0.020-inch slots. The material lengths selected will be based upon site-specific groundwater conditions encountered. The screen will be capped at the bottom. All connections will be flush jointed and threaded. The screened section will be joined to a 4-inch diameter, Schedule 40 PVC, flush threaded casing. The casing will extend from the top of the screen to at least ground surface. To ensure the chemical integrity of the test wells, no glues, solvents, or thread compound will be employed during screen and casing installations. Prior to installation, the casing and screen sections will be thoroughly washed using a high-temperature, high-pressure sprayer, with Base potable water.

After the casing and screen have been installed for each well, a sand or gravel pack will be emplaced between the screen and the boring wall. The pack will consist of washed and bagged rounded sand or gravel with a grain size distribution compatible with the screen and the formation. The pack will be emplaced from the bottom of the borehole to 2 feet above the top of the screen. The auger flights will be used as the tremie pipe. Granulated or pelletized bentonite will be placed (in the well and measure it with a weighted tape) above the sand/gravel pack to a minimum thickness of 2 feet to provide an adequate seal. The bentonite seal will be wetted in the hole using 1-2 gallons of Base potable water to ensure that the seal is developed before cementing operations begin. Neat cement (Type I Portland cement) grout will be emplaced from above the top of the bentonite seal to land surface. No more than an eight percent gel mixture may be used. For water table conditions, grout will be emplaced through the augers and then the auger string withdrawn. If artesian conditions exist, a small diameter tremie pipe will be used to emplace the grout.

Two methods for the well surface completions will be employed at Carswell AFB depending on input from base officials. If well stick-up is of concern in an area, the well will be completed flush with the land surface. In the case of flush completion, the PVC casing will be cut 2 to 3 inches below land surface, and a watertight protective manhole with a locking cap will be installed. A locking system will be provided to discourage any tampering. When aboveground surface completion is used, the PVC well casing will be extended about 2 or 3 feet above land surface. An end plug or casing cap will be provided for each well. The extended PVC casing will be shielded with at least a 4-inch diameter steel guard pipe. The guard pipe will be placed over the PVC casing and cap and will be seated in a 24-inch by 24-inch by 4-inch concrete surface pad. The protective casing will be installed with a lockable cap or lid to discourage vandalism. In the case of an aboveground completion, three 3-inch diameter steel guard posts, will be installed radially from each well head. The guard posts will be placed approximately 2 to 3 feet into the ground and extend 5 feet above the ground surface. At some sites, the guard posts may be removable to facilitate access for sampling activities. In these cases, a locking mechanism will be provided to prevent unauthorized removal.

All monitoring wells and boreholes will be surveyed for elevations and 24 locations. A registered professional land surveyor will be retained to survey the vertical elevations of the wells and the tops of the boreholes. This survey will have an accuracy for vertical elevations of +0.01 foot for all monitoring wells and +0.1 foot for boreholes. Horizontal locations will be accurate to +1 foot. All surveying will use an established U.S.C & G.S. or U.S.G.S. benchmark as point of origin. All surveyed points and benchmarks used will be recorded on site maps.

4) Aquifer Tests. Slug tests will be conducted on three selected monitoring wells after the completion of groundwater sampling. The slug test provides an indication of aquifer characteristics such as hydraulic conductivity. Also, this test is ideally suited for low-producing formations that cannot be pumped. Monitoring wells will be selected with the hydrogeologic characteristics that will optimize slug testing. The resulting data will be used in conjunction with the groundwater geologic data. The slug test equipment will be decontaminated to prevent any well contamination.

   Following completion and development of the monitoring wells, but prior to sampling activities at each site, a round of water level measurements will be conducted on the monitoring wells. Water levels will be measured to the nearest 0.01 foot from the top of the marked casing using an electric line water level indicator. When the electrode of the water level meter comes in contact with the water, a meter reacts or a tone sounds. Additionally, the surface of the water will be examined for the presence of hydrocarbons. If hydrocarbons are present, the thickness of the layer will be measured and recorded.

5) Groundwater Sampling. Each monitoring well will be purged immediately prior to sample collection to ensure that fresh formation water is collected. Purging will occur at least three days after completion of monitoring well development. when possible, sampling will begin at upgradient monitoring wells and/or low contamination areas then move to downgradient and/or higher contamination areas.

   Purging operations will be conducted using a submersible pump or a bailer. Purging operations will be considered complete when three wetted well casing volumes have been removed or when the pH (+0.1 unit), temperature (+0.5 degrees C), specific conductance (+10 micromhos), color and odor of the discharge are stabilized. After purging the wells, groundwater samples will be collected from the discharge line of the submersible pump or with a Teflon bailer or 2-inch stainless steel Kemerer sampler. This latter sampler can provide non-aerated groundwater samples at discrete depths which aids in ensuring the integrity of any volatiles in the groundwater.

   The methods for obtaining the water data are as follows. All downhole equipment used during the purging of the monitoring wells will be carefully washed to prevent cross-contamination. Details of the decontamination process are provided in the Quality Assurance Project Plan (QAPP) in Appendix C. As an additional step to prevent cross-contamination of the wells, purging/sampling operations will progress from areas suspected to contain little or no contamination to areas assumed to have higher contamination levels. The purged groundwater will be disposed through an oil/water separator connected to a sanitary sewer.

   a) Temperature. Measurements of the sample temperature will be taken using a mercury thermometer. The field measurement represents the temperature of the groundwater at a particular location and time.
   b) pH. The pH of each sample will be measured by a Myron L pDS (Model EPll/pH) meter or equivalent. The pH of the sample will be measured as quickly as possible after collection.
   c) Specific Conductivity. The specific conductivity of each sample will be measured with a Myron L pDS meter (Model EPll/pH) or equivalent. Elevated specific conductivities indicate the presence of conductive ions in the groundwater.

Water samples collected from the wells will be placed in laboratory prepared containers, preserved as appropriate, chilled to 4 degrees C and shipped to the Southwestern Division Laboratory. The groundwater samples and type of analysis will be summarized per Table I of Appendix B. Also, the table will show data for surface water sampling. Chain-of-custody documents will accompany all samples. Analytical methods, preservations and holding times are provided in detail in the QAPP (included in Appendix C).

When split samples are required, the sample will be divided such that all the containers have a representative portion. In the case of solid samples (soil and formation), samples will be split longitudinally when possible and any loose material will be divided as equally as possible among the containers. Samples for volatile contaminants will be placed directly into the sample container with minimal disturbance. Water samples will be split by pouring an equal volume of liquid among the containers for each collection. The containers will then be labeled on-site and the samples recorded in a log book.

During the borehole and monitoring well drilling activities, cuttings that are suspected of being hazardous because of abnormal discoloration, odor or air monitoring levels will be containerized as discussed previously in Subsection 5.2, Subsurface Soil Surveys. To determine the final disposition of the cuttings in the drums, a composite sample will be obtained from each drum identified using a stainless steel scoop. Up to two composite samples will be collected for chemical analysis. Each composite sample of the drill cuttings will be analyzed for TCLP concentrations of metals, pesticides, herbicides, volatiles and semivolatiles to determine if the soil cuttings must be disposed of as a hazardous waste.

The objectives of the data evaluation process are to summarize the existing information on the hazardous waste sources, pathways, receptors, and to evaluate potential impacts on the base and public health, and the environment. Site-specific analytical data resulting from the field investigation at the Base as well as regional information are considered in the evaluation process.

The field investigation will generate large amounts of data on the hydrogeology and chemistry about the study sites. A computerized data system will be used to convert the raw field data and analytical data into a usable form for reporting. Therefore, the computerized data system will be designed to support the following activities.

* Archive, analyze and manipulate physical, chemical, biological and geological data collected.
* Analyze data with respect to trends or violations of environmental protection guidelines.
* Produce subsets of data to form summary reports and data files which can be analyzed by environmental models and statistical algorithms.
* Interpret relationships between contaminant migration and biogeochemical relationships existing at a particular site.

Scheduling

Wells shall be monitored during 3 months. Sampling event spaced at month intervals and analyzed in accordance with USEPA SW-846. The report shall contain a site map and it will depict site No. 64 and 67, existing, proposed monitoring wells and geologic cross-sections. Plans and schedule for submitting the hydrologic information and well construction. Carswell Air Force Base will prepare the final report on the soils and groundwater. Four copies will be submitted with the RF1. The following items will be included:

a. Contours of the groundwater surface based on measurements in piezometers, monitoring wells and apparent direction of groundwater flow.
b. The geologic cross-section depicting the near-surface stratigraphy.
c. Logs of all soil borings, monitoring wells, results of analyses for soil and groundwater.
d. Contours of groundwater contamination and definition of plume.

Certification for Wastes and Submittals

The assessment of the site will be based on the value of the data collected. The physical, chemical data and field observations will be the foundation for making the interpretation about the site. The option of no wastes per Appendix IX will be exercised if analyses indicate so.

5. STATUS OF STUDY

The work plan was utilized to conduct the RI/FS investigation in the first half of 1993.

6. STUDY SCHEDULE

The final draft of the work plan was submitted in April 1992.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Work Plan
French Underdrain System (SWMU No. 64)
Oil/Water Separator (SWMU No. 67)
Author: U.S. Army Corps of Engineers, Fort Worth District
Doc No: CAFB-71
Submittal: October 1991

1. STUDY OBJECTIVES

The work plan is designed to act as a guideline during the performance of a remedial investigation at the French Underdrain system (SWMU No. 64) and the Oil/Water Separator (SWMU No. 67).

The data provided by an earlier investigation was used to formulate the work plan. Samples were collected in the 1990 field program and analyzed for volatile (organic and inorganic), metal species (for filter and unfiltered samples) in order to evaluate total dissolved metals (period April to May 1990). The organic and inorganic exceeds the EPA primary drinking water standards. Based on the 1990 volatile organic compound analytical results, the abandoned gasoline station does not appear to be contributing appreciable organic contamination to the shallow groundwater system. Any contaminants in the groundwater would be expected to move hydraulically downgradient, eventually entering the Oil/Water Separator and the unnamed stream or Farmers Branch itself where the initially low concentrations would be further diluted. No metals were detected above MCLs in the shallow groundwater system.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

In order to determine the current conditions at the sites and assess the likely environmental impact of past releases, it will be necessary to perform the following site exploration activities.

* Conduct an oil and gas survey of the old gas station area to identify and confirm the existence of any USTs. This survey will aid the proper placement of monitoring wells.
* Use the existing monitoring wells to confirm the potentiometric values and groundwater direction, and we propose three new monitoring wells, one monitoring background as shown in Figure 7.
* Use the existing monitoring wells and new monitor wells to assess groundwater contamination. All new well installed will have long screens extending above the water table to intercept floating hydrocarbon product (if any).
* Locate the depth and length of the french underdrain system in order to test the effectiveness and operation of the system. The operation and effectiveness of the system can be tested by placing monitoring wells upgradient and downgradient of the french drain. Sample and analysis of these wells will determine if the french drain is trapping and redirecting hydrocarbon products.
* Assess the operation and function of the existing Oil/Water Separator.

* Perform three single well aquifer tests on selected upper zone wells in order to determine the transmissivity of the Upper Zone.
* Conduct two rounds of groundwater sampling and analyze for general water quality parameters, petroleum hydrocarbons, metals and volatile organic compounds.

Groundwater Testing Parameters

* Volatile Organics: Benzene, Toluene, Ethylbenzene, Xylene
* Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Silver, and Zinc
* Oil & Grease
* Total Petroleum Hydrocarbons
* EPA Method 8240
* EPA Method 8240
* EPA Method 7060
* EPA Method 6010
* EPA Method 7471
* EPA Method 7740
* EPA Method 9071
* EPA Method 418.1

Hydrogeologic Assessment

The purpose of the hydrogeologic assessment is to develop a complete understanding of the groundwater system on-and off-base by integrating the available data from earlier investigations and by conducting additional field studies to fill data gaps or provide additional detail where necessary. Specific purposes of this evaluation include: developing a better understanding of on-and off-base groundwater flow; relationships between saturated zones; extent and migration of contamination plumes; seasonal changes in water levels and flow. Results of this study will form the framework of the evaluation of groundwater impacts, qualitative risk assessment, and remedial action alternatives. The information developed in the detailed site characterization of individual contamination areas will form an integral part of the data used in this task.

The hydrogeologic assessment will draw on the results of all previous groundwater investigations conducted at Carswell AFB. In addition to those sources, previous studies will now be updated with any regional and area studies by federal, state, and local agencies and other published and unpublished information will be used.

Geophysical Surveys. Magnetometer surveys will be performed at SWMU 64. of the total magnetic field and magnetic gradient will be taken at appropriate locations using an EDA PPM 500 proton magnetometer (or equivalent).

Subsurface Soil Surveys. No boreholes will be drilled for this investigation. The existing monitoring wells will be utilized to provide the chemical data. Air monitoring during all well drilling and soil boring work will be accomplished with an organic vapor analyzer utilizing a photoionization detector (PID) or flame ionization detector (FID) to identify the presence of potentially hazardous and/or toxic vapors or gases. The air monitoring results will be noted in the boring logs. If soil encountered during well drilling is suspected to be hazardous because of abnormal discoloration, odor or air monitoring levels, the drill soil cuttings will be containerized in new, unused drums. A different drum will be used for each boring where soil encountered is suspected to be hazardous. The field log will reflect the boring logs depth(s) from which the suspected contaminated soil cuttings were collected. Composite drill cutting samples will be obtained for chemical analysis in accordance with the EPA publication SW-846, per Table I of Appendix B.

Monitoring Wells. The objective of the investigation at Carswell AFB is to define the presence, magnitude, direction, rate and extent of movement of any identified contaminants. To accomplish this task, four monitoring wells will be installed.

The field team will use a hollow-stem auger rig to drill the upper zone monitoring wells. This method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for formation samples. The hollow-stem auger can be used as a temporary casing to prevent the borehole from caving during drilling and completion of test wells. For the depths and geology involved, this drilling method will provide fast, efficient performance at a relatively low operating cost.

Each new monitoring well will be developed as soon as practical after completion. The monitoring wells will be developed by a submersible pump, and/or bailer. Monitoring well development will continue until the discharge water is clear and free of sediment to the fullest extent possible. All water during development will be collected and disposed of through an existing oil/water separator connected to a base sanitary sewer. The development water production (rates), pH, specific conductances and water temperature will be measured. These data will be included in the final report.

Following the completion of drilling operations, each well will be screened above and below the water table surface with a minimum of 10 feet and maximum of 35 feet of screen. The screen will consist of 4-inch diameter PVC casing with up to 0.020-inch slots. The material lengths selected will be based upon site-specific groundwater conditions encountered. The screen will be capped at the bottom. All connections will be flush jointed and threaded. The screened section will be joined to a 4-inch diameter, Schedule 40 PVC, flush threaded casing. The casing will extend from the top of the screen to at least ground surface. To ensure the chemical integrity of the test wells, no glues, solvents, or thread compound will be employed during screen and casing installations. Prior to installation, the casing and screen sections will be thoroughly washed using a high-temperature, high-pressure sprayer, with Base potable water.

After the casing and screen have been installed for each well, a sand or gravel pack will be emplaced between the screen and the boring wall. The pack will consist of washed and bagged rounded sand or gravel with a grain size distribution compatible with the screen and the formation. The pack will be emplaced from the bottom of the borehole to 2 feet above the top of the screen. The auger flights will be used as the tremie pipe. Granulated or pelletized bentonite will be placed (in the well and measure it with a weighted tape) above the sand/gravel pack to a minimum thickness of 2 feet to provide an adequate seal. The bentonite seal will be wetted in the hole using 1-2 gallons of Base potable water to ensure that the seal is developed before cementing operations begin. Neat cement (Type I Portland cement) grout will be emplaced from above the top of the bentonite seal to land surface. No more than an 8-percent gel mixture may be used. For water table conditions, grout will be emplaced through the augers and then the auger string withdrawn. If artesian conditions exist, a small diameter tremie pipe will be used to emplace the grout.

Two methods for the well surface completions will be employed at Carswell AFB depending on input from base officials. If well stick-up is of concern in an area, the well will be completed flush with the land surface. In the case of flush completion, the PVC casing will be cut 2 to 3 inches below land surface, and a watertight protective manhole with a locking cap will be installed. A locking system will be provided to discourage any tampering. When aboveground surface completion is used, the PVC well casing will be extended about 2 or 3 feet above land surface. An end plug or casing cap will be provided for each well. The extended PVC casing will be shielded with at least a 4-inch diameter steel guard pipe. The guard pipe will be placed over the PVC casing and cap and will be seated in a 24-inch by 24-inch by 4-inch concrete surface pad. The protective casing will be installed with a lockable cap or lid to discourage vandalism. In the case of an aboveground completion, three 3-inch diameter steel guard posts, will be installed radially from each well head. The guard posts will be placed approximately 2 to 3 feet into the ground and extend 5 feet above the ground surface. At some sites, the guard posts may be removable to facilitate access for sampling activities. In these cases, a locking mechanism will be provided to prevent unauthorized removal.

All monitoring wells and boreholes will be surveyed for elevations and 24 locations. A registered professional land surveyor will be retained to survey the vertical elevations of the wells and the tops of the boreholes. This survey will have an accuracy for vertical elevations of +0.01 foot for all monitoring wells and +0.1 foot for boreholes. Horizontal locations will be accurate to +1 foot. All surveying will use an established U.S.C & G.S. or U.S.G.S. benchmark as point of origin. All surveyed points and benchmarks used will be recorded on site maps.

Aquifer Testing. Slug tests will be conducted on three selected monitoring wells after the completion of groundwater sampling. The slug test provides an indication of aquifer characteristics such as hydraulic conductivity. Also, this test is ideally suited for low-producing formations that cannot be pumped. Monitoring wells will be selected with the hydrogeologic characteristics that will optimize slug testing. The resulting data will be used in conjunction with the groundwater geologic data. The slug test equipment will be decontaminated to prevent any well contamination.

Following completion and development of the monitoring wells, but prior to sampling activities at each site, a round of water level measurements will be conducted on the monitoring wells. Water levels will be measured to the nearest 0.01 foot from the top of the marked casing using an electric line water level indicator. When the electrode of the water level meter comes in contact with the water, a meter reacts or a tone sounds. Additionally, the surface of the water will be examined for the presence of hydrocarbons. If hydrocarbons are present, the thickness of the layer will be measured and recorded.

Groundwater Sampling. Each monitoring well will be purged immediately prior to sample collection to ensure that fresh formation water is collected. Purging will occur at least three days after completion of monitoring well development. when possible, sampling will begin at upgradient monitoring wells and/or low contamination areas then move to downgradient and/or higher contamination areas.

Purging operations will be conducted using a submersible pump or a bailer. Purging operations will be considered complete when three wetted well casing volumes have been removed or when the pH (+0.1 unit), temperature (+0.5 degrees C), specific conductance (+10 micromhos), color and odor of the discharge are stabilized. After purging the wells, groundwater samples will be collected from the discharge line of the submersible pump or with a Teflon bailer or 2-inch stainless steel Kemerer sampler. This latter sampler can provide non-aerated groundwater samples at discrete depths which aids in ensuring the integrity of any volatiles in the groundwater.

The methods for obtaining the water data are as follows. All downhole equipment used during the purging of the monitoring wells will be carefully washed to prevent cross-contamination. Details of the decontamination process are provided in the Quality Assurance Project Plan (QAPP) in Appendix C. As an additional step to prevent cross-contamination of the wells, purging/sampling operations will progress from areas suspected to contain little or no contamination to areas assumed to have higher contamination levels. The purged groundwater will be disposed through an oil/water separator connected to a sanitary sewer.

Temperature. Measurements of the sample temperature will be taken using a mercury thermometer. The field measurement represents the temperature of the groundwater at a particular location and time.

pH. The pH of each sample will be measured by a Myron L pDS (Model EPll/pH) meter or equivalent. The pH of the sample will be measured as quickly as possible after collection.

Specific Conductivity. The specific conductivity of each sample will be measured with a Myron L pDS meter (Model EPll/pH) or equivalent. Elevated specific conductivities indicate the presence of conductive ions in the groundwater.

Water samples collected from the wells will be placed in laboratory prepared containers, preserved as appropriate, chilled to 4 degrees C and shipped to the Southwestern Division Laboratory. The groundwater samples and type of analysis will be summarized per Table I of Appendix B. Also, the table will show data

for surface water sampling. Chain-of-custody documents will accompany all samples. Analytical methods, preservations and holding times are provided in detail in the QAPP (included in Appendix C).

When split samples are required, the sample will be divided such that all the containers have a representative portion. In the case of solid samples (soil and formation), samples will be split longitudinally when possible and any loose material will be divided as equally as possible among the containers. Samples for volatile contaminants will be placed directly into the sample container with minimal disturbance. Water samples will be split by pouring an equal volume of liquid among the containers for each collection. The containers will then be labeled on-site and the samples recorded in a log book.

During the borehole and monitoring well drilling activities, cuttings that are suspected of being hazardous because of abnormal discoloration, odor or air monitoring levels will be containerized as discussed previously in Subsection 5.2, Subsurface Soil Surveys. To determine the final disposition of the cuttings in the drums, a composite sample will be obtained from each drum identified using a stainless steel scoop. Up to two composite samples will be collected for chemical analysis. Each composite sample of the drill cuttings will be analyzed for TCLP concentrations of metals, pesticides, herbicides, volatiles and semivolatiles to determine if the soil cuttings must be disposed of as a hazardous waste.

The objectives of the data evaluation process are to summarize the existing information on the hazardous waste sources, pathways, receptors, and to evaluate potential impacts on the base and public health, and the environment. Site-specific analytical data resulting from the field investigation at the Base as well as regional information are considered in the evaluation process.

The field investigation will generate large amounts of data on the hydrogeology and chemistry about the study sites. A computerized data system will be used to convert the raw field data and analytical data into a usable form for reporting. Therefore, the computerized data system will be designed to support the following activities.

* Archive, analyze and manipulate physical, chemical, biological and geological data collected.
* Analyze data with respect to trends or violations of environmental protection guidelines.
* Produce subsets of data to form summary reports and data files which can be analyzed by environmental models and statistical algorithms.
* Interpret relationships between contaminant migration and biogeochemical relationships existing at a particular site.

Scheduling

Wells shall be monitored during 3 months. Sampling event spaced at month intervals and analyzed in accordance with USEPA SW-846. The report shall contain a site map and it will depict site No. 64 and 67, existing, proposed monitoring wells and geologic cross-sections. Plans and schedule for submitting the hydrologic information and well construction. Carswell Air Force Base will prepare the final report on the soils and groundwater. Four copies will be submitted with the RFI. The following items will be included:

a. Contours of the groundwater surface based on measurements in piezometers, monitoring wells and apparent direction of groundwater flow.
b. The geologic cross-section depicting the near-surface stratigraphy.
c. Logs of all soil borings, monitoring wells, results of analyses for soil and groundwater.
d. Contours of groundwater contamination and definition of plume.

Certification for Wastes and Submittals

The assessment of the site will be based on the value of the data collected. The physical, chemical data and field observations will be the foundation for making the interpretation about the site. The option of no wastes per Appendix IX will be exercised if analyses indicate so.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The work plan was submitted in October 1991.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Stage 2
Remedial Investigation Report for the East Area (Final)
Author: Radian Corporation
Doc No: CAFB-73
Submittal: October 1991

1. STUDY OBJECTIVES

This Remedial Investigation (RI) was performed by Radian under the U.S. Air Force Installation Restoration Program (IRP) to characterize environmental contamination present in East Area IRP sites on Carswell AFB, the existence of which was documented in preceding IRP studies. The affected environmental media include soil, surface water, and groundwater present in the Upper Zone aquifer. In contrast to Upper Zone groundwater contamination that occurs within the Flightline Area, contamination in the East Area is considerably less extensive, and is of varying nature that can be directly correlated with discrete point sources (i.e., the subject IRP sites of this report).

The most recent field and analytical effort was conducted in 1990 to provide additional information necessary to support a Feasibility Study (FS) of remedial alternatives applicable to the East Area sites. The 1990 effort was limited to further characterization of these four East Area sites:

* Site LF01 - Landfill 1
* Site SD13 - Unnamed Stream and Abandoned Gasoline Station
* Site ST14 - POL Tank Farm
* Site BSS - Base Service Station

2. STUDY ACCOMPLISHMENTS

Two major tasks were performed to address existing data gaps. Monitor wells were installed at Sites SD13 and ST14 to provide new or additional information on the extent of Upper Zone groundwater contamination, the potentiometric surface configuration, and groundwater flow directions. One additional round of groundwater samples was collected from the newly installed and existing monitor wells, and four surface water samples were collected from Unnamed Stream at Site SD13. All samples were analyzed for waste-specific indicator chemicals for each site. Metals analyses were performed on both filtered and unfiltered samples.

3. DATA/INFORMATION DEVELOPED

The Upper Zone aquifer was the focus of the East Area IRP efforts. The Upper Zone deposits in the East Area vary from approximately 7 to 20 feet thick, except immediately adjacent to the Trinity River where they are thicker. Groundwater in the Upper Zone aquifer was encountered at depths ranging from approximately 6 to 13.5 feet below ground level (bgl). Groundwater flow in the East Area is generally toward the Trinity River. Based on six slug tests performed in East Area wells in 1988, calculated hydraulic conductivities of the Upper Zone range from approximately 10^{-5} to 10^{-2} cm/sec. A series of hydrogeologic cross-sections through the East Area was prepared from boring logs and synoptic water level measurements. They are included in Section 3 of this report to illustrate the local subsurface conditions.

The main surface water bodies located in the East Area are the West Fork of the Trinity River, Farmers Branch, and the Unnamed Stream at Site SD13. The Unnamed Stream emerges from an oil/water separator and flows into Farmers Branch, which in turn discharges to the Trinity River along the eastern boundary of Carswell AFB.

All 21 monitor wells in the East Area were completed in the Upper Zone aquifer at the time of this investigation. Groundwater samples were collected from all wells for chemical analysis during April and May 1990. Four surface water samples were also collected. Since the wastes and known contaminants vary from site to site, not all samples were analyzed for the same suite of indicator chemicals. Therefore, the analytical results are most conveniently discussed on a site-by-site basis. Both organic and inorganic constituents exceeding EPA Maximum Contaminant Levels (MCLs) for drinking water were detected in the East Area in past sampling efforts.

No definable volatile organic or metals contaminant plumes were identified in the Upper Zone groundwater at Landfill 1 (Site LF01). Although several volatile organic compounds were detected in past sampling efforts, and in groundwater samples collected most recently in 1990, all concentrations have been below MCLs. Further, the occurrence of detectable concentrations of volatile organic compounds is sporadic, and therefore inconsistent with the existence of a coherent plume. No metals were detected in concentrations above MCLs in any groundwater or surface water samples collected in 1990. Therefore, the previously interpreted metals contamination is not supported by the most recent data.

IRP activities conducted at Site SD13 (Unnamed Stream and Abandoned Gasoline Station) in 1985 revealed high levels of organic compounds in groundwater, probably originating from petroleum hydrocarbons. However, based on the 1990 volatile organic compounds analytical results, the abandoned gasoline station does not appear to be contributing appreciable organic contamination to the shallow groundwater system. No metals were detected above MCLs in the shallow groundwater at Site SD13. Any contaminants in the groundwater would be expected to move hydraulically downgradient, eventually entering either the oil/water separator and the Unnamed Stream or Farmers Branch itself, where the initially low groundwater concentrations would be further diluted. Still more dilution of contaminants would result as Farmers Branch flows into the West Fork of the Trinity River less than one-half mile from Site SD13. Any VOCs entering Farmers Branch and the Trinity River would be subject to volatilization to the air.

No volatile organic compounds were detected above MCLs in the surface water samples from Site SD13. The results of the laboratory analysis for inorganic constituents suggest that metals in the Unnamed Stream are preferentially adsorbed to sediments rather than remaining dissolved in the surface water. Total arsenic and total lead were detected above MCLs in at least one surface water sample. Selenium in one sample was the only metal reported above the MCL in any dissolved metals analysis. This concentration was determined to be a reporting error and was actually below the detection limit. As evidenced by the lower dissolved and total concentrations of arsenic and lead in the downstream water samples, the metals apparently tend to accumulate in the stream bed sediments. Iron oxides, observed coating bottom sediments in the Unnamed Stream in the Phase II Stage 1 investigation, suggest that precipitation of metals is active. As long as the source of these metals persists, the metals will continue to accumulate in the sediments in the upper reaches of the stream.

Benzene, ethylbenzene, chlorobenzene, toluene, and total xylenes were detected in the groundwater at Site ST14 (POL Tank Farm). Of these, ethylbenzene was the most common. However, benzene was the only volatile organic compound detected at a concentration which exceeded its MCL. Two separate accumulations of benzene are suggested. These plumes are roughly coincident with the two plumes interpreted earlier. Monitor well ST14-17M, located at the center of the benzene plume beneath the fuel loading facility, had the highest concentration of benzene, and the only concentration in excess of the MCL. Over 2 feet of free product was encountered at ST14-17M during the 1990 sampling event. The highest concentrations of chlorobenzene, toluene, and total xylenes were also detected in this well.

Chromium was detected above its MCL in only one well at Site ST14, and this concentration was measured in the total metals analysis. Lead was detected above MCLs in three monitor well samples at ST14, but only one analysis was for dissolved metals. The single dissolved lead occurrence above the MCL does not suggest significant groundwater contamination.

Both volatile organic compounds and metals were detected at Site BSS (Base Service Station). In the previous Stage 2 investigation (Radian, 1989), volatile organic compounds were detected primarily in groundwater samples from monitor well BSS-B. In samples collected during the Spring 1990 sampling event, volatile organic compounds were detected only in this well. Because of the apparent localized nature of the volatile organic contamination, the underground storage tank adjacent to monitor well BSS-B is interpreted as the source of the observed contamination.

In the 1990 sampling event, cadmium was detected above the MCL in monitor well BSS-C in the total metals analysis. Cadmium was not detected in any other well, or in the filtered sample (dissolved metal fraction) from the same well. Therefore, groundwater contamination at the site is interpreted to be limited to volatile organic compounds.

4. RECOMMENDATIONS

In general, the contaminant concentrations detected in groundwater and surface water samples collected in 1990 were lower than the concentrations of those same analytes detected in previous IRP studies. This trend may be the result of normal variability or natural attenuation of these constituents in the groundwater and surface water systems, however, it should be noted that the weeks immediately preceding the Spring 1990 sampling event were characterized by abnormally high precipitation (and flooding). The resultant increase in infiltration and recharge may have had the effect of diluting contaminants, resulting in lower concentrations of detected constituents. It is recommended that remedial alternatives to be developed in the FS incorporate technologies (i.e., verification sampling, long-term monitoring) to resolve this uncertainty.

Baseline risk assessments incorporating the 1990 analytical results were performed for the East Area sites included in the 1990 effort. Indicator chemicals, contaminant release, transport and fate mechanisms, and potential receptors and exposure pathways, specific to each of the East Area sites were identified and evaluated. All of the East Area sites were determined to pose no significant human health threat, based on evaluation of carcinogenic and noncarcinogenic (chronic) risks. In all cases, noncarcinogenic risks were too low to merit quantification. Environmental (terrestrial wildlife and aquatic organisms) risks were concluded to be minimal.

Using all available information generated in the IRP, the East Area sites were evaluated using the Defense Priority Model (DPM). The East Area sites (and the combined IRP sites in the Flightline Area) received the following scores and ranks:

Rank	Site	Score
1	Unnamed Stream (SD13)	20,760
2	Flightline Area (LF04, LF05, WP07, FT09)	19,381
3	Landfill 1 (LF01)	7,036
4	Base Service Station (BSS~	5,929
5	POL Tank Farm (ST14)	4,584

Based on a more detailed review of available data, Radian assigns a higher priority to the POL Tank Farm and the Base Service Station, respectively, than to Landfill 1. A Decision Document for Site BSS (Radian, 1990), describing on a preliminary basis the recommended remedial alternative, has already been prepared and provided to the Air Force.

Specific recommendations regarding the objectives for remedial actions are:

1) Reduce or eliminate potential receptors to human health and the environment,

2) Reduce or eliminate the potential for future contaminant migration in the groundwater and surface water,
3) Reduce, eliminate, or immobilize contaminants in residual wastes or near surface soil (Upper Zone deposits).

5. STATUS OF STUDY

Since the submittal of the results of the remedial investigation, a Work Plan for the Remedial Feasibility investigation has been formulated for the East Area. The plan was submitted in May 1991.

6. STUDY SCHEDULE

The Remedial Investigation was conducted in stages from 1988 to 1991. The report was submitted in October 1991.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Stage 2
Final Report for Carswell Air Force Base
Remedial Investigation Report for the Flightline Area (Final)
Author: Radian Corporation
Doc No: CAFB-74
Submittal: October 1991

1. STUDY OBJECTIVES

This Remedial Investigation (RI) was performed by Radian under the U.S. Air Force Installation Restoration Program (IRP) to characterize environmental contamination present in Flightline Area IRP sites on Carswell AFB, the existence of which was documented in preceding IRP studies. The affected environmental media include soil, surface water, and groundwater present in the Upper Zone aquifer. The main contaminants are volatile organic compounds (principally trichloroethene (TCE)) associated with waste chlorinated solvents.

The most recent field and analytical effort was conducted in 1990 to provide additional information necessary to support a Feasibility Study (FS) of remedial alternatives applicable to the Flightline Area sites. The 1990 effort was limited to further characterization of these four IRP sites:

* Site LF04 - Landfill 4
* Site LF05 - Landfill 5
* Site WP07 - Waste Burial Area
* Site FTO9 - Fire Department Training Area 2

2. STUDY ACCOMPLISHMENTS

Four major tasks were accomplished to address the existing data:

1) Drilling and logging of 29 soil borings to identify the distribution of paleochannel deposits, suspected as preferential pathways for migration of contaminants in Upper Zone groundwater;
2) Installation of 10 additional monitor wells, screened to the base of the Upper Zone Aquifer to provide additional information on the areal and vertical extent of groundwater contamination and possible existence of DNAPL;
3) Groundwater and surface water sampling, analysis and static water level measurement: and
4) Aquifer testing to determine Upper Zone hydraulic properties in the Flightline Area.

3. DATA/INFORMATION DEVELOPED

The major findings of the investigation were as follows:

1) Based on all available data, groundwater contamination appears to be limited to the shallowest water-bearing zone, known as the Upper Zone aquifer. In the Flightline Area, as well as across Carswell AFB and the adjoining area of Air Force (AF) Plant 4, the Upper Zone consists of unconsolidated Quaternary and Recent alluvial deposits (sand, gravel, silt and clay) that contain groundwater under unconfined conditions. The Upper Zone deposits in the Flightline Area vary from approximately 5 to 49 feet thick, and are underlain by low permeability limestones and shales of the Cretaceous Goodland and Walnut Formations which form a basal aquiclude. Groundwater in the Upper Zone was encountered at depths ranging from approximately 4 to 30 feet below ground level (bgl) and groundwater flow in the Flightline Area is generally toward Farmers Branch.

A series of hydrogeologic cross sections through the Flightline Area was prepared from boring logs and synoptic water level measurements. They are included in Section 3 of this report to illustrate the local subsurface conditions.

The main surface water bodies located in the Flightline Area are Farmers Branch, an unnamed tributary that flows into Farmers Branch, and two small ponds on the base golf course. Farmers Branch eventually discharges to the Trinity River, which is located along the eastern boundary of Carswell AFB. The Upper Zone groundwater and surface water bodies in the Flightline Area are hydraulically related, with groundwater discharging to surface water.

2) Trichloroethene (TCE), vinyl chloride, tetrachloroethene, and the cis- and trans- isomers of 1,2-dichloroethene (1,2-DCE) are the main contaminants detected in the groundwater and surface water in the Flightline Area. Based on the concentrations and distribution of these compounds in groundwater, most recently determined in the 1990 sampling and analysis program, the four former waste disposal areas (Sites LF04, LF05, WP07, and FTO9) appear to be sources for some of the groundwater contaminants detected downgradient of the sites. However, all of these compounds were also detected in samples from monitor wells located hydraulically upgradient of all Carswell AFB IRP sites in the Flightline Area, indicating that additional off-base sources must also be contributing to the existing Upper Zone groundwater contamination. The occurrence of volatile organic contaminants in the Upper Zone groundwater on the AF Plant 4 property, upgradient of the Flightline Area, has been documented (Hargis and Associates, 1989). The source(s) of the contamination on AF Plant 4 have thus far not been identified. However, it is likely that they are also the source(s) for the contamination detected in the upgradient Flightline Area wells, and are contributing some component to the contaminant plumes that exist downgradient of the Flightline Area IRP sites.

3) In conjunction with lithologic logs obtained in previous drilling efforts, logs from the new soil borings were used to delineate the thick accumulations of sand and gravel deposited in paleochannels eroded into the surface of the underlying bedrock. Figure ES-2 is the resulting sand and gravel isopach map of the Flightline Area. The areas of thickest sediment correspond well with the highest concentrations of TCE determined in 1988, suggesting that TCE (and other groundwater contaminants) may be preferentially migrating along these relatively permeable deposits in the Upper Zone. The locations of existing Carswell AFB monitor wells and wells installed in the Flightline Area by Hargis and Associates for AF Plant 4 were reviewed to determine the optimum locations for the new wells installed in 1990. Locations were selected to assess the preferential pathway hypothesis, as well as to better determine the areal extent of contamination, and the degree of continuity of the on-site contaminant plume with documented groundwater contamination present upgradient on the adjacent AF Plant 4 property. The latter objective could not be achieved because no AF Plant 4 wells were sampled concurrently with the Carswell AFB Flightline Area wells.

4) The monitor wells installed in 1990 were completed to intercept the base of the Upper Zone Aquifer to determine if dense non-aqueous phase liquid contaminant (DNAPL) is present in the Flightline Area. None was detected.

The results of the 1990 sampling and analytical effort confirmed that migration of the volatile organic contaminant plumes in the Upper Zone groundwater does occur preferentially within the eroded bedrock paleochannels. A secondary component of movement is in the direction of groundwater flow, generally toward Farmers Branch. The maximum downgradient limit of vinyl chloride contamination was defined by the existing well network, which was also adequate to identify multiple sporadic occurrences of PCE. However, the areal extent of TCE and total 1,2-DCE in groundwater was not determined. Samples from monitor wells located along the downgradient limit of the well network contained concentrations from 1300 to 2700 µg/L, and 280 to 540 µg/L, respectively.

5) In contrast to findings and interpretations from previous investigations, the groundwater and surface water analytical results for samples collected in 1990 provide little evidence of a metals contamination problem. No metals were detected in concentrations above MCLs in any samples analyzed for dissolved metals and there is no apparent pattern to the few detected concentrations above MCLs in the total metals analyses. In previous sampling events, only the total metals fractions were analyzed.

6) A pumping well and observation well for evaluation of Upper Zone Aquifer properties were installed just north of the northeast corner of Landfill 4, near the axis of a major paleochannel. The observation well was located approximately 50 feet north of the pumping well. Seven additional monitor wells were included in the observation well network, but the measured water levels showed no response to pumping after 20 hours of pumping at the optimum rate determined in the preceding step test (approximately 20 gallons/minute). Data from the pumping test and subsequent recovery test were analyzed using the Cooper-Jacob method, and the computer Well Hydraulics Interpretation Program (WHIP-tm). The resulting calculated aquifer properties of transmissivity, hydraulic conductivity, and storage coefficient are summarized in Table ES-1. The values all fall within the range expected for clean sands and gravels (Freeze and Cherry, 1979).

7) Upper Zone groundwater in the Flightline Area was determined to discharge to surface water, based on synoptic water level measurements in the monitor wells and at a staff gauge in Farmers Branch. This interpretation is supported by the similarity in groundwater and surface water contaminant distributions and concentrations in samples collected in 1990. The chemistry of surface water in the unnamed tributary to Farmers Branch suggests the water is virtually equivalent to the groundwater plume composition at the sample collection point. Volatile organic contaminants, most notably TCE, in concentrations above MCLs were detected in samples collected from both the upgradient and farthest downgradient sampling points on Farmers Branch, suggesting contributions from off-base sources, as well as the potential for off-base migration of contaminants. Estimated concentrations of TCE and total 1,2-DCE leaving the Flightline Area via Farmers Branch are 45 μg/L and 8.4 μg/L, respectively.

8) A baseline risk assessment, incorporating the 1990 analytical results, was performed for the Flightline Area. Site FT09 (Fire Department Training Area 2) was not included in the risk assessment because a remedial action has been selected for this site. The remedial design includes technologies that eliminate the potential for continuing releases from the site. Indicator chemicals, contaminant release, transport and fate mechanisms, and potential receptors and exposure pathways, specific to the Flightline Area were identified and evaluated. The Flightline Area was determined to pose no significant human health threat, based on evaluation of carcinogenic and noncarcinogenic (chronic) risks. Environmental (terrestrial wildlife and aquatic organisms) risks were determined to be minimal.

4. RECOMMENDATIONS

Using all available information generated in the IRP, the Flightline Area (combined Sites LF04, LF05, WP07 and FT09) was evaluated using the Defense Priority Model (DPM). The Flightline Area received a total score of 19,381 and ranked second among the five Carswell AFB IRP sites/areas evaluated with the model. While the Flightline Area contamination poses no immediate human health threat, remedial action is indicated to prevent continuing contaminant release and migration. Recommendations for addressing remaining data needs for design and implementation of a remedial action are provided in Section 7. It is anticipated that all of the required data can be obtained within the detailed design phase of the selected remedial action, and no additional separate remedial investigation effort is proposed.

5. STATUS OF STUDY

Since the submittal of the results of the remedial investigation, a Work Plan for the Feasibility Study has been formulated for the Flightline Area. The plan was submitted in May 1991.

6. STUDY SCHEDULE

The Remedial Investigation was conducted in stages from 1988 to 1991. The report was submitted in October 1991.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: RCRA Facility Investigation/Remediation Plan
Removal of Buried Drums and an Underground Storage Tank
SWMU Number 24 - Waste Burial Area
Author: U.S. Army Corps of Engineers, Fort Worth District
Doc No: CAFB-79
Submittal: May 1991

1. STUDY OBJECTIVES

The remediation plan calls for a two-phased approach designed to address the physical removal of the buried underground storage tank (UST), and then the restoration of the site to its original condition. Specifically, first phase consists of;

1) excavate and temporarily store approximately 12 buried 55-gallon drums and their contents,
2) removal and temporary storage of the already UST, and
3) store any soils from the excavations that are determined to be contaminated.

The contaminated drums and soil will be permanently disposed of by CAFB officials in accordance with all applicable state and federal regulations. The second phase of the remediation consist of placing an impervious cap on the site, pumping and treating the contaminated groundwater and establishing a groundwater monitoring plan to ensure site remediation is complete. This second phase shall be addressed in a detailed remedial investigation plan which shall be submitted for approval at a later date.

Prior to formulation of the remediation plan, pursuant to a request from the U.S. Army Corps of Engineers, Fort Worth Division, geophysical survey was performed at site 10 in order to define the general layout of the waste burial site. The survey consisted of ground-penetrating-radar (GPR) survey and an EM-31 conductivity survey. The nature of the survey was to identify the existence and approximate location of subsurface anomalies, which would indicate the location suspected buried drums that are thought to contain trichloroethene (TCE).

The results of the GPR unit field investigation(s) were:

1) unsuccessful at obtaining conclusive data with a 100 Hz and with a smaller 30 Hz antenna; and
2) not useful for determining the location of the suspected buried drums.

The EM-31 conductivity meter results indicated anomalies along the east border of the site and along the south border parallel to the fence line. The latter was subsequently determined to be a utility conduit leading to manhole near line 7, station 3.

The EM-31 was switched to an in-phase mode which allowed it to be used as a metal detector. Nine separate anomalies were identified. The anomalies not detected by metal detection could indicate: a TCE contamination plume migrating downgradient, north; or drums buried deeper than the penetration capabilities of the metal detectors.

2. STUDY ACCOMPLISHMENTS

The plan was utilized to perform field investigation.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

This volume presents methodology for conducting additional assessments.

5. STATUS OF STUDY

The field investigation was performed in the latter part of 1991. The report of findings of that investigation was submitted in 1992.

6. STUDY SCHEDULE

The work plan was submitted in May 1991.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Subsurface Contamination Assessment
White House Communications
Building No. 1337
Author: Maxim Engineers, Inc.
Doc No: CAFB-80
Submittal: April 1990

1. STUDY OBJECTIVES

The purpose of the investigation was to determine the impact to the environmental media near Building No. 1337 (White House Communications) at Carswell AFB. Pesticides impacts were detected in the soil during previous sampling investigations conducted near the site. The scope of work for this investigation called for the advancement of borings in order to collect soil samples for determination of any pesticide impacts.

2. STUDY ACCOMPLISHMENTS

Twenty-four (24) soil borings were advanced west and south of Building #1337. Approximate boring locations were designated prior to drilling by base personnel. Borings were continuously sampled with a split-spoon sampler down to depths of 9-10 feet. One sample from each boring was retained for laboratory analysis of pesticide contaminants. Nine of the 24 samples were collected from the 3 to 5 feet below land surface whereas additional samples were collected from the 8-10 foot depth interval.

3. DATA/INFORMATION DEVELOPED

The results of the investigation indicated that samples collected from 20 of the 24 borings contained non-detectable concentrations of pesticides and PCB's. Very low levels of chlordane were encountered in samples collected from three borings placed on the southeast part of the property. One sample placed in the central part of the property contained low levels of endrin aldehyde. Hydrocarbon constituents were detected in samples collected from borings placed along the south property boundary at concentrations ranging from 210-4800 ppm. Several samples also displayed traces of free product and emitted odors similar to diesel fuel. Because some of the samples were collected from the water-bearing intervals it was suspected that at least some degree of groundwater contamination was probable in beneath some areas of the property.

4. RECOMMENDATIONS

No recommendations were advanced by the authors.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

Investigation performed in early part of 1990, report submitted in April 1990.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: RCRA Permit, Part B, Number HW 50289
Remedial Investigation/Feasibility Study
Volume 3
Appendix F: - East Area Remedial Investigation
- Weapons Storage Area
- Other Non-IRP Sites

Author: Radian Corporation
Doc No: CAFB-81
Submittal: May 1991

1. STUDY OBJECTIVES

The objective of this investigation was to provide a detailed description of the existing environmental conditions in the East Area (IRP Sites LF01, Landfill 1; SD13, Unnamed Stream and Abandoned Service Station; ST14, POL Tank Farm; and BSS, Base Service Station) and the Weapons Storage Area so that remedial actions plans could be formulated. Appendix F provides a copy of the results of the Remedial Investigation of the East Area submitted in April 1991 (Document #CAFB-73). Previous studies documented soil and groundwater contamination, particularly organic and volatile organic compounds. The contamination was detected within the deposits and groundwater of the Upper Zone, but the areal and vertical extent of impact have yet to be determined. This study was designed to address the existing data gaps resulting from the previous investigations.

2. STUDY ACCOMPLISHMENTS

Two major tasks were performed during the Remedial Investigation in order to address existing data gaps. Monitor wells were installed at Sites SD13 and ST14 to provide new or additional information on the extent of Upper Zone groundwater contamination, the potentiometric surface configuration, and groundwater flow directions. One additional round of groundwater samples was collected from the newly installed and existing monitor wells, and four surface water samples were collected from Unnamed Stream at Site SD13. All samples were analyzed for waste-specific indicator chemicals for each site. Metals analyses were performed on both filtered and unfiltered samples.

3. DATA/INFORMATION DEVELOPED

The Upper Zone aquifer was the focus of the East Area IRP efforts. The Upper Zone deposits in the East Area vary from approximately 7 to 20 feet thick, except immediately adjacent to the Trinity River where they are thicker. Groundwater in the Upper Zone aquifer was encountered at depths ranging from approximately 6 to 13.5 feet below ground level (bgl). Groundwater flow in the East Area is generally toward the Trinity River. Based on six slug tests performed in East Area wells in 1988, calculated hydraulic conductivities of the Upper Zone range from approximately 10^{-5} to 10^{-2} cm/sec. A series of hydrogeologic cross-sections through the East Area was prepared from boring logs and synoptic water level measurements. They are included in Section 3 of this report to illustrate the local subsurface conditions.

The main surface water bodies located in the East Area are the West Fork of the Trinity River, Farmers Branch, and the Unnamed Stream at Site SD13. The Unnamed Stream emerges from an oil/water separator and flows into Farmers Branch, which in turn discharges to the Trinity River along the eastern boundary of Carswell AFB.

All 21 monitor wells in the East Area are completed in the Upper Zone aquifer. Groundwater samples were collected from all wells for chemical analysis during April and May 1990. Four surface water

samples were also collected. Since the wastes and known contaminants vary from site to site, not all samples were analyzed for the same suite of indicator chemicals. Therefore, the analytical results are most conveniently discussed on a site-by-site basis. Both organic and inorganic constituents exceeding EPA Maximum Contaminant Levels (MCLs) for drinking water were detected in the East Area in past sampling efforts.

No definable volatile organic or metals contaminant plumes were identified in the Upper Zone groundwater at Landfill 1 (Site LF01). Although several volatile organic compounds were detected in past sampling efforts, and in groundwater samples collected most recently in 1990, all concentrations have been below MCLs. Further, the occurrence of detectable concentrations of volatile organic compounds is sporadic, and therefore inconsistent with the existence of a coherent plume. No metals were detected in concentrations above MCLs in any groundwater or surface water samples collected in 1990. Therefore, the previously interpreted metals contamination is not supported by the most recent data.

IRP activities conducted at Site SD13 (Unnamed Stream and Abandoned Gasoline Station) in 1985 revealed high levels of organic compounds in groundwater, probably originating from petroleum hydrocarbons. However, based on the 1990 volatile organic compounds analytical results, the abandoned gasoline station does not appear to be contributing appreciable organic contamination to the shallow groundwater system. No metals were detected above MCLs in the shallow groundwater at Site SD13. Any contaminants in the groundwater would be expected to move hydraulically downgradient, eventually entering either the oil/water separator and the Unnamed Stream or Farmers Branch itself, where the initially low groundwater concentrations would be further diluted. Still more dilution of contaminants would result as Farmers Branch flows into the West Fork of the Trinity River less than one-half mile from Site SD13. Any VOCs entering Farmers Branch and the Trinity River would be subject to volatilization to the air.

No volatile organic compounds were detected above MCLs in the surface water samples from Site SD13. The results of the laboratory analysis for inorganic constituents suggest that metals in the Unnamed Stream are preferentially adsorbed to sediments rather than remaining dissolved in the surface water. Total arsenic and total lead were detected above MCLs in at least one surface water sample. Selenium in one sample was the only metal reported above the MCL in any dissolved metals analysis. This concentration was determined to be a reporting error and was actually below the detection limit. As evidenced by the lower dissolved and total concentrations of arsenic and lead in the downstream water samples, the metals apparently tend to accumulate in the stream bed sediments. Iron oxides, observed coating bottom sediments in the Unnamed Stream in the Phase II Stage 1 investigation, suggest that precipitation of metals is active. As long as the source of these metals persists, the metals will continue to accumulate in the sediments in the upper reaches of the stream.

Benzene, ethylbenzene, chlorobenzene, toluene, and total xylenes were detected in the groundwater at Site ST14 (POL Tank Farm). Of these, ethylbenzene was the most common. However, benzene was the only volatile organic compound detected at a concentration which exceeded its MCL. Two separate accumulations of benzene are suggested. These plumes are roughly coincident with the two plumes interpreted earlier. Monitor well ST14-17M, located at the center of the benzene plume beneath the fuel loading facility, had the highest concentration of benzene, and the only concentration in excess of the MCL. Over 2 feet of free product was encountered at ST14-17M during the 1990 sampling event. The highest concentrations of chlorobenzene, toluene, and total xylenes were also detected in this well.

Chromium was detected above its MCL in only one well at Site ST14, and this concentration was measured in the total metals analysis. Lead was detected above MCLs in three monitor well samples at ST14, but only one analysis was for dissolved metals. The single dissolved lead occurrence above the MCL does not suggest significant groundwater contamination.

groundwater samples from monitor well BSS-B. In samples collected during the Spring 1990 sampling event, volatile organic compounds were detected only in this well. Because of the apparent localized nature of the volatile organic contamination, the underground storage tank adjacent to monitor well BSS-B is interpreted as the source of the observed contamination.

In the 1990 sampling event, cadmium was detected above the MCL in monitor well BSS-C in the total metals analysis. Cadmium was not detected in any other well, or in the filtered sample (dissolved metal fraction) from the same well. Therefore, groundwater contamination at the site is interpreted to be limited to volatile organic compounds.

4. RECOMMENDATIONS

In general, the contaminant concentrations detected in groundwater and surface water samples collected in 1990 were lower than the concentrations of those same analytes detected in previous IRP studies. This trend may be the result of normal variability or natural attenuation of these constituents in the groundwater and surface water systems, however, it should be noted that the weeks immediately preceding the Spring 1990 sampling event were characterized by abnormally high precipitation (and flooding). The resultant increase in infiltration and recharge may have had the effect of diluting contaminants, resulting in lower concentrations of detected constituents. It is recommended that remedial alternatives to be developed in the FS incorporate technologies (i.e., verification sampling, long-term monitoring) to resolve this uncertainty.

Baseline risk assessments incorporating the 1990 analytical results were performed for the East Area sites included in the 1990 effort. Indicator chemicals, contaminant release, transport and fate mechanisms, and potential receptors and exposure pathways, specific to each of the East Area sites were identified and evaluated. All of the East Area sites were determined to pose no significant human health threat, based on evaluation of carcinogenic and noncarcinogenic (chronic) risks. In all cases, noncarcinogenic risks were too low to merit quantification. Environmental (terrestrial wildlife and aquatic organisms) risks were concluded to be minimal.

Using all available information generated in the IRP, the East Area sites were evaluated using the Defense Priority Model (DPM). The East Area sites (and the combined IRP sites in the Flightline Area) received the following scores and ranks:

Rank	Site	Score
1	Unnamed Stream (SD13)	20,760
2	Flightline Area (LF04, LF05, WP07, FT09)	19,381
3	Landfill 1 (LF01)	7,036
4	Base Service Station (BSS~	5,929
5	POL Tank Farm (ST14)	4,584

Based on a more detailed review of available data, Radian assigns a higher priority to the POL Tank Farm and the Base Service Station, respectively, than to Landfill 1. A Decision Document for Site BSS (Radian, 1990), describing on a preliminary basis the recommended remedial alternative, has already been prepared and provided to the Air Force.

Specific recommendations regarding the objectives for remedial actions are:

1) Reduce or eliminate potential receptors to human health and the environment,

2) Reduce or eliminate the potential for future contaminant migration in the groundwater and surface water,
3) Reduce, eliminate, or immobilize contaminants in residual wastes or near surface soil (Upper Zone deposits).

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The Remedial Investigation was conducted in stages from 1988 to 1991. The report was submitted in April 1991.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume I - Final Draft
Author: Radian Corporation
Doc No: CAFB-83
Submittal: September 1985

1. STUDY OBJECTIVES

The objectives of the Phase II, Stage 1 investigation was to determine the impact to the environmental media resulting from the waste disposal practices at Carswell AFB. Twenty-two disposal or spill sites (seventeen sites at Carswell AFB and five sites at the Weapons Storage Area located west of Carswell AFB) were identified as potential hazardous waste sites during the Phase I studies for the Installation Restoration Program (IRP) in February 1984. Ten of the twenty-two sites were considered to present significant concern to the local environment.

Twelve sites of the twenty-two Phase I IRP sites were targeted for Phase II, Stage 1 studies, including:

* Site #1 - Landfill 1
* Site #3 - Landfill 3
* Site #4 - Landfill 4
* Site #5 - Landfill 5
* Site #10 - Waste Burial Area
* Site #11 - Fire Department Training Area 1
* Site #12 - Fire Department Training Area 2
* Site #13 - Flightline Drainage Ditch
* Site #15 - Entomology Dry Well
* Site #16 - Unnamed Stream
* Site #17 - POL Tank Farm

Sites 1, 13, 15, 16, and 17 are located in the East Area. The remaining seven sites are located in the Flightline Area. The specific objectives for each of the target sites were to delineate the degree and extent of contamination, identify the environmental consequences of any migrating pollutants, and the to formulate recommendations regarding the need of any additional work.

2. STUDY ACCOMPLISHMENTS

The field program performed at each site involved a multi-phase investigation consisting of a variety tasks, including a geophysical survey, soil boring and monitor well installation, and soil and groundwater sampling. The manner in which each of these tasks were performed was as follows:

Geophysical Surveys: Geophysical surveys were performed in order to delineate define the boundaries of the waste-disposal areas at several sites. Several geophysical techniques were used during the investigation, including earth resistivity by direct current Schlumberger soundings (vertical electrical soundings - VES), magnetic and magnetic gradient surveying, and fixed frequency electromagnetic profiling (EMP) surveys at three different effective depths of exploration. Geophysical surveys were performed at Sites 1, 3, 4, 5, 10, 11, and 12.

Soil Borings/Soil Sampling: Soil borings were drilled using the hollow-stem drill method. The borings were performed in order to collect soil samples for determining the lithologic make-up of the individual sites and to determine the quality of the soil. Each boring was progressed to the

general depth of the water table. At those sites where the water table was at a significant depth below the surface, the borehole was created using the a drill rig and a hollow-stem auger. Samples were collected with a split-spoon sampler. In those areas where the water table was shallow, soil samples were collected with a hand-auger. Split-spoon samples were collected at Sites 1, 4, 5, 10, 11, 11, 13, 15, 17, and 18. Hand-auger samples were collected from Sites 11, 12, 13, and 16.

Monitor Well Installation/Groundwater Sampling: Monitor wells were installed in order to provide access to the groundwater within the Upper Zone and Paluxy aquifer for characterization and quality monitoring. The Upper Zone wells were installed using the hollow-stem method. Each of these wells were constructed with 2-inch diameter PVC screen and casing. The Paluxy wells were installed using the mud-rotary method. These wells were constructed with 5-inch diameter PVC screen and casing. Surface casing were used in the construction of these wells in order to isolate the water within the Paluxy from the Upper Zone. A total of sixteen Upper Zone wells and two Paluxy wells were installed in the Flightline Area (Sites 4, 5, 10, 11, and 12). Seven Upper Zone wells were installed at Sites 1 and 15 in the East Area.

Surface Water Sampling: Surface water samples for laboratory analysis were also collected from Sites 4, 5, 12, and 16.

3. DATA/INFORMATION DEVELOPED

The major findings at each of the targeted sites study are is summarized below.

Site #1 Landfill

The analytical results of the groundwater at Landfill 1 was inconclusive.

Site #3 Landfill

The hydrogeologic investigation revealed significant levels of contamination in the upper zone north of the landfill. The study results showed that the Goodland/Walnut aquitard rocks may be eroded along the east side of the AFB Plant 4 property to the point where its capability to inhibit the vertical exchange of groundwater between the Upper Zone and the Paluxy aquifer has been significantly reduced.

Site #4 Landfill 4

The analytical results indicated that the Upper Zone groundwater within the Upper Zone along the east side of the landfill contained elevated levels of halogenated organic compounds.

Site #5 Landfill 5

The groundwater within the Upper Zone showed elevated levels of halogenated organic compounds, including TCE, in both upgradient and downgradient directions of the landfill. The stream to the north of the landfill showed elevated levels of vinyl chloride.

Site #10 Waste Burial Area

The close proximity of the Waste Burial Area relative to landfills #4 and #5 automatically indicated that the groundwater within the Upper Zone in that area was significantly impacted.

Site #11 Fire Training Area 1

Results of the Stage 1 investigation showed very low levels of organic compounds in the groundwater of the Upper Zone. TCE was also discovered in the soil samples collected from the training area.

Site #12 Fire Training Area 2

The analytical results indicated that the groundwater in the Upper Zone is impacted with halogenated and aromatic organic compounds. TCE concentrations in downgradient of the site were significantly higher than that measured onsite.

Site #16 Unnamed Stream

The results of the investigation at Site #16 showed significant organic contamination in the Upper Zone west of the inferred location of the french drain. Elevated levels of metals and some miscellaneous organic compounds were also detected.

Site #17 POL Tank Farm

The analytical results from groundwater samples collected from borings placed at the POL Tank Farm indicated that the Upper Zone is contaminated with organic compounds.

Site #15 Entomology Draw Well

No groundwater impacts were detected at the Entomology well.

Weapons Storage Area (WSA)

The investigation in the Weapons Storage Area did not include an analysis of the groundwater in the Upper Zone. Soil samples were collected for laboratory analysis from borings placed west of the Inspection Shop. Elevated levels of TCE were detected in some of those samples. A sample collected from the potable water supply well contained elevated levels of radium.

Site #13 Flightline Drainage Ditches

The analytical results of samples collected from the Flightline Drainage Ditch shoed that the soil have been affected by runoff from the flight line. The investigation did not assess the quality of the groundwater.

4. RECOMMENDATIONS

According to DOD criteria, investigation sites can be classified into one of the following categories:

Category I - No further action is required,

Category II- Requires additional monitoring or work to assess the extent of current or future contamination, or

Category III - Ready for remedial action.

The recommended classification for each of the targeted sites during the Stage 1 program, along with the suggested additional actions were as follows:

A. Category II Sites

Site 1. Landfill

- Collect groundwater samples for laboratory analysis from the four Upper Zone monitor wells.
- Investigate the condition and contents of metal drums stored south of the DPDO yard.
- Perform aquifer tests on selected upper zone wells in order to determine the hydraulic characteristics of the Upper Zone.

Site 3. Landfill

- Install two Upper Zone monitor wells so that the quality of the groundwater can be determined along the north side of the site.

Site 4. Landfill 4

- Install three Upper Zone monitor wells east and north of the landfill.
- Perform aquifer tests on selected Upper Zone wells.
- Collect groundwater samples the newly installed wells and from the Paluxy well.

Site 5. Landfill 5

- Install five Upper Zone monitor wells to the east, west, and south of the landfill in order to define water quality conditions downgradient of the site.
- Perform aquifer tests on selected Upper Zone wells.
- Collect groundwater samples from the existing Paluxy well.

Site 10. Waste Burial Area

- Combine the Waste Burial Area with Landfill No. 5 (Site #5) because of the close proximity. Additional work recommendations for Landfill #5 apply.

Site 11. Fire Training Area 1

- Collect groundwater samples on a regular basis from the two existing Upper Zone wells.

Site 12. Fire Training Area 2

- Install two Upper Zone wells north and east of the site in order to determine the down gradient water quality conditions.
- Conduct a series of soil borings in the vicinity of the fire training area in order to assess near-surface soil conditions.
- Resample existing monitor wells.
- Perform aquifer tests on selected wells.

Site 16. Unnamed Stream

- Install four Upper Zone wells in the vicinity of the old gasoline station and the Unnamed Stream in order to determine groundwater quality.
- Perform aquifer tests on selected Upper Zone wells.

Site 17. POL Tank Farm

- Install five Upper Zone monitor wells upgradient and down gradient of the POL Tank Farm in order to determine quality of the groundwater.
- Perform aquifer tests on selected Upper Zone wells.

Site 15. Entomology Dry Well

- Search for the dry well in order to collect a sample. If the well can not be located, then hand-augered soil borings should be performed in the probable location of the dry well in order to assess the impact to the soil and groundwater in that area.
- Water levels at the existing Upper Zone monitor wells should continue to be measured in order to determine the direction of groundwater flow.

Weapons Storage Area (WSA)

- Resample the potable supply well.
- Install three Upper Zone wells west of the Inspection Shop in order to determine the quality of the groundwater.

B. **Category III Sites**

Site 13. Flightline-Drainage Ditches

- Prior to corrective action, the ditch should be dredged to remove the contaminated. Install a concrete liner in the ditch.
- Repair the pipe which supplies fuel from the Fuel Systems Shop.
- Install an oil/water separator in the ditch above its discharge point into Farmers Branch.

5. STATUS OF STUDY

The scope of this investigation involved the initial onsite at twelve of the twenty-two site targeted for study during the Phase I investigation. The remaining ten sites were eventually addressed during the upcoming phases of the Phase II investigation.

6. STUDY SCHEDULE

Authorization to proceed on the CAFB Phase II, Stage 1 program was given in September 1984. Field activities were started at the twelve sites targeted for this portion of the investigation in December 1984.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Phase II - Confirmation/Quantification
Stage 1
Volume 3: Appendices B-L
Author: Radian Corporation
Doc No: CAFB-85
Submitted: September 1985

1. STUDY OBJECTIVES

The purpose of the Stage 1 investigation was designed to determine the presence (if any) of any impacted soil and/or groundwater at eleven of the IRP sites targeted during the Phase I investigation. These sites are the Flightline Drainage Ditch (IRP Site No. 13), the Fire Department Training Area No. 2 (Site No. 12), the POL Tank Farm (Site No. 17), the Waste Burial Area (Site No. 10), The Unnamed Stream (Site No.16), the Entomology Dry Well (Site No. 15), Landfill No. 1 (Site No. 1), Landfill No. 4 (Site No. 4), Landfill No. 5 (Site No. 5), Fire department Training Area No. 1 (Site No. 11), and Landfill No. 3 (Site No. 3). Although no designated as an IRP site, the Inspection Shop at the Weapons Storage Area was also targeted. The specific objectives were to determine the following:

1) the presence or absence of contamination within the specified areas of the survey;
2) the potential for migration of identified contaminants in the various environmental media;
3) additional investigations necessary to define the magnitude, extent, direction and rate of migration of identified contaminants; and
4) potential environmental consequences and health risks of migrating contaminants.

2. STUDY ACCOMPLISHMENTS

This document contains Appendices B through L of the investigation report. Volumes 1 and 2 of this report are presented as Documents CAFB-83 and CAFB-84. The individual appendices presented in this document contain the following information:

Appendix B - Definitions, Nomenclatures, and Units
Appendix C - Scope of Work
Appendix D - Well numbering System
Appendix E - Well Logs
Appendix F - Raw Field Data
Appendix G - Sampling and Analytical Procedures
Appendix H - Chain-of-Custody Forms
Appendix I - References
Appendix J - Biographies of Key Personnel
Appendix K - Geophysical Tracings
Appendix L - Safety Plan

The specific information contained within each appendices is as follows:

Appendix B - Definitions, Nomenclatures, and Units

Appendix B provides the definitions and abbreviations of key words used in the report.

Appendix C - Scope-of-Work

Appendix C provides the Scope-of-Work for the investigation. The plan called for the following tasks to be performed:

1) Site 13, Flightline Drainage Ditch

   a. Hand auger six soil borings to a depth of 10 feet. Samples shall be collected at two foot intervals for laboratory analysis of EP toxicity, toxicity, and oil and grease.
   b. Collect three sediment samples for laboratory analysis of EP toxicity, toxicity, and oil and grease.

2) Site 12, Fire Department Training Area No. 2

   a. Conduct a geophysical survey (electromagnetics and electrical resistivity) to determine geologic conditions and plume existence.
   b. Install three groundwater monitoring wells (one upgradient, two downgradient) in the upper zone to an average depth of 40 feet (total of 120 linear feet) and collect split-spoon samples for laboratory analysis of oil and grease, toxicity, phenols, heavy metals, and purgeable organics.
   c. Collect two rounds of groundwater samples from each well (total of six samples) one month apart for laboratory analysis of TOC, toxicity, oil and grease, phenols, heavy metals, and purgeable organics.
   d. Collect two surface water samples (one month apart) from the small tributary to Farmers Branch north of the site for laboratory analysis of oil and grease, toxicity, phenols, heavy metals, and purgeable organics.
   e. Hand auger one soil boring to a depth of ten feet and collect five soil samples (two feet intervals) for laboratory analysis of EP toxicity, toxicity, and oil and grease. Collect one groundwater for laboratory analysis of oil and grease, toxicity, phenols, heavy metals, and purgeable organics.

3) Site 17, POL Tank Farm

   a. Advance eight soil borings (two upgradient, six downgradient) to a maximum depth of 20 feet each (total of 160 linear feet) and analyze soil from each borehole for signs of fuels by observing odor, color, and OVA measurements.
   b. Collect one water sample from each borehole (total of eight) for laboratory analysis of TOC, toxicity, and oil and grease.
   c. Collect split-spoon samples from each of the eight wells for laboratory analysis of toxicity, and oil and grease.

4) Site 10, Waste Burial Area

   a. Conduct a geophysical survey (electromagnetic, electrical resistivity, and magnetometer) to define the site geologic conditions, waste boundaries, and any plume present.
   b. Install three upper zone monitor wells (one upgradient, two downgradient) to an average depth of 40 feet (total of 120 linear feet), and collect split-spoon samples for laboratory analysis of oil and grease, and toxicity.
   c. Collect two water samples (one month apart) from each well for laboratory analysis of TOC, toxicity, and oil and grease.

5) Site 16, Unnamed Stream

a. Hand auger three soil borings to a maximum depth of 10 feet each (total of 30 linear feet), and collect samples at two foot intervals for laboratory analysis of TOX, oil and grease, lead, and purgeable organics.
b. Collect samples (one month apart) from the stream for laboratory analysis of TOC, TOX, oil and grease, lead, and purgeable organics.
c. Collect two water samples (one month apart) from the oil/water separator for laboratory analysis of TOC, TOX, oil and grease, lead, and purgeable organics.
d. Conduct a geophysical survey (magnetometer) in the vicinity of the abandoned gas station to determine if the tanks are still in place and to evaluate potential of the site as a source of contamination.
e. Advance three soil borings to an average depth of 40 feet (total of 120 linear feet) and analyze soils using an OVA. Collect three water samples for laboratory analysis of TOC, TOX, heavy metals and purgeable organics.

6) Site 15, Entomology Dry Well

a. Collect one sample from the entomology dry well for laboratory analysis of pesticides and TOC.
b. Install three wells in the upper zone (two downgradient and on upgradient) to an average depth of 40 feet (total of 120 linear feet). Collect groundwater samples twice (one month apart) for laboratory analysis of pesticides and TOC. Collect split-spoon samples for laboratory analysis of pesticides.

7) Site 1, Landfill 1

a. Conduct a geophysical surveys (electromagnetic, electrical resistivity, and magnetometer) to delineate waste boundaries and aid in selection of monitor well locations.
b. Install four wells (one upgradient and three downgradient) into the upper zone at an average depth of 30 feet (total of 120 linear feet).
c. Collect two water samples (one month apart) from each well (total of eight samples) for laboratory analysis of TOC, TOX, oil and grease, pesticides, phenols, heavy metals, and purgeable organics. Collect split-spoon samples for laboratory analysis of TOC, TOX, oil and grease, pesticides, phenols, heavy metals, and purgeable organics.

8) Site 4, Landfill 4

a. Conduct geophysical surveys (electromagnetic, electrical resistivity, and magnetometer) to define geological conditions and waste/plume boundaries in the upper zone.
b. Collect two grab samples (one month apart) of the surface water from the stream east of the site for laboratory analysis of TOC, pesticides, and purgeable organics.
c. Advance five boreholes (one upgradient and four downgradient) into the upper zone at an average depth of 40 feet each (total of 200 linear feet) and collect split-spoon samples for laboratory analysis of phenols and heavy metals.
d. Convert five boreholes to groundwater monitor wells and collect two groundwater samples (one month apart) from each well for laboratory analysis of TOC, oil and grease, pesticides, phenols, heavy metals, and purgeable organics.
e. Install one downgradient well to a depth of 200 feet into the Paluxy and collect two groundwater samples (one month apart) for laboratory analysis of TOC, oil and grease, pesticides, phenols, heavy metals, and purgeable organics.

9) Site 5, Landfill No. 5

   a. Conduct geophysical surveys (electromagnetic and electrical resistivity) to define geological conditions and waste boundaries in the upper zone.
   b. Install three groundwater monitor wells)one upgradient and two downgradient) in the upper zone (total of 120 linear feet) and collect two groundwater samples (one month apart for laboratory analysis of TOC, TOX, oil and grease, pesticides, phenols, heavy metals, and purgeable organics. Collect split-spoon samples (one month apart) for laboratory analysis of TOX, oil and grease, pesticides, phenols, heavy metals, and purgeable organics.
   c. Install one upper Paluxy monitor well (200 linear feet) upgradient of this site and collect two groundwater samples (one month apart) for laboratory analysis of TOC, TOX, oil and grease, pesticides, phenols, heavy metals, and purgeable organics. Collect split-spoon samples for laboratory analysis of TOX, oil and grease, pesticides, phenols, heavy metals and purgeable organics.
   d. Collect two surface water grab samples (one month apart) from the small stream that flows around the site for laboratory analysis of TOC, oil and grease, pesticides, and purgeable organics.

10) Site 11, Fire Department Training Area No. 1

   a. Advance two boreholes (one upgradient and one downgradient) to an average depth of 40 feet (total of 80 linear feet) and collect split-spoon samples for laboratory analysis of TOX, oil and grease, pesticides, phenols, heavy metals and purgeable organics.
   b. Convert two boreholes as groundwater monitor wells and collect two water samples per well (one month apart) for laboratory analysis of TOC, TOX, oil and grease, pesticides, phenols, heavy metals, and purgeable organics.
   c. Hand auger one soil boring to a depth of 10 feet and collect soil samples at two-foot intervals (total of five) for laboratory analysis of pesticides, and purgeable organics.

11) Site 3, Landfill No. 3

   a. Conduct geophysical surveys (electromagnetic and electrical resistivity to define lateral and vertical boundaries of any contaminant plume.

12) Weapons Storage Area (WSA) Inspection Shop Site

   a. Hand auger three soil borings to an average depth of five feet and spaced five feet apart.
   b. Collect two soil samples from each boring for laboratory analysis of purgeable organics and oil and grease.
   c. Collect one groundwater sample from the onsite potable water well for laboratory analysis of radioisotopes.

In addition to the specific tasks described in Section A, the following work elements were performed to complete the investigation.

1) Measure water levels and determine groundwater flow direction.
2) Containerize drill cuttings for proper disposal, and collect a soil sample for lab analysis of EP toxicity and ignitibility.
3) Prepare an informal technical information report for USAF OEHL review.
4) Prepare a draft report documenting investigation findings.

Appendix D - Well Numbering System

Appendix D provides an explanation of the numbering system utilized during the investigation.

Appendix E - Well Logs

Appendix E provides the drilling logs for the each of the borings and monitor wells installed during the investigation.

Appendix F - Raw Field Data

Appendix F provides the analytical data from samples analyzed during the investigation.

Appendix G - Sampling and Analytical Procedures

Appendix G contains the sample collection and analysis protocol used during the investigation.

Appendix H - Chain-of-Custody Forms

Appendix H contains copies of all of the Chain-of-Custody forms utilized during the investigation.

Appendix I - References

Appendix I contains references for material used and/or cited in the Phase II field investigation or Confirmation/Quantification Report

Appendix J - Biographies of Key Personnel

Appendix J contains the resumes of Radian personnel who participated during the Phase II Investigation.

Appendix K - Geophysical Tracings

Appendix K provides the raw data generated during the geophysical surveys conducted during the investigation.

Appendix L - Safety Plan

The Health and Safety Plan describes the health and safety procedures that was enforced for the Phase II Stage 1 investigation. All Radian employees and subcontractors were required to follow the plan.

3. DATA DEVELOPED

This document presents analytical and geophysical results.

4. RECOMMENDATIONS

No recommendations were presented in this volume. (see CAFB-83).

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: RCRA Facility Assessment
Preliminary Review/Visual Site Inspection
Author: A.T. Kearney
Doc No: CAFB-87
Submittal: March 1989

1. STUDY OBJECTIVES

This study was performed as part of the RCRA Facility Assessment (RFA). The purpose of this study is to perform corrective actions on solid waste management units (SWMUs) and other areas of concern (OACs) at interim status hazardous waste management facilities. These actions were mandated by the 1984 Hazardous and Solid Waste Amendments (HSWA) and delegates authority to the U.S. EPA. These corrective actions are intended to address unregulated releases of hazardous constituents to air, surface water, soil, and groundwater, as well as the generation of subsurface gas.

The major objective of the RFA program is to identify releases and potential releases, and to determine which of these require further investigation or immediate response. According to the EPA's RCRA Facility Assessment Guidance Document, the four purposes of and RFA are to:

1) Identify and gather information of releases at RCRA-regulated facilities;
2) Evaluate solid waste management units and other areas of concern for releases to all media and evaluate regulated units for releases to media other than groundwater;
3) Make preliminary determinations regarding releases of concern and the need for further actions and interim measures at the facility; and
4) Screen from further investigation those SWMUs which do not pose a threat to human health and the environment.

2. STUDY ACCOMPLISHMENTS

The three basic steps of the RFA consist of a Preliminary Review (PR) of available information, a Visual Site Inspection (VSI) to verify information collected during the PR and to obtain additional information on releases, and, if warranted, a Sampling Visit (SV) to fill data gaps by obtaining field sampling and analytical data. Each of the IRP sites identified in the Facility Restoration program was visited during the VSI. This document presents the results of the PR and VSI.

3. DATA/INFORMATION DEVELOPED

The following presents a listing of the findings and recommendations determined for each of the SWMU sites investigated during the VSI:

SWMU #	Site Description	Recommendation
1	Pathological Waste Incinerator	No Further Action
2	Pathological Waste Storage Shed	No Further Action
3	Metal Cans	No Further Action
4	Facility Dumpster	No Further Action
5	Building 1628 Waste Accumulation Area	A Remedial Feasibility Investigation (RFI) is warranted due to presence of stresses vegetation and surface staining.
6	Building 1628 Wash Rack and Drain	An RFI is warranted due to questionable integrity of subsurface piping.

7	Building 1628 Oil/Water Separator	No Further Action
8	Building 1628 Sludge Collection Tank	No Further Action
9	Building 1628 Work Station Waste Area	No Further Action
10	Building 1617 Work Station Waste Area	No Further Action
11	Building 1617 Waste Accumulation Area	No Further Action
12	Building 1619 Waste Accumulation Area	An RFI is warranted due to evidence of potential releases.
13	Building 1710 Visual Information Center Work Station Waste Accumulation Areas	No Further Action
14	Building 1060 Bead Blaster Collection Tray	No Further Action
15	Building 1060 Paint Booth Vault	No Further Action
16	Building 1060 Waste Accumulation Area	An RFI is warranted due to evidence for potential releases.
17	Landfill No. 7	An RFI is warranted due to potential for presence of hazardous materials.
18	Fire Training Area No. 1	An RFI is warranted to documented presence of groundwater and soil impacts.
19	Fire Training Area No. 2	An RFI is warranted to the documented presence of groundwater and soil impacts.
20	Waste Fuel Storage Tank	An RFI is warranted due to documented presence of groundwater and soil impacts.
21	Waste Oil Tank	An RFI is warranted due to potential for subsurface releases.
22	Landfill No. 4	An RFI is warranted due to documented presence of groundwater and soil impacts.
23	Landfill No. 5	An RFI is warranted to the documented presence of groundwater and soil impacts.
24	Waste Burial Area	An RFI is warranted due to the documented presence of groundwater and soil impacts.

4. RECOMMENDATIONS

Recommendations are presented in Section 3 of this summary.

5. STATUS OF STUDY

The information gathered during this investigation was used to obtain a SWMU permit for the facility.

6. STUDY SCHEDULE

The VSI was conducted in February, 1989. The report was submitted in March 1989.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Remedial Investigation/Feasibility Study
Stage 2
Flightline Area
Appendix H
Author: Radian Corporation
Doc No: CAFB-99
Submittal: May 1991

This document is a support document for the referenced report and as such does not present objectives or recommendations. The main body of the report is presented in Document CAFB-97, Draft Remedial Investigation for the Flightline Area.

Appendix H provides the Quality Assurance/Quality Control (QA/QC) analytical results. The results are divided between 6 tables (Table 1 through 6). The individual tables contain the following:

Table 1: Summary of Blank Results
Table 2: Detailed Listing of Blank Results
Table 3: Detailed Listing of Quality Control Check Sample (QCCS) Results
Table 4: Detailed Listing of Spike Results
Table 5: Precision Estimates by Source of Variability
Table 6: Sample Extraction and Analysis Data

Title: Installation Restoration Program
Remedial Investigation/Feasibility Study
Volume 1: Technical Report (Final)
Author: Radian Corporation
Doc No: CAFB-NA1
Submitted: April 1989

1. STUDY OBJECTIVES

The purpose of the RI/FS Stage 2 investigation was to determine the magnitude and extent of contamination identified in the RI/FS Stage 1 investigation (Radian, 1986, Document Number CAFB-83), identify environmental consequences of migrating pollutants, and recommend additional investigations to identify the magnitude, extent and direction of movement of discovered contaminants. A baseline risk assessment and preliminary assessment of possible remedial alternatives was included in the Stage 2 investigation.

2. STUDY ACCOMPLISHMENTS

The RI/FS Stage 2 investigation included the performance of two soil gas surveys, drilling of boreholes and installation of monitor wells in alluvial (upper zone) material, collection of soil samples from boreholes and hand-auger holes, collection of sediment samples, and analysis of samples for a variety of inorganic and organic constituents. All data related to field activities and laboratory analyses performed for the Stage 2 investigation were incorporated into the IRP Information Management System (IRPIMS) database. These data are included in the text and appendices of this document and were provided to USAFOEHL in an Informal Technical Information Report after field activities were completed.

A baseline risk assessment was conducted to determine the potential carcinogenic risk associated with each Carswell AFB IRP site, characterize the potential for noncarcinogenic effects, and use the results to rank and prioritize sites for remedial action. The methodology used in the baseline risk assessment involved several sequential steps to derive the values and assumptions necessary to calculate exposure, dose, and risk. The steps included selecting and characterizing indicator chemicals, estimating contaminant release rates, evaluating exposure pathways, and developing exposure scenarios. These tasks produced inputs to a computerized risk assessment model, the Radian Risk Assessment Model (R-RAM), which calculated the pollutant-specific estimates of exposure, dose, and risk for direct and indirect routes of exposure. Exposure pathways which were not qualified were described qualitatively.

An additional activity of the Stage 2 investigation was the evaluation and screening of preliminary alternative remedial actions. Possible remedial actions were identified for each of the contaminated environmental media, including soil, groundwater, and surface water. Next, a preliminary screening process was conducted to identify a comprehensive set of available control measure technologies and select those that were applicable to the IRP sites. These technologies were then evaluated according to effectiveness and ease of implementation. Finally, these technologies were combined into site-specific alternatives to address the environmental conditions determined by the Stage 2 field and laboratory activities.

3. DATA DEVELOPED

The IRP RI/FS Stage 2 investigation conducted at Carswell AFB is the second study to define the nature and extent of contamination at the facility. The geologic setting and occurrence and character of the groundwater have been previously described in the Stage 1 report, so that the emphasis of investigation has been to fill in gaps in the data.

In summary, Carswell AFB is underlain at the surface by alluvial and terrace deposits of gravel, sand, silt, and clay. These materials are underlain by limestone and shale bedrock that has been eroded to form an uneven surface, upon which the alluvium rests. The thickness of the alluvium, termed the upper zone, ranges from a few feet to more than 40 feet at the IRP sites. Groundwater occurs in most locations of the upper zone, typically in sand or gravel deposits at the base of the upper zone in sharp contact with the bedrock. Groundwater flow is generally toward the nearest surface water body, usually Farmers Branch or the Trinity River. Previous studies have shown that the shallowest bedrock, the Goodland and Walnut Formations, is dry. The uppermost bedrock aquifer at Carswell AFB is the Paluxy Aquifer, which is penetrated by two monitor wells at depths of approximately 70 feet below the land surface.

Results and Significance of Chemical Analyses

To determine possible water quality effects on the local groundwater systems, concentrations of organic and inorganic compounds detected in groundwater samples were compared to various water quality criteria. These criteria, from federal drinking water regulations, standards, and guidelines, include final and proposed Maximum Contaminant Levels (MCLs) and proposed Maximum Contaminant Level Goals (MCLGs) above zero (0), established by the EPA as part of national drinking water regulations. The MCLGs are nonenforceable health goals set, with an adequate margin of safety, at levels that would result in no known or anticipated adverse health effects. The MCLs are enforceable standards set at levels as close to the MCLGs as feasible.

In the absence of regulatory standards for some compounds, other human health criteria have been used for the interpretation of IRP data. Although these criteria do not now have the force of standards, they do provide a valid means of assessing the relative degree of contamination. Using human health criteria and standards is a stringent way to evaluate groundwater contamination at Carswell AFB. Since the upper zone is not used as a drinking water supply source, contaminants in-situ in this unit have neither human health nor environmental consequences. Groundwater in the Paluxy Formation, however, issued directly as a drinking water source.

No guidelines exist concerning the maximum allowable or recommended pollutant concentrations in soils for protection of human health and the environment.

The areas of subsurface contamination at Carswell AFB are focused at the Flightline Area sites, the POL Tank Farm, and the Base Service Station. The extent of the TCE plume, associated with Landfills 4 and 5 and the Waste Burial Area, has not been completely defined upgradient(west) or downgradient(north and east) of these sites. Since shallow groundwater flow is generally west to east, the existence of TCE west of IRP sites indicates an additional upgradient TCE source not related to current IRP sites. Field evidence and further review of Carswell AFB records suggests that TCE may be attributable to an additional fire training area, near Building 4126. Other possibilities, including TCE in shallow groundwater documented east of AF Plant 4, may require further consideration.

The areas of hydrocarbon contamination in groundwater are also revealed by results of the soil gas survey, which identified similar areas with hydrocarbon vapors in the subsurface. The contamination is associated with fuels storage and handling facilities at Site 17.

Soil gas survey results for the Base Service Station are illustrated in Figure 6. The areas of the soil gas plumes also coincided with concentrations of aromatic hydrocarbons detected in shallow groundwater. The area of greatest aromatic hydrocarbon concentrations in groundwater coincides with the soil gas plume located just north of the service station at the underground gasoline storage tanks (Well BSS-B).

Results of the Baseline Risk Assessment

The IRP sites may be grouped as follows:

1. Sites which have no significant impact (NSI on Table 13) on human health. No further action is necessary unless impacts on wildlife can be substantiated.
2. Sites which have a low or moderate potential for impact on human health. Remedial action is appropriate.
3. Sites which have a high potential impact on human health or which pose an immediate and direct health hazard. Swift remedial action is required.

Considering the results of the field program and the baseline risk assessment, the following sits may be placed into the group indicating no further action is necessary.

Site	Rationale
Landfill 3 (Site 3)	Little evidence of disposal actions, no soil contamination, some metals in groundwater above MCLs, little or no opportunity for exposure.
FDTA 1 (Site 11)	No soil or groundwater contamination, little opportunity for exposure.

Landfill 4 (Site 4) and the Waste Burial Area (Site 10) are shown to have no significant impact in terms of risk assessment. The risk assessment focused on possible exposures due to contaminants, which were judged to be minimal at the sites themselves. However, since both of these sites are underlain by, but not necessarily contributing to, the plume of TCE in groundwater at the Flightline Area, these sites are considered to be in the second group.

Sites in the second group, indicating a low to moderate health risk, and appropriate for remedial actions are listed below. The preliminary risk assessment ranking number indicates the relative priority of action, with a rank of 1 indicating the greatest need for action.

Site	Preliminary
FDTA 2 (Site 12)	1
Unnamed Stream (Site 16)	2
Base Service Station (Site BSS)	3*
Entomology Dry Well (Site 15)	3*
Landfill 1 (Site 1)	3*
Flightline Drainage Ditch (Site 13)	3*
Weapons Storage Area (Site WSA)	4
POL Tank Farm (Site 17)	5
Landfill 5 (Site 5)	6
Landfill 4 (Site 4)	7*
Waste Burial Area (Site 10)	7*

* Equivalent ranking, based on magnitude of contaminant concentrations which might reach sensitive receptors.

Preliminary Alternative Remedial Actions

Alternatives were considered for further IRP activities at each site investigated in the RI/FS Stage 2 study. The types of alternatives considered for each site include continued monitoring, additional field investigations, no further action, and applicable contaminant control technologies.

The applicable control technologies identified and evaluated for soil contaminants include institutional actions, containment, removal, treatment, disposal, and subsurface vapor control. For groundwater, applicable control technologies consist of institutional actions, containment, extraction/recovery, treatment, vapor control, and discharge. Technologies for surface water remedial actions also include diversion/collection, in addition to the technologies identified for groundwater.

4. RECOMMENDATIONS

According to Air Force criteria, each site has been assigned to one of the following IRP categories:

Category 1 - Sites where no further action is required.

Category 2 - Site requiring additional IRP effort to:

1. Determine the mobility, toxicity, and volume of detected contaminants;
2. Evaluate human health and environmental risks associated with each contaminant; and,
3. Conduct the detailed evaluation of remedial alternatives.

Category 3 - Sites where the feasibility study process has been completed.

Sites investigated during the Stage 2 program fall into either Category 1 or Category 2. No sites were eligible for inclusion into Category 3, since only the first phase of the feasibility study process was completed and remedial alternatives were not selected. Table 14 summarizes the recommendations for further action based on the RI/FS Stage 2 investigation at Carswell AFB. Technical rationale supporting the recommendations are also in Table 14.

Category 1 Sites

Results of the Stage 2 investigation indicate that there are two sites where no further action is necessary at this time. These sites are:

- Landfill 3 (Site 3); and,
- Fire Department Training Area (Site 11).

Category 2 Sites

Category 2 sites are defined as sites requiring additional monitoring, effort to quantity or further assess the extent of contamination, and/or detailed evaluation of remedial alternatives. The sites or groups of sites listed as Category 2 sites are:

- Landfill 1 (Site 1);
- Landfills 4, 5, Waste Burial Area (Sites 4, 5, and 10);
- Fire Department Training Area 2 (Site 12);
- Flightline Drainage Ditch (Site 13);
- Entomology Dry Well (Site 15);
- Unnamed Stream (Site 16);
- POL Tank Farm (Site 17);
- Base Service Station (Site BSS); and,
- The Weapons Storage Area (Site WSA).

5. STATUS OF STUDY

The Phase II RI/FS has been completed.

6. STUDY SCHEDULE

The field investigation was performed in the latter part of 1988. The report was submitted in April 1989.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Remedial Investigation/Feasibility Study
Stage 2
Volume 2: Appendices A-E
Author: Radian Corporation
Doc No: CAFB-NA2
Submitted: April 1989

1. STUDY OBJECTIVES

The purpose of the Remedial Investigation/Feasibility Study (RI/FS) Stage 2 investigation was to determine the magnitude and extent of contamination identified in the RI/FS Stage 1 investigation (Radian, 1986 - Document Number CAFB-83), identify environmental consequences of migrating pollutants, and recommend additional investigations to identify the magnitude, extent and direction of movement of discovered contaminants. A baseline risk assessment and preliminary assessment of possible remedial alternatives was incorporated into the Stage 2 investigation.

This investigation was performed as part of the Installation Restoration Program (IRP), which consists of several phases, including a preliminary assessment (Phase I), an RI/FS (Phase II), screening of remedial alternatives, selection of preferred alternatives, and the design and implementation of the selected remedial alternative.

Volume 2 of the report contains the data collected during the field investigation, as presented in Appendices A through E.

2. STUDY ACCOMPLISHMENTS

Appendices A through E contain the following information:

Appendix A - Statement of Work
Appendix B - Lithologic Logs and Well Data
Appendix C - Raw Field Data
Appendix D - Surveying Data
Appendix E - Chain-of-Custody Forms

The specific information contained within each appendix is as follows:

Appendix A - Statement of Work

The contractor was required to perform the following tasks:

1) Literature Search. Conduct a literature search to determine the geological, hydrogeological, and environmental settings for the investigation.
2) Public Health and Environmental Requirements. Determine the necessary requirements to develop data quality objectives, and to evaluate the threat of contaminants to public health and welfare.
3) Field Investigation. Perform a field investigation at each of the targeted sites. The investigation at each site will require some combination of the following activities:

    a) Soil Borings - Install soil borings in order to collect soil samples for determination of site lithology and chemical analysis.

b) Monitor Wells - Install monitor wells in order to provide access to the groundwater within the Upper Zone and/or the Paluxy aquifers.
c) Groundwater Sampling - Collect groundwater samples from each of the monitor wells in order to determine chemical concentration.
d) Aquifer Testing - Measure the water level elevations at each monitor well in order to determine the horizontal and/or vertical gradient of the target aquifers. Permeability tests will also be conducted to determine the other hydraulic properties of the aquifers.
e) Geophysical Surveys - Perform magnetometer surveys to investigate anomalies discovered during the Stage 1 investigation.
f) Soil Gas Survey - Conduct soil gas surveys to determine the concentration of organic vapors in the soil.
g) Qualitative Risk Assessment - Following review of the data gathered during the field investigation, determine the potential risk to human health and welfare or the environment from the contaminants identified.
h) FONSIs - Prepare draft FONSIs for each IRP site where the results of the initial investigation indicate that there is a significant threat to human health and welfare.
i) Preliminary Alternative Remedial Actions - For all past hazardous waste disposal and spill sites investigated, except where a FONSI is applicable, utilize the data and conclusions obtained from the hydrogeological survey, site characterization, and qualitative risk assessment to develop preliminary alternative remedial actions.
j) Final Report - Prepare a draft final report documenting all findings from the initial investigative stage of the RI/FS.

Appendix B - Lithologic Logs and Well Data

Appendix B presents the Lithologic Logs and the Construction Schematics for each monitor well installed during the investigation.

Appendix C - Raw Field Data

Appendix C presents the Well Purging Records and Slug Test Data from the investigation.

Appendix D - Surveying Data

Appendix D presents the Well Survey Data from the investigation.

Appendix E - Chain-of-Custody Forms

Appendix E presents copies of all of the Chain-of-Custody forms utilized during the investigation.

3. DATA DEVELOPED

This document presents lithologic and analytical appendices of data which was developed during this investigation.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Jet Fuel Contamination Assessment
Hydrant Fueling System
Author: U.S. Army Corps of Engineers, Fort Worth District
Doc No: CAFB-NA3
Submittal: November 1988

1. STUDY OBJECTIVES

The purpose of the investigation was to determine the degree of jet fuel contamination present in the soil in the vicinity of the buried fuel tanks located at the Hydrant Fueling Facility.

2. STUDY ACCOMPLISHMENTS

The investigation involved the collection of soil samples from hand auger borings installed around five pumphouses (Pumphouse No.s 4150, 4152, 4153, 4154, and 4170) in order to determine the lithology of the site and measure the concentration of the hydrocarbons present through laboratory analysis. A total of 52 boring were performed, including one at each pumphouse to provide background information. Each boring was drilled to a depth of approximately 20 feet below land surface (bls). Samples were obtained at depths of 12 and 20 feet bls. Samples were packed in jars for laboratory analysis.

Laboratory analysis was performed by Anachem, Inc. Each sample was analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) using EPA method 418.1.

3. DATA/INFORMATION DEVELOPED

Background samples showed that the concentration of naturally-occurring hydrocarbons in the soil ranged from 20 to 40 parts per million (ppm). The results of the samples collected from each pumphouse are as follows:

a) Pumphouse No. 4150 - The subsurface around pumphouse No. 4150 consists of a mixture of sand and clay fill material to depths of 10 to 15 feet bls. Underlying the fill is undisturbed clay, sand and gravel. Groundwater was not encountered. The laboratory results indicated high concentrations of TRPH in the majority of the samples.
b) Pumphouse No. 4152 - The subsurface around pumphouse No. 4150 consists of a mixture of sand and clay fill material to depths of 8 to 14.5 feet bls. Underlying the fill is undisturbed clay and sand. Groundwater was not encountered. The laboratory results indicated high concentrations of TRPH in the majority of the samples.
c) Pumphouse No. 4153 - The subsurface around pumphouse No. 4150 consists of a mixture of sand and clay fill material to depths of 8 to 16 feet bls. Underlying the fill is undisturbed clay and sand. Groundwater was not encountered. The laboratory results indicated elevated concentrations of TRPH were detected in the samples collected from only a couple of borings, but strong odors were noted everywhere.
d) Pumphouse No. 4154 - The subsurface around pumphouse No. 4150 consists of a mixture of sand and clay fill material to depths of 13 feet bls. Bedrock comprised of undisturbed weathered clay shale was encountered below that depth. Groundwater was encountered at several borings. The laboratory results indicated elevated concentrations of TRPH were detected at most boring locations.
e) Pumphouse No. 4170 - The subsurface around pumphouse No. 4150 consists of a mixture of sand and clay fill material extending from depths of 2.7 to 13 feet bls. Limestone gravel was encountered below that depth. Groundwater was encountered everywhere at a depth of 10 to

12 feet bls. The laboratory results indicated elevated concentrations of TRPH were detected at most boring locations.

Conclusions reached by these findings:

* The source of the soil contamination is thought to be leakage from buried fuel tanks, lines, or connections at the pumphouse facility.
* The potential for rapid contaminant migration is high due to the lithologic make-up of the upper surface. The porous sands and gravels allow for easy infiltration.
* The Texas Water Commission (TWC) recommends removal and disposal of the underground tank and impacted soil.
* The limit minimum allowable TRPH concentration that a material can have to be considered hazardous is 50,000 ppm. None of the samples collected during the investigation were in excess of this concentration.

4. RECOMMENDATIONS

The following recommendations were made:

* Underground storage tanks located at pumphouse No.s 4150, 4152, 4154, and 4170, along with the impacted soil, should be excavated and disposed of at a sanitary landfill. The tank at pumphouse No. 4153 may be abandoned in place.
* A plan describing the general procedures for removal or abandonment of the underground buried tanks should be submitted to the TWC for review prior to construction.
* Removal of the tanks should be performed in accordance with the guidelines prescribed in Title 31, Natural Resources and Conservation, Part IX, TWC, Chapter 334, "Underground Storage Tanks".

5. STATUS OF STUDY

No information available as to any actions taken in response to the recommendations.

6. STUDY SCHEDULE

The field investigation was performed in August 1988. The report was submitted in November 1988.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Limited Subsurface Investigation
Hydrant Fueling System - Spot 35
Author: Maxim Engineers, Inc.
Doc No: CAFB-NA4
Submittal: October 1990

1. STUDY OBJECTIVES

The purpose of the investigation was to determine the degree of jet fuel contamination present in the soil in the vicinity of the hydrant fueling system at Spot 35. The investigation was initiated by the failure of a pressure test of a 30-foot section of pipe in the hydrant system. Jet fuel was also observed at the surface near the terminus of the pipeline.

2. STUDY ACCOMPLISHMENTS

The investigation involved the collection of soil samples from borings installed around the affected section of pipe in order to determine the lithology of the site and measure the concentration of the hydrocarbons through laboratory analysis. A total of 9 boring were performed. The borings ranged in depth from 10 to 27.5 feet below land surface (bls). Samples were obtained in 3-foot composite intervals. Borings were installed using a rotary drill rig and samples were obtained with a split-spoon sampler. Soil samples were placed in jars and shipped to the laboratory for chemical analysis. A total of 17 soil samples were collected for laboratory analysis. Each sample was analyzed for Total Recoverable Petroleum Hydrocarbons (TRPH) using EPA method 418.1.

Three of the soil borings were used to construct 2-inch diameter monitor wells. The 3 wells ranged in depth from 25 to 27.5 feet bls. Groundwater samples were collected from the wells and analyzed for TRPH, and the four BTEX compounds (benzene, toluene, ethylbenzene, and xylene.

3. DATA/INFORMATION DEVELOPED

The following findings were made during the investigation:

* The upper subsurface in the study area is comprised of alluvial deposits of clay and sand. The clay is generally brown in color with some intermingled gray. The clay ranges in plasticity from medium to high. The sand is brown in color and is restricted to lenses within the clay. The alluvial soils overlie the lithified shale and limestone of the Fredericksburg Group. The water table was encountered at a depth ranging from 20 to 25 feet bls.
* The results of the laboratory analysis indicated that high concentrations of TRPH were present in 5 of the nine soil borings. The TWC action level for TRPH in soil is 100 parts per million (ppm). in the majority of the samples.
* The TRPH concentration in the groundwater samples collected from all three monitor wells were in excess of the TWC maximum allowable level of 1 ppm.
* The limits of the impacted area appear to be restricted to the porous sand of the trench line. A continuous clay layer which varies in thickness form 13 to 22 feet is situated between the affected section of pipe and the water table. This clay layer is of sufficient confining nature to restrict the vertical movement of fluids.
* Because of the presence of the clay layer, the TRPH detected in the three monitor wells is thought to have originated from a source other than the leaking pipeline at Spot 35.

4. RECOMMENDATIONS

The following recommendations were made:

* Excavate and dispose the impacted soil in the vicinity of the 30-foot section of defective pipe. Repair the pipeline.
* Because the groundwater impacts are though to be attributed to a separate source, it is recommended that an additional investigation be performed to further identify the source of the release and to delineate the extent of impacted groundwater.

5. STATUS OF STUDY

No information available as to any actions taken in response to the recommendations.

6. STUDY SCHEDULE

The field investigation was performed in September 1990. The report was submitted in October 1988.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Analytical Results - Recovery Wells
Author: International Technology Corporation
Doc No: CAFB-X1
Submitted: February 1993

1. STUDY OBJECTIVES

No objectives are presented in this document which summarizes analytical results.

2. STUDY ACCOMPLISHMENTS

Groundwater samples were collected and analyzed.

3. STUDY DATA/INFORMATION

This letter contains the raw laboratory analytical data as submitted by International Technology Corporation Technology Analytical Services. The analytical results are for seven water samples. Three water samples were collected from recovery wells RW-1, RW-2, and RW-3. Additionally, a trip blank, matrix spike, matrix spike duplicate, duplicate, and a duplicate were submitted for chemical analysis. The samples were analyzed for metals, volatile organics and extractables.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

4. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in this report has not been entered into the IRPIMS.

8. DISCREPANCIES

No discrepancies noted.

Title: Sampling Results
Remedial Investigation/Feasibility Study
Base Service Station (Site No. 16)
Author: U.S. Corps of Engineers
Doc No: CAFB-X2
Submittal: May 1993

1. STUDY OBJECTIVES

The purpose of this report is to document a groundwater and surface water sampling event performed by the COE personnel at the Base Service Station (IRP Site No. 16). The information obtained from this event is intended to be used to begin defining the extent of the groundwater contaminant plume, to aid in determining if the source of the petroleum release to the West Fork Trinity River is the BSS, and to develop a plan for both completing the plume definition and for obtaining aquifer characteristics for evaluating remediation alternatives. It is not intended to be a comprehensive report documenting the history of the site or the data obtained from previous investigations. Where applicable and when available, data from previous investigations have been used to aid in assessing the subsurface conditions at the site and in interpreting the sampling and analytical data obtained from this event.

2. STUDY ACCOMPLISHMENTS

Ten groundwater monitoring wells, five surface water locations, and one shallow soil boring were sampled during the investigation. All samples were shipped to the Corps of Engineers Southwestern Division Laboratory in Dallas, Texas. Specific sample locations are described in the following.

1) Shallow Soil Sample Location. One shallow soil sample, SED1, was collected on 5 May 1993 from the top 2 inches of soil along the western bank of the West Fork Trinity River at a location where a strong petroleum odor was noted emanating from the soil during a pre-sampling site visit. The sample was analyzed for total recoverable petroleum hydrocarbons (TRPH), benzene, ethyl benzene, and xylenes (BTEX), and polynuclear toluene, aromatic hydrocarbons (PAH) using TWC guidelines for sampling for an unknown petroleum source. Total metals were not analyzed because whether the source was the BSS or the pipeline, lead was not expected. Volatile organic compounds (VOCs) also were not analyzed because it was originally intended the sample be collected as a sediment sample within the river.

2) Surface Water Sample Locations. A total of five surface water samples were collected during this event. It was originally intended that only one surface water sample, SW-1, would be collected and it would be taken from the West Fork Trinity River where seepage had been observed. This sample was collected on the same day as SED-1, 5 May 1993, at a location immediately downslope from the soil sample location. The sample location was within the limits of the boom, however, no sheen or other physical evidence of petroleum hydrocarbons was present at the time of sampling. The sample was analyzed for TRPH, BTEX and methyl tertiary butyl ether (MTBE), PAH, and VOCs using TWC guidelines for sampling for an unknown petroleum source. Total metals were not analyzed for the same reason cited for SED-1.

   Four additional surface water samples, SW-2 through SW-5, were added to the sampling plan during the week of 10 May when it was noted that the culvert beneath the eastern driveway of the BSS had a strong gasoline odor, and there was a sheen on the standing water at the downstream end of this pipe. When the tank excavation was opened and groundwater was observed at roughly 5 feet below the ground surface, it also became suspect that this groundwater may be discharging to surface drainage via the gravel bed underlying the culvert. Walking the various drainage paths leading from the site showed that these converge at the

intersection of Jennings and Rogner Drives and continue to flow eastward along an unlined ditch which discharges to the West Fork of the Trinity River. Sample SW-2 was collected at the discharge of the culvert underlying the BSS driveway. Sample SW-3 was collected at the headwall of the drainage ditch running along the southern end of the site and collecting drainage from the west. Sample SW-4 was collected at a point where these two drainage pathways converge at the southeast corner of the intersection. Sample SW 5 was collected at a location immediately downstream of where all surface drainage collects at the intersection, but upstream of the oil/water separator discharge. All of these samples were analyzed for TRPH, BTEX, and MTBE.

3) Groundwater Monitoring Wells. The 10 groundwater monitoring wells which were sampled during this event were BSS-A, BSS-B, MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, SAV-1, and SAV-2. Wells BSS-A and BSS-B were installed by Atec Associates for Radian Corporation in February 1988 during the first attempt to determine if petroleum hydrocarbon contamination was present. A third well, BSS-C, was also installed at that time, but was later abandoned when it suffered surface damage. The well is still in place, but has not been plugged and was not sampled during this event. Its condition also was not determined. Wells MW-1 and MW-2 were installed by Maxim Engineers in August 1992 as part of further investigations for determining the extent of contamination at the site. These wells were both sited downgradient of the BSS. Maxim Engineers later installed an upgradient well, MW-3, in September 1992. In October 1992, Leak-Tec installed wells MW-4, MW-5, and MW-6. Wells SAV-1 and SAV-2 were installed approximately 2 weeks prior to this sampling event for the purpose of beginning extraction and treatment of the contaminated groundwater. They were originally labeled as wells MW-1 and MW-2 on the field data reports, but have been temporarily relabeled as SAV-1 and SAV-2 to avoid duplication.

   The depth to water was measured in each well prior to purging. The standard procedure for obtaining this measurement included using gasoline gauging paste to record the presence of any free product. Depths recorded were in most cases measured from a surveyed reference point on the well for which an elevation had been determined. The exception to this was wells SAV-1 and SAV-2 for which only a ground elevation had been surveyed. The sampling crew measured the stick-up of the well casing, and this measurement was added to the surveyed ground elevation for determining the elevation of the groundwater in each of these wells in order to determine the potentiometric surface of the Upper Zone in the study area.

4) Soil Boring Locations. Four soil borings have been drilled at the site during two previous investigations. Atec drilled a soil boring, BSS-D, approximately 150 feet east of BSS-B in 1988. Three other borings, ST161 through ST16-3, were drilled in December 1992 by the COE along the former pump islands for the purpose of assessing the extent of contamination in this area.

3. DATA/INFORMATION DEVELOPED

The findings of the sampling investigation were as follows:

1) Piezometric Surface. Groundwater occurs under water table conditions within the clay, sand, and gravel alluvial deposits overlying the Goodland Limestone. Groundwater flows eastward across the site at a gradient of 0.035. Applying this value to the distance between the tank excavation and the sampling locations SED-1 and SW-1 (700 feet) yields a difference in groundwater elevation of 24.5 feet, which corresponds roughly to a groundwater flow path from the BSS to the seepage area at the river.

2) Groundwater Analytical Results. No free product was encountered in any of the wells sampled. Only one well, MW-3, located upgradient to the site, showed no indication of petroleum

hydrocarbon contamination. The concentration of TDS in this well was 464 mg/L. Detected concentrations of MTBE, total BTEX, and TRPH are each contoured. Configurations of each of these contaminant plumes appear to generally agree with the direction of groundwater flow, with the highest concentrations originating from the direction of the former underground storage tank system. The highest concentrations of each of these three Petroleum contaminants were found in well BSS-B situated adjacent to the tank embayment, and the two wells SAV-1 and SAV-2 situated immediately downgradient from the embayment. Well BSS-B detected 7.6 mg/L MTBE, 42.1 mg/L BTEX, and 10.1 mg/L TRPH; well SAV-1 detected 5.3 mg/L MTBE, 23.3 mg/L BTEX, and 11.8 mg/L TRPH; and well SAV-2 detected 7.1 mg/L MTBE, 28.2 mg/L BTEX, and 9.0 mg/L TRPH .

The configuration of the TRPH contaminant plume indicates two areas of high concentration. One area is centered around well SAV-1. The other area is centered around well BSS-B. These two areas of high TRPH concentration may be indicative of two releases from the BSS system. The distribution of the high concentrations of the contaminants plotted generally agree with the results of the soil gas survey performed in February 1993 by Target Environmental Services, Inc. and the fact that free product had been recovered from well BSS-B in the past. However, the soil gas survey failed to identify the contamination present in wells MW-1 and MW-2.

3) Surface Water Analytical Results. No petroleum hydrocarbons were detected in SW-1 the boomed location in the river. Only two samples, contaminant taken from SW-2 and SW-3, showed any hydrocarbon contamination. Sample SW-2 contained the highest concentrations with TRPH at 0.3 mg/L, total BTEX at 136.4 µg/L, and MTBE at 350 µg/L. This sample was collected at the discharge of the culvert underlying the BSS main driveway at the approximate elevation of 559, where groundwater is expected to occur. Sample SW-3, taken from the ditch collecting drainage upgradient of the BSS, detected only TRPH at a concentration of 1.1 mg/L. The elevation of this location is also approximately 559, the same at which groundwater occurs. Samples SW-4 and SW5, taken at locations further drainage system, contained no hydrocarbons.

4) Shallow Soil Sample. The analytical results for the shallow soil sample collected on the western bank of the West Fork Trinity River are showed TRPH concentrations of 117 mg/kg. The PAH compounds detected were benzo(b)fluoranthene (23.6 µg/kg), benzo(a)pyrene (20.9 µg/kg), and dibenzo(a,h)anthracene (20.5 µg/kg). These compounds are typically associated with coal tar and crude oil. No BTEX or MTBE was detected.

The following conclusions were drawn from these findings:

1) The extent of the plume has not been fully defined. Information is lacking for closing high concentration contours in the vicinity of the tank embayment. Information is also lacking for closing concentration contours along the sewer line to the south and along the installation boundary.
2) Groundwater sampling results strongly indicate the UST system at the BSS, rather than the Chevron pipeline, is the source of a gasoline groundwater contaminant plume which extends at least as far eastward as wells MW-1 and MW-2, and likely discharges to the West Fork Trinity River. The relationship between groundwater elevations, groundwater gradient, and location and elevation of the seepage area along the West Fork Trinity River also support this conclusion.
3) The analytical results of the soil sample taken at the river are inconclusive for identifying the source of seep.
4) Well MW-3 is a good upgradient well representing background conditions for the BSS site. No petroleum hydrocarbons were detected in this well. The TDS concentration of 464 mg/L classifies the groundwater quality as Group 1 in accordance with TWC UST guidance. Therefore, cleanup standards for the groundwater become 50 ppb benzene, 500 ppb total BTEX,

and 1 ppm TRPH, as long as there are no water wells within a one-half mile radius of the release.

5) The configuration of the TRPH contaminant plume indicates two areas of highest concentration. One of these areas is at the former location of the USTs. The other area is around wells is SAV-1 and SAV-2, which are situated immediately east of the sewer line. The highest concentration contour for both MTBE and BTEX also extend to the vicinity of the sewer line east of the BSS. This may indicate the sewer line may be affecting migration of the gasoline by providing a preferential flow path.
6) Groundwater beneath the BSS discharges to surface water drainage via the gravel beds beneath the culverts at the site. Surface water discharge occurs at approximate elevation 559. Surface drainage leads to the West Fork Trinity River via an unlined drainage ditch southeast of the site. However, TRPH contamination present near the groundwater discharge location was no longer present in samples taken further downstream in the ditches indicating dilution and volatilization had occurred over distance.
7) Surface water discharging from the drainage ditch collecting drainage west and upgradient of the site contains TRPH.

4. RECOMMENDATIONS

Results from this sampling event can be used to determine the additional information required for defining the extent of the contaminant plume and for calculating aquifer characteristics necessary for intercepting the plume prior reaching the West Fork Trinity River. The following recommendations are made for making these determinations.

1) Install five monitoring wells 16 to finish defining the extent of the contaminant plume. One well should be located to close the high concentration contours near the former tank location. Another well is necessary to better define contours southeast of the site and to better determine the influence, if any, of the sewer line as a migration pathway running through this area. Another three wells are necessary to define the extent and concentration strength of the plume as it leaves the installation boundary to the east. This information should also help determine if another source (i.e., the Chevron pipeline) is responsible for the seepage area at the river. These three wells may be utilized later as possible recovery wells.
2) After installing the additional wells, perform another complete round of groundwater sampling to redefine the contaminant plume. Lead should be included in the analyses.
3) Resample the soil and the surface water at the seepage area along the West Fork Trinity River. A soil sample should be obtained from a greater depth, if possible, and the analyses should include VOCs and lead. The surface water sample should be attempted a day or two after a heavy rain since it was observed by both COE and CAFB personnel that migration occurs at a greater rate at this time. When taking the surface water sample from the river, it may be advantageous to disturb the river bottom at the sampling location by poking it with a stick. This may release hydrocarbons trapped by the sediment. Include lead in the analyses for the surface water sample.
4) Sample surface drainage upgradient of the BSS in both drainage ditches draining the site to verify whether contaminated groundwater is migrating along these pathways or there is an upgradient source for the TRPH detected. An orange colored seepage area has been observed discharging to this drainage system upgradient 1501.
5) Renumber all of the wells monitoring the BSS to simplify record keeping and reporting. Wells should be permanently marked.
6) Properly develop wells SAV-1 and SAV-2 for future monitoring and sampling. Complete the wells properly at the ground surface and survey well casing elevations.
7) Plug well BSS-C in accordance with TWC requirements.
8) Determine whether there are any water wells within a one-half mile radius of the site for the purpose of setting clean-up standards for remediation.

9) After sampling the newly installed wells, perform a pump test to determine hydraulic conductivity values for designing a recovery system for the site. Recharge of the wells may be too fast for performing slug tests for making these calculations. It will be important to observe any effect on the river while performing any drawdown tests.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The investigation was performed from 5-14 May 1993. The report was submitted in may 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Investigation of Groundwater Pollution
Author: U.S. Army Corps Of Engineers
Doc No: CAFB-X3
Submitted: October 1986

1. STUDY OBJECTIVES

Commencing in December 1982, Hargis and Associates, under a contract with General Dynamics Corporation, conducted an extensive investigation to determine the presence and extent of industrial chemical pollution at Air Force Plant No. 4. The primary purpose of this study was devoted to the delineating the extent of impacted to the groundwater flowing within the overburden (commonly referred to as the Upper Zone) and the upper and middle zones of the Paluxy Formation aquifer. Paluxy groundwater was monitored because the aquifer is a principal potable water source for the contiguous city of White Settlement.

2. STUDY ACCOMPLISHMENTS

The initial investigation, conducted in the first part of 1985, involved the installation of monitor wells to provide access to the groundwater within the Upper Zone and both the upper and middle zones of the Paluxy Formation. Groundwater samples were collected for chemical analysis. Subsequent analysis of the samples showed significant concentrations of trichloroethylene and 1,2-trans-dichloroethylene n one of the wells (Well P-8U) completed in the upper part of the Paluxy aquifer. The same wells also showed lesser concentrations of other chlorinated hydrocarbons. Hargis interpreted this information to indicate that chemically polluted groundwater from the Upper Zone was recharging the upper part of the Paluxy aquifer beneath the east parking lot of the plant.

In early May 1985, the Fort Worth District, Corps of Engineers, operating for Kansas City District Superfund, was asked to review existing data, investigate the distribution of chemical pollution within the Paluxy, and to locate the area in which polluted Upper Zone groundwater enters the Paluxy aquifer. The Corps proposed to drill six monitor wells into the upper part of the Paluxy aquifer and five monitor wells into the Upper Zone in the east parking lot of the plant. Also, the Corps proposed to have geophysical logs run in Paluxy monitor wells P-l through P-4, and P-5(M) through P-10(M).

These proposals were not implemented because of funding curtailment. However, the following investigative work was allowed to be performed by Hargis at the plant during a 1986 investigation :

1) Three pairs of Paluxy monitoring wells were drilled along the south boundary of the plant to determine if pollutants discovered in well P-8(U) had reached the south plant boundary. One of each pair of these wells was completed in the upper zone of the Paluxy and the other was completed in the middle zone. Groundwater was sampled in these wells and tested by Hargis and Associates.
2) In addition to the drilling of 3 pairs of Paluxy monitoring wells, 28 exploratory borings were drilled in the east parking lot to obtain data for mapping topography of the eroded surface of bedrock in the area where the overburden might be in direct contact with the Paluxy aquifer.

3. DATA/INFORMATION DEVELOPED

The results of the 1986 investigation indicated the following:

1) To date, none of the wells completed in the upper and middle zones of the Paluxy along the south boundary of the plant have showed impacted groundwater.

2) The exploratory drilling found that an erosion channel located in the east parking lot area does not penetrate the Paluxy Formation. A sandstone bed, located immediately beneath the Walnut limestone and separated from the upper part of the Paluxy aquifer below by 8 to 14 feet of shale, was recognized through correlation of the lithologic logs from the borings and wells installed along the southern boundary of the plant. The log of boring 8A3F-110, and in short-interval cores installed in that area, predicted contact between the overburden and the Paluxy Formation, which became known as the "window." Groundwater contained in this sandstone may be the only groundwater within the Paluxy aquifer to be impacted in the "window" area.

4. RECOMMENDATIONS

The following recommendations were made by the Corps based on the information collected during the 1986 investigation:

1) It is recommended that sampling and testing of groundwater from all of the well pairs along the south boundary of the plant continue, preferably on a short-cycle basis.
2) It is recommended that two monitor wells be installed immediately south of the "window" area to isolate the uppermost Paluxy sandstone from the upper zone of the Paluxy aquifer proper. If these wells find pollution to be restricted to the uppermost Paluxy sandstone, it is recommended that additional monitor wells be drilled into the upper zone of the Paluxy aquifer in the vicinity of monitor well P-8(U) to determine whether and to what extent pollution has spread in the upper Paluxy zone proper from well P-8(U).
3) It is also recommended that several the east parking lot to water and to locate sand monitor wells be completed in the overburden in better define distribution of polluted groundwater and gravel deposits in the erosional channel in the bedrock. Additionally, these wells may offer an opportunity to determine the velocity at which groundwater moves through the overburden by injecting a nonhazardous dye tracer in selected wells.

5. STATUS OF STUDY

The recommendations made here were incorporated into the work plans for the Phase II investigation completed at the plant in 1987.

6. STUDY SCHEDULE

The field investigation was performed in latter part of 1985 and the early part of 1986. The report was submitted in October 1986.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Preliminary Assessment/Investigation of Radium Contamination Weapons Storage Area
Author: U.S. Corps of Engineers
Doc No: CAFB-X4
Submittal: January 1992

1. STUDY OBJECTIVES

The Corps of Engineers conducted an investigation designed to assess the extent of radium contamination at the Weapons Storage Area. This report describes the assessment results and makes recommendations regarding the remedial actions.

2. STUDY ACCOMPLISHMENTS

The primary aspects of the investigation were as follows:

Groundwater

Groundwater samples have been periodically collected from the operational water well in Building 8504 for testing gross alpha activity and chemically tested for radium 226 and 228. Sampling has been conducted quarterly since November 1987 to present (date of report). Test results from 8 of the 19 samplings to date produced combined radium 226/228 concentrations above the limit of 5 pCi/L for State drinking water standards. However, none of the gross alpha values exceeded the 15 pCi/L State drinking water standards. Tests of three of the eight samplings produced values at least twice the maximum allowed, while the other five had test values only slightly above the maximum value permitted. Test values of gross alpha activity varied widely, but presented no recognizable pattern, appearing almost randomly. Normally, concentrations of groundwater contaminants change gradually because groundwater moves through the earth slowly.

Rainfall data were plotted against gross alpha activity to discover if any relationship between the two might exist. A positive correlation between the two was found between the earliest datum in November 1987 and August 1989. This means that in each instance of positive correlation when the gross alpha value rose, the monthly rainfall datum rose also, and at approximately the same rate. As the values diminished, both gross alpha activity (radium concentration) and monthly rainfall fell together. A plot of these values accompanies this report. It should be noted that correlation, or absence of correlation between the two sources of data is influenced to some extent by which day of each sampling month water samples were taken.

Soil Borings

Twelve shallow soil borings were dug on the downslope side of Building 8503 in order to collect soil samples for laboratory analysis. Building 8503 was the location for the maintenance operations on nuclear weapons. Three other borings of the same type were drilled along the ridge crest on which Building 8503 is located, assuming them to represent background radium contents. Samples from all 15 shallow borings were taken between a depth of 0.5-feet and 1.5 feet below land surface. The pattern of soil radium content anticipated was only partially realized. While higher radium content was found on the downslope side of Building 8503 as expected, higher radium content was also found in all three of the background borings along the top of the ridge. Plate 1 shows the boring locations. See Table 1 for summary of soil sample analysis. Complete laboratory report is at Appendix A.

3. DATA/INFORMATION DEVELOPED

The following findings were reported:

1) Source. Location of the original source of radium contamination is not yet known. It is speculated that the original source was Building 8503 where nuclear weapons were maintained. Alternatively, it has been suggested that the original source of radium was luminous instrument dials and the like, which may have been disposed of in a dump at the Weapons Storage Area. The pattern of radium contamination of shallow soils, so far as it has been developed, suggests that some secondary radium contamination may have occurred because of leaking waterlines and/or sewer lines. Correlation between rainfall and gross alpha values, together with the rapid changes in the gross alpha values, suggests the possibility of a defective seal between the casing and the hole in the water well in Building 85041 allowing radium contaminated rainfall runoff to quickly descend from the near surface to the producing interval of the well, resulting in rapidly changing radium concentrations in produced well water. See Plate 2, "Plot of Rainfall versus Radium Concentrations in Well Samples."
2) Water Wells. Of two water wells at subject facility, only well IAW 16144 in Building 8504 remains operational.
3) The range of natural background radium 226/228 content has not yet been established unambiguously in the subject area. Additional shallow soil samples should be taken to adequately define the contents of naturally occurring radium. These samples should be collected as remotely as possible from likely polluting activity as can be contrived. The three samples already taken and tested to represent background appear to have been located too close to areas of activity and possibly within minor drainages which could have introduced radium contaminated surface runoff.
4) Creek Contamination. It is not yet known whether the north and south forks of Live Oak Creek are contaminated with radium. Water samples from both
5) Strong Radiation Sources. A strong total gamma source (radium) appears to be located very near where sample E (9.5 to 10.0 feet in depth) was taken in boring 8A-l (boring located on the south side of the Radioactive Disposal Area). Sample E tested 105.7 pCi/g (total gamma).
6) Radium Contaminated Groundwater Recharge. Paluxy groundwater produced by well IAW 161-44 is believed contaminated with radium 226/228 by one of two possible mechanisms: (1) radium contaminated water percolating downward from the ground surface behind the casing of the well to the producing interval of the well (failed grout seal between the well casing and the wall of the hole); and (2) radium contaminated rain runoff flowing to the south, downslope into the south fork of Live Oak Creek. Also, the septic sewer system filter bed is located next to a steep bedrock slope which descends directly to the creek. The filter bed is located on the Walnut Formation, only a few feet above the top of the Paluxy aquifer. The Walnut is considered to have hydraulic conductivity too low for groundwater flow, and is suspected to have insufficient ability to hold or dispose of all effluent from the sewer system. If this is correct, excess effluent probably returns to Live Oak Creek. If radium contaminated surface water reaches the creek, by whatever route, it is likely to be picked up by well IAW 161-44 only if the well develops a pumping cone of depression in the water table of the Paluxy aquifer sufficiently deep to reverse the normal groundwater gradient from creek bank to Live Oak Creek, instead allowing groundwater to flow from the creek to the well. If well IAW 16-44 produces radium contaminated water from Live Oak Creek, the contaminated water is being recycled by means of the sanitary sewer system. Data have not yet been developed to adequately define the route(s) of radium contaminants from source to well IAW 161-44.

4. RECOMMENDATIONS

The authors recommended a remedial investigations consisting of:

1) Additional record searches and interviews should be conducted to obtain more information on radium source locations(s) and other pertinent matters. Especially important are the as-built drawings of the water well in Building 8504 and those of the water and sanitary sewer systems. Electric and sample logs of both the well in Building 8504 and the abandoned well in Building 8502 will be extremely important for determining zonation of the Paluxy aquifer and of significant help in locating the most hydraulically conductive portions of it. Length of the normal pumping period of the well into building 8504 to replenish water in the water tower adjacent to the well, and the typical period between pumpings are desired data. Information on any dump areas not yet reported and what was placed in them is of special interest. Air Force nuclear authorities will be consulted as to whether maintenance of weapons in Building 8503 could have allowed any radium 226/228 to be released.

2) Soil borings - background (naturally occurring) radium content. Ten borings 1.5 feet deep, one sample per boring.

   a) Soil borings - sanitary sewer system filter bed. Five borings approximately 5 feet deep, two samples per boring.

3) Stream samples - North and South Forks of Live Oak Creek - eight water samples, four samples each fork.

4) Well water samples - two samples for radium anion determination.

5) Pump test of water well IAW 161-44. This test depends upon installation of an "air line" in the well through which water levels in the well can be measured while the well is being pumped. The test is designed to discover the magnitude of piezometric slope change to be expected within normal pumping and shutdown periods. If conditions permit, attempt will be made to determine hydraulic conductivity of the Paluxy aquifer by means of the pumping test.

6) Walnut test boring. Two borings approximately 15 feet deep located near the top of the ridge in the vicinity of well in Building 8504. These borings are to be cored and water pressure tested to better define hydraulic properties of the Walnut Formation.

7) Continue plotting monthly rainfall against radium content of the well in Building 8504 as developed by Carswell Bioenvironmental Office.

8) Prepare a report covering results of above investigations.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The assessment was performed in the latter part of 1991. The report of findings was submitted in January 1992.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Community Relations Plan
Author: U.S. Department of the Air Force
Doc No: CAFB-X5
Submittal: April 1993

1. STUDY OBJECTIVES

The Community Relations Plan (CRP) is part of the program implemented at all installations with IRP sites, in accordance with DOD and EPA guidelines. This proactive public information program is required by CERCLA to help ensure that the community will:

1) be informed of planned and ongoing activities,
2) be given the opportunity to comment on and provide input to technical decisions, and
3) to allow environmental concerns to be addressed as early as possible during the remedial process. The CRP addresses activities to inform the public, such as preparation and coordination of news release, development of fact sheets for general distribution, community interviews, information repositories, etc.

2. STUDY ACCOMPLISHMENTS

There are many different types of community related activities that may be utilized as part of a CRP. At Carswell, and Environmental Advisory Committee (EAC) was formed in July 1992 to serve this function and is concerned with ongoing IRP and compliance activities, as well as other as related disposal and reuse issues. Advisory Committee members include representatives from Carswell, Plant 4, Air Force Base Disposal Agency (AFBDA), the Texas Water Commission (TWC), EPA Region VI, AFCEE, U.S. Army Corps of Engineers, CRA, and city/state officials. Meeting will be held on a quarterly basis. The Air Force will, with the acceptance of each RI/FS by the regulatory community, prepare a proposed plan for the remediation of site(s) which will include a discussion of alternatives considered. The plan will be distributed to the public for comment and the Air Force will respond to all comments.

3. DATA/INFORMATION DEVELOPED

The CRP program will promote community involvement through the following avenues:

1) Fact Sheets. Fact sheets will provide summaries of environmental investigation will be prepared and distributed by the AFBDA and its AE contractor as needed to give the public a better understanding of the environmental issues at the base.
2) Briefings and Discussions. AFBDA will maintain the EAC, conduct briefings, presentations, and discussions with interested individuals, groups, organizations, and agencies when necessary to communicate developments in the environmental clean-up process.
3) Press and News Releases. Periodic press and news releases will be submitted by the AE contractor to the AFBDA site manager. These submittals should be facilitated by the AE contractor's capability and access to utilize a computer and network or modem. Press releases will be made as developments occur in the environmental clean-up process and to announce any related meetings.
4) Administrative Record. An Administrative Record has been prepared for Carswell IRPs. Final restoration-related documents are located in the White Settlement Public Library to encourage public review of ongoing IRP activities. The AE contractor shall be responsible for updating the Administrative Record and for adding public comment to the Record after the AFBDA site manger's review.

5) Public Comments. Formal public comment periods are held for the RI/FS and Proposed Plan. The RI/FS, Proposed Plans, and Records of Decisions (ROD) are handled by the individual AE firms which are contracted for the separate IRP sites. AFBDA and its contracted AE firms shall acquire from the IRP site-AE firms a record of unsolicited comments and comments received after the comment period, and related ROD records, as part of the administrative record.
6) Public Information Repositories. The contracted AE firm shall, in conjunction with the Administrative Record, file final restoration-related documents in the White Settlement Public Library and in the downtown Fort Worth Library. provisions should be made to ensure shelf space and cataloging of materials to accommodate the collection.
7) Mailing Lists. A mailing list should be developed and updated periodically in order to distribute press and news releases, fact sheets, and related materials.
8) Revision of the CRP. The CRP may be revised at any time to incorporate new information or to reflect changes in the community's concern. The RI/FS process for Carswell is currently in progress. During the investigation and remediation activities, the Air Force will evaluate the community's involvement and may revise the schedule of community relations activities.
9) Activities Schedule. Due to the diversity of the environmental conditions under evaluation, clean-up activities will be initiated at varying stages. AFBDA and its contracted AE firm shall acquire from the IRP site-AE firms this information to coordinate with the listed Community Relations Activities.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

The CRP continues to perform appointed duties.

6. STUDY SCHEDULE

The Community Relations Plan was submitted in April 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Investigation/Remediation Report
Spot 35 (Fuel Spill)
Author: U.S. Corps of Engineers
Doc No: CAFB-X6
Submittal: November 1992

1. STUDY OBJECTIVES

This document presents drilling logs relating to the referenced investigation.

2. STUDY ACCOMPLISHMENTS

This document presents lithologic data which was developed during the investigation.

3. DATA/INFORMATION DEVELOPED

This document contains only the drilling logs and construction diagrams for the monitor wells installed during the investigation.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

Title: Soil Gas Survey
Base Service Station (IRP Site 16)
Author: Target Environmental Services, Inc.
Doc No: CAFB-X07
Submittal: March 1993

1. STUDY OBJECTIVES

TARGET Environmental Services, Inc. conducted a soil gas survey at Site ST-16, Base Service Station, where evidence of impact to the groundwater had been documented during the Phase II investigation. The purpose of the soil gas survey was to help determine the areal extent of the impacted groundwater plume emanating from the service station.

2. STUDY ACCOMPLISHMENTS

A total of 86 borings were drilled in order to collect soil samples for screening of petroleum hydrocarbons. One sample was collected from each boring, from a depth interval ranging from depths of 4 to 9 feet below the land surface. Each sample was analyzed on a gas chromatography equipped with a flame ionization detector (GC/FID) for the presence of any petroleum hydrocarbon vapors.

3. DATA/INFORMATION DEVELOPED

High levels of Total FID Volatiles were present along the sewer line east of Rogner Drive. Moderate levels occurred along the western side of Rogner Drive and in a sample collected south of the sewer line. All of these samples were collected from a depth of 4 feet. Low levels were observed in three isolated areas along the eastern and southern survey boundaries. Significant levels of volatile hydrocarbons were not present at a depth of 9 feet throughout the grassy area in the central portion of the survey area.

The chromatogram signatures of the samples collected on the western side of Rogner Drive are characteristic of a relatively unweathered gasoline. Early eluting peaks representing the most volatile and mobile gasoline hydrocarbons are observed in the signatures of the samples collected along the sewer line.

Soil gas data support the introduction of gasoline hydrocarbons into the subsurface at the base service station. Chromatographic data suggests that the sewer line may be providing a conduit for vapor migration in this area. The low levels of gasoline hydrocarbons observed along the eastern survey boundary may be the result of revolatilization of hydrocarbons dissolved in the groundwater, suggesting that the groundwater plume may extend this far. The connection between the source at the base service station and the low levels at the eastern site boundary were not determined by this survey. Vertical vapor migration may have been impeded in the central portion of the survey area by the clay/silt soils.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

Data collected during the soil gas survey were used to formulate the Remedial Investigation/Feasibility Study plan (Document CAFB-X034), submitted in March 1993.

6. STUDY SCHEDULE

The soil gas survey was performed on February 24, 25, and 26 1993. The report was submitted in March 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Environmental Impact Statement
Author: Carswell Redevelopment Authority
Doc No: CAFB-X8
Submittal: February 1993

1. STUDY OBJECTIVES

Carswell Air Force Base (AFB), Texas, was one of the bases recommended by the 1991 Defense Base Closure and Realignment Commission for closure. The Commission's recommendations were accepted by the President and submitted to Congress on July 12, 1991. As Congress did not disapprove the recommendations in the time given under the Defense Base Closure and Realignment Act (DBCRA) of 1990 (Public Law [P.L.] 101-510, Title XXIX), the recommendations have become law. Carswell AFB is scheduled to be closed in September 1993.

The Air Force is required to comply with the National Environmental Policy Act (NEPA) in the implementation of the base disposal and reuse. The Air Force must now make a series of interrelated decisions concerning the disposition of base property. This environmental impact statement (EIS) has been prepared to provide information on the potential environmental impacts resulting from disposal and proposed reuse of the base property. The Federal Aviation Administration (FAA) and the Federal Bureau of Prisons (FBOP) are cooperating agencies in the preparation of this EIS, who will make decisions on their own and assist the Air Force in making related decisions concerning Carswell AFB property. Several alternative reuse concepts are studied to identify the range of potential direct and indirect environmental consequences of disposal.

After completion and consideration of this EIS, the Air Force will prepare decision documents stating what property is excess and surplus, and the terms and conditions under which the dispositions will be made. These decisions may affect the environment by influencing the nature of the future use of the property.

2. STUDY ACCOMPLISHMENTS

Scope of Study.

The Notice of Intent to prepare an EIS for the disposal and reuse of Carswell AFB was published in the Federal Register on October 9, 1991. Issues related to the disposal and reuse of Carswell AFB were identified during an ensuing scoping period. A public scoping meeting was held on October 29, 1991, at the VVIII Rogers Coliseum in Fort Worth, Texas. The comments and concerns expressed at this meeting and in written correspondence received by the Air Force, as well as information from other sources, were used to determine the scope and direction of studies and analyses required to accomplish this EIS.

This EIS discusses the potential environmental impacts associated with the Proposed Action and reasonable alternatives. In order to establish the context in which these environmental impacts may occur, potential changes in population and employment, land use and aesthetics, transportation, and utility services are discussed as reuse-related influencing factors. Issues related to current and future management of hazardous materials and wastes are also discussed. Potential impacts to the physical and natural environment are evaluated for soils and geology, water resources, air quality, noise, biological resources, and cultural resources. These impacts may occur as a direct result of disposal or as an indirect result of changes due to reuse.

The baseline against which the Proposed Action and alternatives are analyzed consists of the conditions projected at base closure in 1993. Although the baseline assumes a closed base, a reference to preclosure conditions is provided in several sections (e.g., air quality and noise) to allow a comparative analysis over time. This will assist the Air Force decision maker and other agencies that may be making decisions relating

to disposal and reuse of Carswell AFB in understanding potential long-term trends in comparison to historic conditions when the installation was active.

The Air Force is also preparing a separate Socioeconomic Impact Analysis Study (SIAS) on the economic impacts expected in the region as a result of the closure, disposal, and reuse of Carswell AFB. That document, although not required by NEPA, will assist the local community in planning for the transition of the base property from military to civilian use. Population and employment data developed for the SIAS were used to establish influencing factors in the EIS.

Summary of Environmental Impacts

This EIS considers environmental impacts of the Air Force's disposal of the installation, as well as interim activities (e.g., interim outleases) that may be allowed by the Air Force before final disposal, and portrays a variety of potential land uses to cover reasonable future uses of the property and facilities by others. Several alternative scenarios, including the community's proposed plan, were used to group reasonable land uses and to examine the environmental effects of likely reuses of Carswell AFB.

Environmental impacts of the Proposed Action and reasonable alternatives are briefly described below. Influencing factors include projections of the reuse activities that would likely influence the biophysical environment, including ground disturbance, socioeconomic factors, and infrastructure demands and are summarized in Table S-1. The employment and population trends are depicted in Figures S-1 and S-2. Impacts of the Proposed Action and alternatives over the 20-year study period are summarized in Table S-2. Impacts for air quality are summarized over a 10-year period due to the speculative nature of projecting pollutant concentrations far in the future. The table includes a summary of closure baseline conditions to provide a basis for comparison of reuse-related changes and associated impacts.

Mitigation and Pollution Prevention

Options of mitigating potential environmental impacts that might result from the Air Force disposing of property or from the implementation of the Proposed Action or alternatives by property recipients are presented and discussed. Since most potential environmental impacts would result directly from the reuse by others, the Air Force would not typically be responsible for implementing such mitigation. Full responsibility for these suggested mitigation, therefore, would be borne primarily by future property recipients or local governmental agencies. Mitigation suggestions affected resource areas, where appropriate, are summarized along with the environmental impacts of the Proposed Action and alternatives in Table S-2.

3. DATA/INFORMATION DEVELOPED

Alternatives for Future Use

Carswell AFB comprises a total of 2,555 acres of fee-owned property; up to 2,197 acres will be available for disposal for civilian reuse, and at least 358 acres will be retained by the Air Force as a cantonment for continued military use. The base property includes three noncontinuous parcels: the main base with 1,964 acres of land currently used for aviation-related, commercial (administrative, industrial, residential, and open space/recreational purposes; a 44-acre property currently developed for residential use; and a 247-acre property with industrial and open space areas.

For the purposes of evaluating potential environmental impacts resulting from the subsequent reuse of this land, the Air Force has based its Proposed Carswell AFB Disposal and Reuse DEIS action on the community's reuse plan. The proposal, developed by Carswell Redevelopment Authority (CRA), focuses on general industrial and business development using the existing aviation-related infrastructure. The reuse plan includes the establishment of a civilian aviation facility used for air cargo, general aviation, and military flight operations. The proposal also includes the development of industrial, institutional, commercial, office,

and residential areas, as well as retention of the existing hospital facility and golf course for civilian use. In addition, the retained military containment is included within the Proposed Action to provide continued support for the Air Force Reserve (AFRES) 301st Fighter Wing (FW), White House Communications Agency (WHCA), Defense Reutilization and Marketing Office (DRMO), and Air Force (AF) Plant #4 (aircraft operations). This military containment is included under all alternatives evaluated.

The following alternatives to the Proposed Action are being considered:

* The Industrial Airport Alternative centers on the development of a civilian aviation facility for industrial (e.g., aircraft maintenance/manufacturing general aviation and military uses, with long-term development for commercial passenger service operations. In addition, the base hospital facility would be converted to a retirement and assisted care complex. As with the Proposed Action, a variety of other non-aviation uses would also be developed; however, the size and location of these land uses differ from the Proposed Action. As previously mentioned, this alternative includes the military cantonment for retained military activities.
* The Military/Mixed Use Alternative provides for the continued use of the airfield for military flight activities only, and does not include any civilian aviation-related development. As a result, the amount of land retained by the Air Force for continued military use would expand to about 1,157 acres to include the airfield. The remaining property available for disposal would be developed for a mixture of nonaviation-related civilian uses similar to the Proposed Action. However, additional residential areas would be provided through the retention of existing housing units, and the existing golf course would be expanded to a 36-hole facility. Other land uses would also differ in size and location in comparison to the Proposed Action.
* Under the No-Action Alternative, the 301st FW, WHCA, DRMO, and limited AF Plant #4 activities would continue to operate within a containment. The airfield would also continue to be operated by the Air Force and used by the 301st FW, AF Plant #4, and other military transients. The remainder of the base property would remain under caretaker status with no civilian reuse in the long term.

This EIS contemplates in part that the Air Force would continue to operate within a containment area and the airfield under the Military/Mixed Use and No-Action alternatives. If the base does not become a civil airport, further recommendations authorizing a contingent course of action by the Air Force may have to be made by a future Base Closure Commission pursuant to P.L. 101-510, and become law. In the absence of such a change in the law, acceptance of that continuing military airfield aspect of these alternatives may not be a choice legally available to the decision maker.

Other land use concepts (including FBOP's proposed land uses) have been identified for discrete facilities or areas of the base property. These include reuse plans that have not been captured within the comprehensive reuse alternatives, including the Proposed Action. These unique proposals for portions of the base property available for disposal could, therefore, be implemented in conjunction with the Proposed Action or any of the alternatives under consideration.

4. RECOMMENDATIONS

Local Community

Redevelopment of the base property under the Proposed Action would result in an increase in employment and population in the region of influence (ROI) consisting of Tarrant, Parker, and Johnson counties. Most of the increases would affect the communities of Fort Worth, White Settlement, and Westworth Village within Tarrant County. Reuse activities would increase employment levels by approximately 30,276 jobs (13,821 direct and 16,455 secondary jobs) by the year 2013, resulting in a total ROI employment of 1,023,083 in 2013. The Proposed Action would increase ROI population by about 27,970 persons, or 1.5 percent over post-closure conditions in the year 2013.

Noticeable changes to on-base land uses would occur due to civilian redevelopment. Proposed on-base land uses would be generally compatible with each other, but the office-industrial development may cause continued conflicts with the recreational use of Lake Worth by restricting public access. Aviation uses would continue to conflict with adjacent residential uses west of, the base; however, elimination of the Air Installation Compatible Use Zone (AICUZ) would reduce some conflicts off-base. Proposed civilian land uses would require modification of the community's current general plans and zoning; however, the development policies within the local communities will likely be revised to reflect the changes in land use as a result of the Proposed Action. New construction and removal of mature landscaping could reduce the visual quality along the Lake Worth shoreline and State Highway (SH) 183; however, the replacement of existing facilities with new residential development within the Kings Branch and Off-Site Weapons Storage Area (WSA) would create positive visual effects.

The Proposed Action would incorporate two new entry points to improve access to the west side of the base. Traffic associated with the Proposed Action would degrade SH 183 to Level of Service (LOS) F causing a need to program future improvements. With planned improvements, the other key roadway segments would be maintained at LOS E or above. No airspace conflicts or air transportation impacts are expected under the Proposed Action.

Utility consumption associated with the Proposed Action would represent a relatively small increase to the ROI demand and could be accommodated by existing and future system capacities. Local utility systems may need to be interconnected to on-base systems and facilities to provide required service. Pretreatment of industrial wastewater on site may be required prior to discharge in accordance with applicable wastewater discharge permits.

Hazardous Materials and Hazardous Waste Management. The quantities of hazardous materials and wastes used and generated by the Proposed Action are expected to be greater than closure conditions. The responsibility for managing hazardous materials and wastes would shift from a single user to multiple, independent users. This may degrade the capability of responding to hazardous materials and waste spills and would also increase the regulatory burden.

Reuse activities are not expected to affect remediation under the Installation Restoration Program (IRP), which is proceeding according to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations, Federal Facilities Agreement (FFA) between the U.S. Air Force, U.S. Environmental Protection Agency (U.S. EPA), and Texas Water Commission (TWC) for AF Plant #4 IRP, and the Defense-State Memorandum of Agreement (DSMOA) for Carswell AFB IRP. However, redevelopment of some properties may be delayed or land use restrictions may be required due to the extent and type of site contamination and by current and future IRP remediation activities. Based on the results of IRP investigations, the Air Force may, where appropriate, place limits on land reuse through deed restrictions on conveyances and use restriction on leases. Prior to disposal, existing underground storage tanks (USTs) not in conformance with current regulations or not required for reuse will be deactivated and removed, unused aboveground storage tanks will be purged, and all oil/water separators will be pumped and cleaned. Appropriate precautions to avoid damage to storage tanks and distribution lines should be implemented during construction and operations. All polychlorinated biphenyl (PCB) equipment and PCB-contaminated equipment under Air Force control will be removed from the base by the time it closes. The explosive ordnance disposal (EOD) range will also be cleared of unexploded ordnance prior to disposal.

Asbestos that poses a health risk will be removed prior to property disposal. Proper management of asbestos remaining in existing buildings will minimize the potential risk to human health and the environment. Demolition or renovation of structures with asbestos-containing materials (ACM) would be subject to applicable regulations and National Emissions Standards for Hazardous Air Pollutants (NESHAP). Increased pesticide usage due to increased landscaped areas would be subject to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and state guidelines. Potential owners of facilities with registered radon levels above 4 picocuries per liter (pCi/L) would be advised of this condition prior to property conveyance.

Medical/biohazardous materials generated under the Proposed Action would be managed under all applicable regulations.

Natural Environment

The Proposed Action would increase effects to soils, geology, water resources, noise, air quality, biological resources, and cultural resources from the closure baseline. This reuse would include construction of new facilities and infrastructure that would disturb or alter 768 acres of land. As soils are moderately susceptible to wind and water erosion, prevention measures may be necessary to minimize those impacts during ground-disturbing activities. Development and ground disturbance would cause changes to surface drainage flows and may increase the amount of impervious surface. Degradation to surface water quality may result from increased storm water runoff and increased wastewater discharge. Compliance with local and National Pollutant Discharge Elimination System (NPDES) permit requirements would minimize water quality impacts. Adequate surface water supplies are available to meet the increased water demand generated by the Proposed Action.

Construction and operations associated with the Proposed Action would increase air pollutant emissions over closure conditions, although adverse impacts are not expected. The Proposed Action would not increase the frequency or severity of violations of the ozone air quality standard or interfere with the State Implementation Plan (SIP) to reach the attainment level for the ozone standard through the application of the SIP's reactive organic gas (ROG) control measures. Other National Ambient Air Quality Standards (NAAQS) would not be exceeded by the Proposed Action.

By the year 2013, the area exposed to aircraft noise levels of day-night average sound level (DNL) 65 decibels (dB) or greater would increase by less than 2 percent (101 acres) over the closure baseline. For comparison, the reuse-related aircraft noise levels would expose less than 70 percent of the area exposed under preclosure conditions when the B-52s and KC-135s were in operation. Based on current land use patterns, about 105 additional residents could be exposed to aircraft noise levels of DNL 65 dB or greater due to civilian aircraft operations in 2013. In addition, surface traffic noise levels would increase over certain roads and expose up to 381 additional residents in 2013 to noise levels of DNL 65 dB or greater when compared to post-closure conditions.

Effects to biological resources would be minimal under the Proposed Action. Adverse impacts to threatened and endangered species or migratory bird habitat are not expected. Development could result in the loss of approximately 0.1 acres of low-quality jurisdictional wetlands. No significant archaeological, Native American, or paleontological resources are known to occur on the base property. Disposal activities have the potential to adversely affect five historic properties that are either already listed on, or potentially eligible for listing on the National Register of Historic Properties.

Industrial Airport Alternative

Local Community. This alternative would increase employment levels by approximately 14,795 jobs (6,913 direct and 7,882 secondary jobs) by the year 2013, resulting in a total ROI employment of 1,007,602 in 2013. The reuse-related jobs are expected to be filled by the available labor pool in the ROI; therefore, no population effects in the ROI are expected due to workers entering the region to fill the reuse-related job positions.

Civilian redevelopment would generate noticeable changes in land uses on base. These proposed land uses would generally be compatible with each other, except some conflicts could occur between the retained military uses and residential areas retained in the northeast portion of the base. Aviation uses would also continue to conflict with residential uses west of the base. However, some off-base land use conflicts would be reduced due to the elimination of the AICUZ. Proposed civilian land uses would require modification of the communities' current general plans and zoning. Revisions to the development policies would likely be made to reflect redevelopment plans. Visual aesthetic impacts would be similar to the Proposed Action.

Existing entry points would be improved to allow access to commercial and aviation support development on base. With planned roadway improvements, the reuse-related traffic increases would maintain LOS D or above along key roadway segments. No airspace conflicts are expected under this alternative. The proposed commercial passenger service would not likely impact the emplacement levels at Dallas/Fort Worth (DFW) International Airport or Dallas Love Field (DAL). The proposed airport development could decrease the air carrier base at DFW; however, other air carriers would likely absorb the vacated gates to improve service. Reuse related utility consumption would represent a minimal increase to the ROI demands and no impacts due to system capacities are expected. System distribution and treatment improvements to provide required service would be similar to the Proposed Action.

Hazardous Materials and Hazardous Waste Management. Quantities of hazardous materials and wastes utilized would be greater than closure conditions and less than the Proposed Action. IRP site remediation could cause delays in redevelopment or require some land use restrictions. Other aspects of hazardous materials and waste management associated with this alternative would be similar to those discussed under the Proposed Action.

Natural Environment. Effects to soils, geology, water resources, air quality, noise, biological resources, and cultural resources would increase over the closure baseline. Types of effects to soils, geology, and water resources would be similar to the Proposed Action, but less land would be disturbed and less water supply would be required to meet reuse-related demands. Air emissions generated by this alternative would be less than under the Proposed Action due to the smaller amount of construction and operation activity; however, impacts would be similar to those described under the Proposed Action. Noise impacts due to aircraft operations would also be less than the Proposed Action. Based on current land use patterns, up to an additional 89 residents could be exposed to aircraft noise levels of DNL 65 dB or greater due to civilian aircraft activities in the year 2013. Increases in surface traffic noise levels from the closure baseline would be less than the Proposed Action due to lower levels of reuse-related traffic. Impacts to biological resources would be similar to or slightly less than the Proposed Action, and no adverse impacts are expected. As discussed under the Proposed Action, adverse impacts to five historic properties may result from disposal activities.

Military/Mixed Use Alternative

Local Community. This alternative would increase employment levels by approximately 6,736 jobs (3,245 direct and 3,491 secondary jobs) by the year 2013, resulting in a total ROI employment of 999,543 in 2013. No population effects would be incurred under the Military/Mixed Use Alterative as the available labor pool within the ROI would be capable of providing the workers needed to fill the reuse-related jobs.

Although civilian land uses would generally be similar to preclosure conditions, conversion of aviation support land uses to industrial and replacement of residential areas with the expanded golf course would result in noticeable changes to on-base land uses. On-base land use conflicts similar to those under the Industrial Airport Alternative may occur between the retained military uses and the residential acres in the northeast portion of the base. Retention of the military airfield and AICUZ guidelines would continue to cause conflicts with adjacent land uses. The continued use of easements for safety buffer zones at the Off-Site WSA would restrict development. This alternative is generally compatible with the residential nature of the current general plans and zoning, although some modifications to the community's plans may be required. Visual impacts would be greater than the Proposed Action and Industrial Airport Alternative due to the low levels of proposed development and the continued industrial use of the Off-Site WSA.

As under the Industrial Airport Alternative, existing entry points would be improved to allow access to industrial and residential development on base. With planned roadway improvements, conditions would remain at LOS D or above along key roadway segments despite reuse-related traffic increases. No airspace conflicts or air transportation impacts are expected under this alternative. Reuse-related utility consumption would be lower than the Proposed Action and no impacts due to system capacities are expected. System distribution improvements to provide required service would be similar to the Proposed Action.

Hazardous Materials and Hazardous Waste Management. Quantities and types of hazardous materials and wastes utilized would increase over closure conditions, but amounts would generally be less than those utilized for the other reuse alternatives. IRP site remediation could cause delays in redevelopment or require some land use restrictions. Other aspects of hazardous materials and waste management associated with this alternative would be similar to those discussed under the Proposed Action and Industrial Airport Alternative.

Natural Environment. Effects to soils, geology, water resources, air quality, noise, biological resources, and cultural resources would increase over the closure baseline. Types of effects to soils, geology and water resources would be similar to the Proposed Action and Industrial Airport Alternative, but less land would be disturbed and less water supply would be required to meet reuse-related demands. Air quality emissions would be less than the other reuse alternatives; however, impacts would be similar to those described under the Proposed Action. No increases in aircraft noise levels would occur since the military aircraft operations would be similar to closure baseline conditions. Increases in surface traffic noise levels from the closure baseline would be less than the Proposed Action due to lower levels of reuse-related traffic. Impacts to biological resources would be similar or slightly less than the Proposed Action and Industrial Airport; and no adverse impacts are expected. As discussed under the Proposed Action, adverse impacts to five historic properties may result from disposal activities.

No-Action Alternative

Local Community. The retained military activities would continue within the cantonment and existing airfield. The remainder of the base would continue to be placed under caretaker status whether or not the U.S. government retains title to the property. Approximately 674 direct jobs and 823 secondary jobs would be established by base closure and would remain unchanged throughout the 20-year analysis period. The presence of an essentially vacant and unused area in the middle of the community could detract development and delay revitalization of adjacent lands. No effects on utilities or on road, air, or railroad transportation are expected.

Hazardous Materials and Hazardous Waste Management. Similar quantities and types of hazardous materials and pesticides would be used to support cantonment operations and grounds maintenance activities as under closure baseline conditions. The 301st FW, DRMO, WHCA, AF Plant #4, and the caretaker would be individually responsible for hazardous materials and waste management in accordance with applicable regulations. Storage tanks would be removed or maintained in place according to required standards. ACM would be managed in accordance with Air Force policy to protect human health and the environment. Pesticide usage would continue to be managed in accordance with FIFRA and state guidelines. Occupied facilities that are affected by radon would be remediated in accordance with Air Force policy.

Natural Environment. Little to no ground disturbance or changes in operations would occur under this alternative; therefore, impacts to soils, geology, water resources, air quality, noise, and biological resources would be negligible relative to the closure baseline. Biological resources may be enhanced compared to preclosure conditions due to reductions in human activity, ground disturbance, and noise levels. Adequate caretaker maintenance would preclude deterioration of any important historic properties.

Other Land Use Concepts

Five other independent proposals for portions of the base have been included as other land use concepts in the environmental analysis. These land use concepts are described below.

McKinney Act. As part of the McKinney Act of 1987 (P.L. 100-77), the U.S. Department of Housing and Urban Development (HUD) evaluates excess government buildings and properties for suitability as housing for the homeless. If suitable and there is a need, these properties can then be made available to homeless providers through the U.S. Department of Health and Human Services (HHS). This assessment has not been completed at Carswell AFB. There are several potential locations within the base property that could support the needs for homeless housing and support facilities. However, for the purposes of analysis in this EIS,

existing Wherry housing units adjacent to SH 183 have been identified as potential low-income housing or housing for the homeless. It is assumed that, with renovation, these units would support about 175 persons in 71 dwelling units.

Fort Worth Aviation Heritage Museum. This proponent has entered a request for use of existing aircraft hangars and parking areas for an air museum and technology center. This center would provide an exhibit hall that could be used by the public and local industries to display and market their products and technologies. In addition, flightline parking/ramp space may be required for aircraft and aerospace equipment. Minimal staff are expected to be associated with operation and maintenance of the museum.

Federal Bureau of Prisons. The FBOP, through the U.S. Department of Justice, has interest in a 145-acre parcel located in the northeast quadrant of the base, encompassing the base hospital, existing housing, and undeveloped land for use as a federal medical center and correctional institution.

The federal medical center would provide in-patient medical care for inmates. This facility would accommodate up to 500 inmates and would employ 350 persons to provide 24-hour medical care and security. The existing hospital complex would require renovation to provide security. The correctional institution would be a detention facility for inmates receiving out-patient care from the medical center or awaiting transfer back to their original institution. The facility would accommodate up to 1,600 inmates in general living units and would generate about 250 jobs. Its development would include demolition of existing housing and new construction.

In addition, FBOP has requested the use of Building 1231 for a showroom and warehouse of products produced by Federal Prison Industries (UNICOR), and Building 1251 for a distribution center. The UNICOR facilities would employ an additional 50 persons in each building.

Gospel Inspirational Fellowship. This proponent has expressed interest in leasing the Carswell AFB chapel (Building 1838) with an option to buy. The Gospel Inspirational Fellowship plans to use the chapel for religious purposes and to establish a counseling center. Employment levels would be minimal.

Regional Military Shopping Center. Under this proposal the Base Exchange (BX) and Commissary would remain under Department of Defense (DOD) ownership/control and would provide services for the military retirees in the region similar to preclosure conditions. The proposed site of approximately 18 acres is in the northeast quadrant of the base. This proposal would generate about 450 direct jobs; 300 of these would be associated with the BX and 150 with the Commissary.

These other land use concepts are analyzed in terms of their effects on the influencing factors and the environment when combined with the Proposed Action and other alternatives. Impacts associated with the implementation of other land use concepts are summarized in Table S-3.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The EIS was submitted in February 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Preliminary Assessment/Investigation
Waste Oil Dump (Site DP17)
Author: U.S. Corps of Engineers
Doc No: CAFB-X9
Submittal: November 1992

1. STUDY OBJECTIVES

This document presents drilling logs relating to the referenced investigation.

2. STUDY ACCOMPLISHMENTS

This document presents raw lithologic data in the form of drilling logs.

3. DATA/INFORMATION DEVELOPED

This document contains only the drilling logs and construction diagrams for the monitor wells installed during the investigation.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This investigation has been completed.

6. STUDY SCHEDULE

This investigation has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Preliminary Assessment/Site Investigation
Landfill No. 6 (Site No. 6) (Draft)
Author: U.S. Corps of Engineers
Doc No: CAFB-X10
Submitted: June 1993

1. STUDY OBJECTIVES

The purpose of this investigation was to conduct the preliminary assessment of the extent impact to the soil and/or groundwater at Landfill No. 6 at Carswell AFB. Landfill No. 6 was originally a gravel pit used for base construction activities. After the gravel had been removed, the site was used for the burial of construction rubble, trees, and miscellaneous trash. The adjacent structures near the site are Buildings 1050 and 1027. Building 1050 is located NW of the site and utilized as a maintenance hangar. Buildings 1027 is located NW of the site and is used as a corrosion control facility. Several drums of hydraulic fluid were reportedly buried in a centrally located pit used for the collection of groundwater. Due to the proximity of Site No. 6 to the flight line shops, it is possible that small quantities of other hazardous materials were buried there. The estimated location and depth of buried drums is not known at the present time. The specific object of this investigation is to locate the buried drums of hydraulic fluid and determine the impact from possible leakage.

A magnetometer survey is necessary to determine their location. The existing site is currently being used to park recreational vehicles, and is completely fenced to limit free access. It is likely that any future activities at the site will not affect the subsurface environment.

2. STUDY ACCOMPLISHMENTS

The site investigation consisted of drilling and sampling five soil borings, designated LF06-1 through LF06-5. Boring LF06-1 was selected as a background sampling location because it was outside the limits of the disposal area and was in the assumed upgradient direction of groundwater flow. Boring LF06-2 was located outside the fenced area to verify the limits of the disposal pit did not extend past the fence. Boring LF06-3 was located in the center of the site for the purpose of encountering any buried debris and associated contamination. Borings LF06-4 and LF06-5 were located at the northernmost corner of the site in an effort to better define the extent of the disposal area.

Borings were drilled by Corps personnel. Each was drilled to a depth at which groundwater was encountered. Soil samples were taken at 2-foot intervals for the entire depth of each boring and were analyzed for benzene, toluene, ethyl benzene, xylenes (BTEX), total recoverable petroleum hydrocarbons (TRPH), and total halogenated organics (TOX). All samples were field screened using a photoionization detector (PID), and the sample showing the highest PID reading was retained for both TCLP lead and TCLP benzene analyses. Twenty-four hours after each boring was completed, the depth to groundwater was recorded and groundwater samples were collected for BTEX, TRPH, total dissolved solids (TDS), and lead analyses. Each boring was then backfilled to the ground surface using a cement-bentonite slurry.

Drilling within the fenced area was difficult due to caving gravel encountered at a depth of approximately 15 feet. Landfilled construction debris consisting of concrete, bricks, asphalt, and cinder materials also made drilling difficult within this area, often limiting the recovery and number of samples collected from borings LF06-3 and LF06-4. Landfilled material was encountered to a depth of 14.1 feet in LF06-3 and to a depth of 19.5 feet in LF06-4. A clayey zone approximately 2.5 feet thick underlay the landfilled debris in LF06-3, which in turn was underlain by fine to coarse grained gravel to the total boring depth of 22 feet. This clayey zone was not present in LF06-4, but the same type of gravel was encountered to the total depth of 22 feet. Groundwater was noted at approximately 19.5 feet in LF06-3 and at approximately 17.5 feet in LF06-4.

Boring LF06-5 was relocated in a northern direction several times within the fenced area in an attempt to drill outside the limits of landfilled debris. The last location of the boring encountered 15 feet of clay containing various amounts of sand and gravel, with coarse to fine grained gravel occurring at 15 feet and extending to the final boring depth of 22 feet. Groundwater was recorded at approximately 18.5 feet.

Boring LF06-2 was drilled immediately outside the southern end of the fenced area to determine if the landfill extended beyond this boundary. No debris was encountered during drilling, indicating this location was beyond the limits of the landfilled area. Groundwater was noted at 15 feet 24 hours after drilling.

Boring LF06-1 was drilled as a background boring to determine background concentrations in soil and groundwater. It was situated approximately 200 feet due west of the southern end of the site across and adjacent to Roaring Springs Road. Subsurface materials encountered consisted of high plasticity clay with sand and gravel zones to a depth of 11 feet, underlain by a thin (1.5 feet) layer of coarse to fine gravel. Limestone was found at 12.6 feet. Groundwater was noted at 10 feet in this boring 24 hours after drilling.

Soil and groundwater samples were shipped to the Corps of Engineers, Southwestern Division (SWD) Laboratory in Dallas. Analyses were performed by NDRC Laboratories, Inc., and by Eureka Laboratories, Inc. The quality assurance/quality control (QA/QC) evaluation was made by SWD Laboratory.

3. DATA/INFORMATION DEVELOPED

Only three borings completed during this investigation detected hydrocarbon contamination. The background boring (LF06-1) detected TRPH as high as 40 ppm down to a depth of 9.5 feet. Borings LF06-3 and LF06-4, located within the limits of the site, detected trace amounts of toluene and xylenes and high concentrations of TRPH. Total recoverable petroleum hydrocarbons (TRPH) were detected at levels as high as 5160 ppm at a depth of 8.0 feet in LF06-3. In LF06-4, TRPH was as high as 401 ppm at 1.5 feet, with a concentration of 225 ppm found at 15.0 feet in the boring. The distribution of petroleum hydrocarbons in both of these borings corresponded with the occurrence of landfilled debris. The occurrence of TRPH in background LF06-1 had no physical evidence of contamination noted during drilling.

Groundwater samples for chemical analyses were collected in only three of the five borings. Caving gravel made it difficult to keep the boring open, even using slotted PVC pipe. Samples were collected from borings LF06-1, LF06-2, and LF06-4. Only one groundwater sample, LF06-1, detected petroleum hydrocarbons. TRPH was detected at 0.3 mg/L in this background boring. No benzene, toluene, ethyl benzene, or xylenes were detected in the water samples from any to the three borings. Total dissolved solids (TDS) ranged from 356 mg/L in LF06-1 up to 736 mg/L in boring LF06-4. The higher TDS value may correspond to the presence of buried debris in this boring.

Only two groundwater samples were obtained for lead analysis. These were taken from borings LF06-1 and LF06-2. Lead was found at 0.361 mg/L in LF06-1 and at 0.068 mg/L in LF06-2. Both of these concentrations exceed the action level for lead of 0.015 mg/L. Relative depths to groundwater recorded in the borings support a general flow direction to the northeast.

The following conclusions were made based on the results of the investigation:

1) Subsurface investigations and surface topography correlate to strongly indicate that the limits of the landfilled gravel pit are within the area currently fenced. Landfilled materials appear to consist of construction-type debris.
2) Contamination associated with these materials consists predominantly of TRPH, with trace amounts of toluene and xylenes. Concentrations of TRPH exceed the current Texas Water Commission guidelines for remediation to 100 ppm for a release from petroleum storage tanks (pst); however, the source of TRPH at this site is not past usage.

3) The contamination source is more likely past disposal of petroleum wastes during construction debris landfilling. It is inconclusive whether TRPH contamination at the site has affected the groundwater because of the difficulties experienced in keeping the borings open to obtain sufficient groundwater sampled.
4) Relative depths to groundwater indicate groundwater is flowing to the northeast. If this is true, then TRPH in the groundwater at the upgradient LF06-1 location is from a source other than Landfill No. 6. The concentration of TRPH detected in the groundwater in this boring was just above the detection limit at 0.3 mg/L. The source of this contamination may be within the soil at this location, which was found to contain up to 40 ppm of TRPH, or it may be another source upgradient of the site. A possible explanation for the low levels of TRPH detected in the soils at and immediately above the groundwater and within the groundwater itself may be another contaminant present which interferes with the Method 418.1 analysis. The site is located very near the suspected limits of the trichloroethene (TCE) groundwater contaminant plume currently being investigated for Air Force Plant 4. Trichloroethene has a C-H bond which interferes with the freon used to run the Method 418.1 analysis. The presence of TCE in the groundwater at the LF06-1 location could interfere with the TRPH analyses and cause false positive readings. TRPH were not detected in the one groundwater sample collected within the limits of the former disposal site (LF06-4).
5) Both groundwater samples collected for lead analysis contained lead concentrations exceeding the current action level of 0.15 mg/L for lead. It is inconclusive whether wastes contained in Landfill 6 have contributed to these concentrations; however, if LF06-1 is upgradient of the site, the high concentration of lead (0.361 mg/L) found in groundwater at this location is likely indicative of either naturally high levels of lead in the groundwater or a contributing source of lead occurring upgradient of the site.

In summary, the construction debris are buried to depths as great as 19.5 feet within the fenced area which defines the extent of Landfill 6. This debris is characterized by high concentrations of TRPH. Groundwater occurs above the maximum burial depth of debris, posing a potential for groundwater contamination. Insufficient groundwater quality data obtained from the soil borings cannot determine whether soil contaminants at the site have impacted the groundwater and which direction they may be migrating. The assumed upgradient sampling location appears to be contaminated. The possibility exists that upgradient contamination is due to TCE in the groundwater and not TRPH.

4. RECOMMENDATIONS

The following recommendations were made:

1) It is recommended that four additional groundwater monitoring wells be installed at the landfill for the purpose of determining groundwater flow direction and to obtain quality groundwater samples to evaluate any impact made by the site. These wells should be installed at least 5 feet into the groundwater, with the screens bracketing the water table. The background monitoring well should screened from the water table surface all the way to the top of underlying bedrock (limestone), located in LF06-1 at 12.6 feet, to ensure interception of any high density contaminants.
2) Because the nature of the source of the petroleum hydrocarbons is uncertain, and TCE is a suspected upgradient groundwater contaminant, soil and groundwater samples should be analyzed for the following constituents using the EPA Test Methods cited: volatile organic compounds (VOC - EPA Method 8240); polycyclic aromatic hydrocarbons (PAH - EPA Method 8100); and total recoverable hydrocarbons (TRPH - EPA Method 418.1). Soil samples for total metals (TM - arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) analyses -should also be taken. Groundwater analyses should include total dissolved solids (TDS - EPA Method 160.1).
3) Soil samples for chemical analyses should be taken from at least three depths within each boring: one sample should be taken of any unsaturated suspected contaminated zone encountered during drilling; another should be taken immediately above the saturated zone; and a third should be

taken at the total depth of the boring. Soil samples should also be collected from the unsaturated zone in each boring for laboratory analysis to determine the following soil characteristics: bulk density; effective porosity; fraction organic carbon I intrinsic permeability; and volumetric water content. Sampling intervals for these physical parameters should best represent the materials through which contaminants would migrate.

4) A complete round of groundwater sampling should be performed after all wells have been installed. Each well should be surveyed to determine groundwater flow direction and to correlate stratigraphy. Results from groundwater analyses will yield direction of groundwater flow and reliable water quality data to determine the impact of soil contamination at the site.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The field investigation was performed during the early part of 1993. The report was submitted in June 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Investigation/Remediation Report
Removal of Buried Drums and An Underground Storage Tank
Waste Burial Area
Author: U.S. Corps of Engineers
Doc No: CAFB-X11
Submittal: January 1992

1. STUDY OBJECTIVES

This Investigation/Remediation Report is prepared in accordance with the RCRA Facility Investigation/Remediation Plan, Removal of Buried Drums and an Underground Storage Tank, SWMU Number 24, Waste Burial Area, Carswell Air Force Base, Texas 7 July 1991. That document summarizes the work performed, result of observations and inspections, and results of the soil testing performed.

The Waste Burial Area is located in the southern portion of Carswell AFB at the northeast corner of the intersection of White Settlement Road and Cody Drive. During a utility installation in the vicinity of the waste burial area, the contractor encountered a buried 55 gallon drum. Subsequent detailed records search revealed the site was used to bury 55 gallon drums and a suspected underground storage tank (UST). The contents of one of the drums located near the ground surface was tested and was found to contain trichloroethylene. A magnetic survey of the area was performed during February 1991 and resulted in the identification of 9 anomalies that were possible drum/UST locations.

2. STUDY ACCOMPLISHMENTS

The removal contractor, Tank Systems, Inc., began excavating at locations determined by an electromagnetic survey. During the excavation the site was monitored using a Photoionizing device. When drums were encountered, the contents, if any, were drained into clean 55 gallon drums. The empty drums were placed into overpack drums. The soil was stockpiled near each excavation and covered with plastic sheeting. The contractor excavated between site "C" and "G". This area was labelled "J". This site was excavated due to the locations of the drums found within the adjacent sites (west edge of C and east edge of G). Soil samples were drawn from each stockpile to determine the presence an level of contamination, if any.

The following material was excavated from each site:

SITE	MATERIAL
A	3 drums (all empty)
B	3 drums (1 empty, 1 w/8 gal product, 1 w/3 gal product), 10 each 5 gal cans
C	1 drums w/25 gal product
D	1 3-inch pipe
E	9 drums (7 empty, 1 w/20 gal product, 1 w/5 gal product)
F	12 drums (11 empty, 1 w/25 gal product)
G	5 drums (2 empty, 3 w/total 50 gal product)
H	1 drum (empty)
I	1 steel power pole anchor

The suspected UST was never detected. It can be concluded that the UST was never disposed of at the site since all anomalies were examined. At sites "D" and "I",clean soil was immediately backfilled since there were no contaminant sources found.

Contaminated soil was placed into clean 55-gallon drums and properly disposed of. Soil that was that was found to have contaminants below the Maximum Contaminant Level (MCL) was used for backfill at the site. Soil was brought to the site to replace the contaminated soil. The site was brought to its original grade and seeded.

At each of the stockpiles, except D and I, a representative soil sample was collected for laboratory testing. The analytical results of each sample were as follows:

Excavation A: Not Tested.

Excavation B: There was a TCE concentration of 153 µg/Kg and a PCE concentration of 9.9 µg/Kg.

Excavation C: There was a TCE concentration of 17.7, a PCE concentration of 13.0 ug/Kg and a TPH concentration of 87 mg/Kg.

Excavation E: There were no significant concentrations of the tested parameters.

Excavation F: There was a TCE concentration of 35.9 µg/Kg, and a TPH concentration of 110 mg/Kg.

Excavation G: There were no significant concentrations of the tested parameters.

Excavation H: There was a TCE concentration of 134 µg/Kg, PCE concentration of 1,470 µg/Kg, and a TPH concentration of 90 mg/Kg.

Excavation J: There was a TCE concentration of 1350 µg/Kg, a PCE concentration of 245 µg/Kg, and a TPH concentration of 65 mg/Kg.

Background: There was a TCE concentration of 28.4 µg/Kg and a TPH concentration of 17 mg/Kg.

Barium was detected in all lettered samples ranging from 57.0 to 95.9 mg/Kg. The background sample had a concentration of 16.0 mg/Kg. A review of previous samples conducted during the Air Force's Installation Restoration Program at Landfill 4 and Landfill 5 indicate Barium levels ranging from 2.8 to 70 mg/Kg. These two sites are located within 400 feet of the waste burial area. This investigation reported a normal range for barium in soils range from 100 to 500 mg/Kg. The barium detected is considered to be naturally occurring at the detected levels.

On 8 October 1991 the results of the soil testing were sent to Mr Alan Church, TWC, via facsimile. On 9 October 1991 a conference call was held with Mr Alan Church; Mr Frank Grey, Carswell AFB: and CPT John Monger, Fort Worth District Corps of Engineers, to discuss the test results and the disposition of the soil. It was concluded by all parties that the soil associated with excavations "B", "H", and "J" shall be placed into 55-gallon drums and properly disposed of at a permitted landfill due to the elevated concentrations of TCE and PCE. The soil resulting from excavations "C", "E", "IF" and "G" shall be used as backfill at the site. After the conference call it was noted Mr. Michael Lee, Corps of Engineers Construction Site Representative, that there were no disposition instructions for stockpile "A". Mr. Lee assumed worse case and had the contractor place the soil into 55-gallon drums for disposal offsite with excavations "B", "H"as a contaminated waste.

The liquids encountered during the excavation were drained into clean 55 gallon drums. A total of approximately 300 gallons of liquids were recovered. All liquids are assumed to be hazardous.

3. DATA/INFORMATION DEVELOPED

This document presents analytical and lithological data gathered during the remedial action.

4. RECOMMENDATIONS

Current plans are to design and construct a RCRA landfill cap over the site. This combined with long-term groundwater monitoring should complete closure of the site.

5. STATUS OF STUDY

A contract was awarded to Dallas Environmental Services Technology, Dallas, Texas, on 23 January 1992 to properly dispose the contaminated soil.

6. STUDY SCHEDULE

The work plan was submitted on 7 May 1991 and approved on 7 July 1991. The field investigation was performed in October 1991. The report of findings was submitted in January 1992.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Results of Chemical Analysis of Soil and Water Samples
Waste Oil Dump
Author: U.S. Army Corps of Engineers, Southwestern Division Laboratory
Doc No: CAFB-X12
Submittal: February 1993

1. STUDY OBJECTIVES

This report presents documentation of receipt of thirty-seven (37) soil samples, three (3) quality assurance (QA) soil samples, 3 quality control (QC) soil samples, 5 groundwater samples, 10 travel blanks, and 3 rinsate blanks, for the Waste Oil Dump.

2. STUDY ACCOMPLISHMENTS

This study documents the receipt of environmental samples.

3. DATA/INFORMATION DEVELOPED

This study documents the receipt of environmental samples.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Results of Chemical Analysis of Soil and Water Samples Landfill 6
Author: U.S. Army Corps of Engineers, Southwestern Division Laboratory
Doc No: CAFB-X13
Submittal: February 1993

1. STUDY OBJECTIVES

This report presents documentation of twenty-five (25) soil samples, two (2) quality assurance (QA) soil samples, 2 quality control (QC) soil samples, 3 groundwater samples, 7 travel blanks, and 3 rinsate blanks, for Landfill 6.

2. STUDY ACCOMPLISHMENTS

This study documents collection of environmental samples.

3. DATA/INFORMATION DEVELOPED

This study documents collection of environmental samples.

4. RECOMMENDATIONS

No recommendations were presented in this document.

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Health & Safety Plan
Remedial Investigation/Feasibility Study
Base Service Station (Site No. 16)
Author: U.S. Army Corps of Engineers
Doc No: CAFB-X14
Submittal: April 1993

1. STUDY OBJECTIVES

This Health and Safety (H&S) Plan establishes the work practices necessary to help ensure protection of personnel during the remedial activities at the Base Service Station (IRP Site No. 16).

The objective for the plan is to provide a mechanism for the establishment of safe working conditions at the site. The safety organization and procedures have been established following an analysis of potential hazards at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of occupational illnesses, accidents and injuries.

All site operations will be performed in accordance with applicable state, local and IT corporate regulations and procedures, OSHA requirements, and client requirements.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

This volume presents methodology for conducting additional assessments.

5. STATUS OF STUDY

This HASP will be utilized during the remedial actions at the Base Service Station.

6. STUDY SCHEDULE

The HASP was submitted in April 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Contract Quality Control Plan (Addendum)
Groundwater Remediation Installation Start-Up
Landfill Nos. 4 and 5
Author: International Technology Corporation
Doc No: CAFB-X16
Submittal: April 1993

1. STUDY OBJECTIVES

This document presents an Addendum to the Contract Quality Control Plan (CQCP) for the work to be performed during the groundwater remediation project at Landfills 4 and 5 (LF 4/5). IT Corporation is contracted with the U.S. Army Corps of Engineers (USACE) to provide remedial design and remedial action, including design, installation, system start up, operations, maintenance, and related quality assurance/quality control (QA/QC), for the groundwater remediation project. This plan focuses on specific QA/QC activities, including inspection, testing, and verification procedures, for contractual elements required to implement groundwater remediation at the project site. The QUAP primarily establishes elements of the program.

The LF 4/5 area is located on the east side of Carswell AFB Taxiway 191. Previous investigations have shown this area to contain unconsolidated sediments (Upper Zone) with trichloroethylene (TCE) contamination. Based on analytical data collected by Radian Corporation in 1990, the TCE contamination forms a narrow concentrated central plume paralleling a bedrock valley with the thickest portion of the upper zone sand and gravels at the project site. A broader, lower-concentrated outlying plume is moving in the direction of the Upper Zone groundwater flow.

IT has designed a groundwater recovery system to partially capture the plume and a treatment scheme which primarily utilizes air stripping technology for the contaminated groundwater. Upon completion of the system, the treated water is designated sanitary sewer manhole connecting to a publicly owned treatment system of the Fort Worth Water Department.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting the remedial actions.

3. DATA/INFORMATION DEVELOPED

Groundwater Remedial Actions. A description and list of all remedial actions, including collection, treatment, and discharge, that are to be performed for groundwater remediation at the project site are presented in the Request for Quotation (RFQ). The remedial actions listed below that have been identified as containing QA/QC components include the following:

* Installation of below grade groundwater collection pipe and electrical conduit
* Installation of below grade treated water discharge pipe
* Installation, operation, and maintenance of a groundwater pumping system in existing recovery well CAR-RW2
* Installation, operation, and maintenance of an modular air stripping treatment unit on rental basis as interim measure
* Installation, operation, and maintenance of groundwater pumping systems in seven existing recovery wells
* Installation, operation, and maintenance of five modular air stripping treatment units for long-term groundwater remediation.

The plan also addresses the handling, sampling, and disposal of the drill cuttings generated during the remediation activities.

Detailed work items and the related QA/QC requirements for the above-mentioned components are presented in Chapter 3.

4. RECOMMENDATIONS

No recommendations were presented in this document.

5. STATUS OF STUDY

Not available.

6. STUDY SCHEDULE

The plan was formulated and submitted in April 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Health & Safety Plan
Groundwater Remediation Investigation
Landfill Nos. 4 and 5
Author: International Technology Corporation
Doc No: CAFB-X17
Submittal: April 1993

1. STUDY OBJECTIVES

This Health and Safety (H&S) establishes the work practices necessary to help ensure protection of personnel during the Groundwater Remedial activities for Landfill No. 4 (LF04) and Landfill No. 5 (LF05) at Carswell AFB.

The objective for the plan is to provide a mechanism for the establishment of safe working conditions at the site. The safety organization and procedures have been established following an analysis of potential hazards at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of occupational illnesses, accidents, and injuries.

All site operations will be performed in accordance with applicable state, local, and IT corporate regulations and procedures, OSHA requirements, and client requirements.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

No recommendations were presented in this document..

5. STATUS OF STUDY

This HASP will be utilized during the remedial actions at Landfill No.s 4 and 5.

6. STUDY SCHEDULE

The HASP was submitted in April 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

Title: Consolidation/Disposal Drilling Work
Landfill Nos. 4 and 5 and the Window Area
Work Plan
Author: International Technology Corporation
Doc No: CAFB-X18
Submittal: July 1993

1. STUDY OBJECTIVES

This work plan addresses the handling and disposal of drummed and roll-off contained wastes generated during the Phase I and Phase II recovery well installation work at Landfills 4 and 5 (LP 4/5) at CAFB and the Window Area at Plant No. 4.

2. STUDY ACCOMPLISHMENTS

The work at each of these areas is described separately since the wastes will be handled under different manifests and contracts. In order to save funds on travel and mobilization of equipment, the work at these sites was done under one mobilization as a continuous effort. Daily activities were recorded by the Site Supervisor on the Field Activity Daily Log (FADL). Daily quality control and health and safety reports for the USACE will also be completed. The drum consolidation work will be conducted in accordance with the existing Health and Safety Plan (HASP), as amended, to address drum handling.

Window Area

Drumming Wastes. Drummed waste including drill cuttings, drilling mud, personnel protective equipment (PPE), and plastic sheeting generated during in the Windows Area is stored in the Lockheed facility along the southern boundary of the East Parking Lot drum storage area (Phase II). Approximately 80 drums were generated during Phase I work and 130 drums during the Phase work.

Drum consolidation and cleaning work will be conducted in the East Parking Lot area The roll-off boxes, decontamination pad, drum crushing area, and equipment storage areas will be set up near the existing drums with Lockheed approval. The work will be conducted in areas where the normal traffic into and out of the plant will not be impacted. Water used for the cleaning of the equipment and drums will be obtained from a source identified by Lockheed.

Transfer of Drums and Slot Setup. The first step in the disposal process will be to vacuum off the free liquid in the drilling mud drums in the Lockheed drum storage area on the west side of the plant. This will be done prior to moving the drums to the East Parking Lot area. The drums will be transported along internal plant roads from the west side to the East Parking Lot area.

Work area preparation in the East Parking Lot will be conducted concurrently with the west side drum dewatering. This will include the construction of a wood and plastic sheeting decon pad. The staging of the roll-off boxes, equipment delivery to the site, and the set up of the boundaries of the exclusion, decon, and clean work zones.

Drum Consolidation. Once the East Parking Lot area has been set up, drums now staged in the area will be opened and the free liquid will be vacuumed out of the drums. The Phase I and Phase II drums will then be emptied into the roll-off boxes. Calcium or another acceptable water fixing agent will be added to the contents of the box and mixed with a backhoe so there is no free liquid in the roll-off. Residual solid material in drums will be removed by hand tools if necessary. The emptied drums will then be cleaned with a steam cleaner and set aside for crushing.

Water collected from the drums and decon area will be placed I the tanker located next to the drums in the East Parking Lot. The tanker will act as a settling tank for solids and the clear liquid will eventually be placed in the tanker at Recovery Well RW-3UR for subsequent treatment at the west side plant. At the end of each shift or during periods of rain, the roll-off box lids will be closed. Plastic sheeting waste will not be consolidated in the roll-offs until the analytical waste characterization results are received. This will allow for this material to be disposed of as municipal waste if laboratory analysis indicates that the soil and drilling muds are not hazardous waste.

Roll-Off Sampling. After the roll-offs are filled and the fixing material has been added and mixed with the drill cuttings, composite samples will be collected to characterize the waste. One composite sample per roll-off will be collected. The composite will be made up of material collected from each comer of the box and two center samples. A clean shovel will be used to dig 1 to 2 feet down into the material to collect the sample. Each composite sample will be analyzed for trichloroethylene (TCE) using U.S. Environmental Protection Agency (EPA) Method 8240 and Toxicity Characteristic Leaching Procedure (TCLP) volatile organics and chromium. The analytical data will be reviewed to determine the waste classification.

Waste Disposal Options. The following waste disposal options will be evaluated based on the result of the waste classification:

- Use of the material as clean fill at the facility.
- Disposal of the waste as a nonhazardous material at a municipal landfill.
- Disposal of the material as a hazardous waste.

If the soil cuttings have TCE levels above the threshold for landfilling, the disposal options may also include pretreatment or incineration technologies. The assumption was made that the waste would go to the Laidlaw facility in South Carolina using truck transportation.

Carswell Air Force Base

Drumming Waste. Drummed waste, including drill during the work in the former radar and two half-full cuttings, drilling mud, PPE, and plastic sheeting generated during Phase I and Phase II work at the LF 4/5 area, is stored in drums and roll-off boxes inside the fence of facility along White Settlement Road. Approximately 50 drums of material cubic yard roll-off boxes are in the area Drum consolidation and cleaning work will be conducted inside the former radar facility fence. The roll-off boxes are already staged in the area and the remaining capacity should be sufficient to handle the rest of the material. A plastic sheeting and wood decontamination pad, drum crushing area, and equipment storage area will be set up near the drums and roll-offs with Air Force approval. The work will be conducted in areas where access through the radar facility to the flightline will not be obstructed. Water for the cleaning of the drums and other equipment will be obtained from the fire hydrant used during the drilling work.

Drum Consolidation and Waste Characterization. The first step will be to vacuum off free liquids in the drums and the roll-off boxes. This may be done concurrently with the work at the Lockheed facility in order to minimize the onsite time for the vacuum truck and operator. Vacuumed water will be discharged from the vacuum truck into the Baker tanker located closest to the flightline. This water will be treated at a later date in the temporary treatment system. The remaining steps in the drum consolidation process and waste characterization process will follow the procedures described under Section 2.0.

Waste Disposal Options. The following waste disposal options will be evaluated based on the results of the waste classification and Air Force waste handling procedures:

* Disposal of the waste as a nonhazardous material at a municipal or industrial waste landfill
* Disposal of the waste at a hazardous waste facility.

If the soil cuttings have TCE levels above the threshold for landing, the disposal options may also include pretreatment or incineration technologies. The east for these services is not included in this proposal. For purposes of prep a budgetary estimate for the work, the assumption was made that the waste would go the Laidlaw facility in South Carolina using truck transportation.

Equipment. The following equipment and services will be utilized for the drum consolidation work:

* Backhoe
* Forklift
* Drum grappler
* Steam cleaner and water tank
* Support vehicles and trailer
* Miscellaneous small and hand tools
* Health and safety equipment
* Air monitoring equipment
* Waste characterization, IT Analytical Services, Austin, Texas
* Vacuum truck, Geoprojects International, Inc., Austin, Texas
* Drum crushing, Lorimar Services, Norman, Oklahoma
* Roll-offs (already at LF 4/5), Fluid Transport, Inc., Snyder, Texas.

Cost Estimate. A cost estimate for the consolidation and disposal of the drilling waste is attached to this work plan. The costs for each area, Air Force Plant No. 4, and Carswell Air Force Base are presented separately. IT plans to do this work with one mobilization to and from the Fort Worth area. All travel costs have been accumulated under Delivery Order No. 001 for the Window Area of Air Force Plant No. 4. There are 210 drums at Air Force Plant No. 4 and only 50 drums at Carswell Air Force Base LF 4/5. The cost for transportation and disposal is based on the material being shipped to a hazardous waste landfill and is for budgetary purposes only.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This study is ongoing.

6. STUDY SCHEDULE

The plan was formulated and submitted in July 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Field Sampling and Analysis Test Plan
Groundwater Remediation
Window Area
Author: International Technology Corporation
Doc No: CAFB-X19
Submittal: October 1992

1. STUDY OBJECTIVES

The Field Sampling, Analysis and Testing Plan (FSATP) was prepared as a portion of the submittal requirements for the Phase I groundwater remediation in the Window Area of Air Force Base Plant 4. This FSATP includes the procedures necessary for the installation of recovery wells in the Window Area and testing of their capabilities. This FSATP is one of three documents prepared addressing the scope of work to be done in the Window Area. Companion documents are the project Contract Quality Control Plan and the Health and Safety (H&S) Plan. These documents cover other aspects of the project and are required for full understanding of project controls and procedures.

The Window Area at Plant 4 to be investigated as part of this work scope is a small portion of the total area of Plant assembly building, within the area occupied by the east parking lot. Previous investigations have shown this area to contain unconsolidated sediments (upper layer) with trichloroethylene (TCE) contamination. The TCE contamination forms narrow, highly-concentrated central plume paralleling the bedrock topography, with a broader, lower-concentrated outlying plume moving in the direction of Upper Zone groundwater flow. Investigations of the underlying Paluxy Aquifer have shown a saturated zone to exist in an upper sand unit of the Paluxy around the Window Area that indicates an interconnection between the upper zone and the Paluxy Aquifer.

The Window Area has been defined as the location where overburden alluvium (upper layer) is in contact with the sandstone of the Paluxy Aquifer. This area has been further expanded as part of this investigation to include regions in which only a thin layer of the Walnut Formation separates the upper layer from the Paluxy Aquifer. The Window Area shown in Figure 1 may include some Walnut Formation within it as the geology of the area is not fully defined.

The primary objective of the Phase I Window Area groundwater remediation is to determine if a groundwater recovery well field will be an effective contaminant removal system in the Window Area. The secondary objective is to set design parameters to assist in the design of a water treatment plant, including flow rates and groundwater chemistry. To accomplish these objectives, the Phase I scope involves the installation, testing, sampling, and analysis of three recovery wells within the Window Area.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

This investigation is ongoing.

6. STUDY SCHEDULE

The sampling plan was formulated and submitted in October 1992.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the database.

8. DISCREPANCIES

No discrepancies noted.

Title: Health and Safety Plan
Groundwater Remediation of Window Area
Air Force Plant No. 4
Author: International Technology Incorporated
Doc No: CAFB-X20
Submittal: October 1992

1. STUDY OBJECTIVE

The objective of this plan is to provide a mechanism for the establishment of safe working conditions at the site. The safety organization and procedures have been established following an analysis of potential hazards at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of accident or energy.

2. STUDY ACCOMPLISHMENTS

This Health and Safety Plan establishes the work practices necessary to help ensure protection of International Technology personnel and subcontractors during the Groundwater Remedial Action for the Window Area at Plant 4.

3. STUDY DATA/INFORMATION

The Health and Safety Plan describes in detail the following items:

- Personnel Responsibilities
- Job Hazard Analysis
- Hazard Control Program
- Personnel Protective Equipment
- Site Control
- Decontamination
- Site Monitoring
- Employee Training
- Medical Surveillance
- Emergency Procedures

Included in the appendices are the following:

- Site and Hospital Location Maps
- Contractor Certifications
- Chemical Information

4. RECOMMENDATIONS

No recommendations were presented in this document..

5. STUDY SCHEDULE

This study is ongoing.

6. STUDY SCHEDULE

This study is ongoing.

7. IRPIMS STATUS

Information included in the Health and Safety Plan has not been entered into IRPIMS

8. DISCREPANCIES

No discrepancies noted.

Title: Contract Quality Control Plan (Addendum)
Groundwater Remediation System
Installation Start-Up
Landfill Nos. 4 and 5
Author: International Technology Corporation
Doc No: CAFB-X22
Submittal: March 1993

1. STUDY OBJECTIVES

This document presents the Contract Quality Control Plan (CQCP) for the work to be performed during the groundwater remediation project at Landfills 4 and 5 (LF 4/5). IT Corporation is contracted with the U.S. Army Corps of Engineers (USACE) to provide remedial design and remedial action, including design, installation, system start up, operations, maintenance, and related quality assurance/quality control (QA/QC), for the groundwater remediation project. This plan focuses on specific QA/QC activities, including inspection, testing, and verification procedures, for contractual elements required to implement groundwater remediation at the project site. The QUAP primarily establishes elements of the program.

The LF 4/5 area is located on the east side of Carswell AFB Taxiway 191. Previous investigations have shown this area to contain unconsolidated sediments (Upper Zone) with trichloroethylene (TCE) contamination. Based on analytical data collected by Radian Corporation in 1990, the TCE contamination forms a narrow concentrated central plume paralleling a bedrock valley with the thickest portion of the upper zone sand and gravels at the project site. A broader, lower-concentrated outlying plume is moving in the direction of the Upper Zone groundwater flow.

IT has designed a groundwater recovery system to partially capture the plume and a treatment scheme which primarily utilizes air stripping technology for the contaminated groundwater. Upon completion of the system, the treated water is designated sanitary sewer manhole connecting to a publicly owned treatment system of the Fort Worth Water Department.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

Groundwater Remedial Actions

A description and list of all remedial actions, including collection, treatment, and discharge, that are to be performed for groundwater remediation at the project site are presented in the Request for Quotation (RFQ). The remedial actions listed below that have been identified as containing QA/QC components include the following:

* Installation of below grade groundwater collection pipe and electrical conduit
* Installation of below grade treated water discharge pipe
* Installation, operation, and maintenance of a groundwater pumping system in existing recovery well CAR-RW2
* Installation, operation, and maintenance of an modular air stripping treatment unit on rental basis as interim measure

* Installation, operation, and maintenance of groundwater pumping systems in seven existing recovery wells
* Installation, operation, and maintenance of five modular air stripping treatment units for long-term groundwater remediation.

Detailed work items and the related QA/QC requirements for the above-mentioned components are presented in Chapter 3.

4. RECOMMENDATIONS

No recommendations were presented in this document..

5. STATUS OF STUDY

This study is ongoing.

6. STUDY SCHEDULE

The plan was formulated and submitted in March 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Preliminary Assessment/Site Investigation
Remedial Investigation/Feasibility Studies
Health and Safety Plan
Author: UNC Geotech
Doc No: CAFB-X23
Submitted: August 1990

1. STUDY OBJECTIVES

The purpose of this Health and Safety Plan is to assign UNC site personnel health and safety responsibilities, to prescribe mandatory operating procedures and to establish personnel protective equipment requirements for job, work, or activity, for alternative and contingency work items, for emergency response, and for spill cleanup and abatement. This plan is to be used for all Remedial Investigation/Feasibility Study (RI/FS) operations at Air Force Plant 4 (AFP 4) including but not limited to monitoring well drilling and construction, soil boring and sampling, and groundwater sampling.

2. STUDY ACCOMPLISHMENTS

The Health and Safety Plan establishes the health and safety procedures for the RI/FS.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

Recommendations for the safe conductance of the study were included in the Health and Safety Plan.

5. STUDY STATUS

This study has been completed.

6. STUDY SCHEDULE

This study has been completed.

7. IRPIMS STATUS

The information included in the Health and Safety Plan is not included in the IRPIMS list.

8. DISCREPANCIES

No discrepancies noted.

Title: Preliminary Assessment/Site Inspection
Volume III: Quality Assurance Project Plan
Author: Geotech
Doc No: CAFB-X24
Submittal: August 1990

1. STUDY OBJECTIVES

This Quality Assurance Project Plan (QAPP) is specific to the work being performed by UNC Geotech (UNC) and their subcontractors for Plant 4. The purpose of this Quality Assurance Project Plan is to provide an orderly assembly of the detailed and specific procedures and practices that delineate how data of known and acceptable quality will be produced for this project. In addition, this project plan describes the organizational structure and responsibilities of the project team.

This QAPP was prepared by the Quality Assurance (QA) Coordinator for issue by the Program Manager. It is also reviewed by the U.S. Department of Energy under the auspices of DOE Contract No. DE-AC07-86ID12584. It will be revised by the QA Coordinator and the Program Manager, as required, to meet the needs of the Program. Revisions will require approvals at the same levels as the original document. Requests for copies of the QAPP should be sent to the QA Coordinator.

The UNC Quality Assurance Manual, UNC Manual-101, is presented as Appendix B to this Quality Assurance Project Plan.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

No recommendations were presented in this document..

5. STATUS OF STUDY

The QAPP was utilized by Geotech in the performance of several remedial action investigations performed during 1991.

6. STUDY SCHEDULE

The QAPP was formulated and submitted in August 1990.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Results of Chemical Analysis of Water Samples
Recovery Well - CAR RW-2
Author: U.S. Corps of Engineers
Doc No: CAFB-X25
Submittal: June 1993

1. STUDY OBJECTIVES

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides raw analytical data only.

2. STUDY ACCOMPLISHMENTS

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides raw analytical data only.

3. DATA/INFORMATION DEVELOPED

This document presents laboratory analytical results of a groundwater sample collected from recovery well CAR RW-2 on May 14 1993.

4. RECOMMENDATIONS

No recommendations were presented in this volume.

5. STATUS OF STUDY

The sample analysis has been completed.

6. STUDY SCHEDULE

The sample analysis has been completed.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Site Specific Health & Safety Plan
Subsurface Barrier Wall Installation
Landfill No. 3
Author: International Technology Corporation
Doc No: CAFB-X26
Submittal: March 1993

1. STUDY OBJECTIVES

This Health and Safety (H&S) Plan establishes the work practices necessary to help ensure protection of IT personnel and subcontractors during the Groundwater Remedial Action for the Landfill No. 3 Area of Plant No. 4.

The objective for the plan is to provide a mechanism for the establishment of safe working conditions at the site. The safety organization and procedures have been established following an analysis of potential hazards at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of occupational illnesses, accidents and injuries.

All site operations will be performed in accordance with applicable state, local and IT corporate regulations and procedures, OSHA requirements, and client requirements.

2. STUDY ACCOMPLISHMENTS

This Health and Safety (H&S) Plan establishes the work practices necessary to help ensure protection of personnel and subcontractors during the Groundwater Remedial Action.

3. DATA/INFORMATION DEVELOPED

This Health and Safety (H&S) Plan establishes the work practices necessary to help ensure protection of personnel and subcontractors during the Groundwater Remedial Action.

4. RECOMMENDATIONS

This volume presents methodology for safely conducting the remedial action.

5. STATUS OF STUDY

This HASP will be utilized during the remedial actions at Landfill No. 3.

6. STUDY SCHEDULE

The HASP was submitted in March 1993. The study is ongoing.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

Title: Sampling and Analysis Plan
Subsurface Barrier Wall Installation
Landfill No. 3
Author: International Technology Corporation
Doc No: CAFB-X27
Submittal: March 1993

1. STUDY OBJECTIVES

This Field Sampling Plan (FSP) has been prepared as a portion of the submittal requirements for the groundwater containment and remediation in Landfill No. 3. This FSP includes the procedures necessary for the investigation of Landfill No. 3, installation of a hydraulic barrier, and installation of a groundwater extraction system. This FSP is one of three documents prepared addressing the scope of work to be done in Landfill No. 3. Companion documents are the project Construction Quality Control Plan (CQCP) and the Health and Safety (H&S) Plan. These documents cover other aspects of the project and are required for full understanding of project controls and procedures.

Landfill No. 3 is to be investigated as part of this work scope is a small portion of the total area of AFP 4 and is located north of the assembly building. Figure 1 shows the general location of this area. Previous investigations have shown this area to contain sediments with organic contaminants, including trichloroethylene, trans-1,2 dichloroethylene, toluene, methylene chloride, and vinyl chloride. The contaminants are located within the landfill materials and are migrating downgradient towards the Meandering Road Creek.

The objectives of the project are to install a hydrologic barrier and groundwater extraction system within the landfill to stop migration of contaminants within the unconsolidated zone. To accomplish these tasks, a geophysical survey program, a geotechnical boring program, and a geotechnical hydrologic testing program will be performed in Landfill No. 3. These programs will gather information necessary for final design and placement of the hydrologic barrier and groundwater exaction system. For the purpose of this FSP, the hydrologic barrier is assumed to be an impermeable wall (e.g., slurry wall), and the groundwater extraction system is assumed to be an extraction well field. Once the programs are completed, the final design will evaluate these and other alternatives.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for correctly conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for correctly conducting additional assessments.

4. RECOMMENDATIONS

This volume presents methodology for correctly conducting additional assessments.

5. STATUS OF STUDY

The QAPP will be utilized in the construction of the barrier wall at Landfill No. 3.

6. STUDY SCHEDULE

The QAPP was submitted in March 1993. The study is ongoing.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Contract Quality Control Plan (Addendum)
Subsurface Barrier Wall Installation
Landfill No. 3
Author: International Technology Corporation
Doc No: CAFB-X28
Submittal: September 1993

1. STUDY OBJECTIVES

This document presents the Contract Quality Control Plan (CQCP) for the work to be performed during the installation of the subsurface barrier wall at Landfill No. 3. This QA/QC plan is required to implement the planned operations. The CQCP primarily establishes elements of the program.

The LF 3 area is located on the east side of Carswell AFB. Previous investigations have shown this area to contain unconsolidated sediments (Upper Zone) which are contaminated with trichloroethylene (TCE). Based on analytical data collected by Radian Corporation (1990), the TCE contamination forms a narrow concentrated central plume paralleling a bedrock valley with the thickest portion of the upper zone sand and gravels at the project site. A broader, lower-concentrated outlying plume is moving in the direction of the Upper Zone groundwater flow.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for correctly conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for correctly conducting additional assessments.

4. RECOMMENDATIONS

This volume presents methodology for correctly conducting additional assessments.

5. STATUS OF STUDY

This study is ongoing.

6. STUDY SCHEDULE

The plan was formulated and submitted in September 1993. The study is ongoing.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Summary of Well Maintenance Activities (Letter Report)
Lockheed-Fort Worth Facility
Author: Hargis & Associates
Doc No: CAFB-X29
Submittal: May 1993

1. STUDY OBJECTIVES

This letter describes the well inventory and repairs conducted by Hargis & Associates at the above-referenced site. The objective of the inventory was to collect data regarding monitor well and pump conditions in order to evaluate the extent of repairs needed. The repairs were then performed along with other routine maintenance tasks such securing the wells and attaching identification tags.

2. STUDY ACCOMPLISHMENTS

Activities included a preliminary inventory of 228 monitor wells. The inventory was meant as a tool to gauge the current top-end condition of each well and the condition of the pump in each well, if so equipped. after the inventory was completed, the information was then used to compile lists of specific repairs that needed to be performed.

Overall, 11 well vaults were replaced. In addition, 2 existing vaults were removed and reset. Four well casings were repaired. Approximately 115 locking plugs were installed with locks. locks were also installed on approximately 70 additional wells and vaults.

All wells were located and accounted for. Well P-12M was found to be lacking 88 feet of backfill between the well casing and the conductor casing. Many wells that have bolt-down lids are missing bolts.

Stainless steel ID tags were affixed to 201 monitor wells. Identification tags were affixed onto the vault lids for wells that had crumbly concrete or did not have an acceptable mounting surface on the rim of the vault. New stainless steel ID tags as specified by Lockheed were attached to most wells using commercial adhesive.

In instances where it was possible, the amount of change in casing height was measured.

3. DATA/INFORMATION DEVELOPED

A tabulation of well status was prepared as a part of this investigation.

4. RECOMMENDATIONS

The following recommendations were made following the well inventory:

1) In the future, well maintenance should be performed as it becomes necessary on an individual basis. Guidelines for well maintenance should be developed and implemented.
2) Arrange for a pump contractor to troubleshoot the submersible pumps which did not function properly or at all. A list of these pumps are provided (Table 3).
3) Order and install locking plugs on selected wells. Concurrently, affix ID tags and install new locks on the small amount of wells that require such attention.

4) Order replacement bolts and the appropriate tap for reinstallation of bolts for bolt-down vault lids. The bolts and lids then could be installed by the routine sampling crew.
5) A drive-through gate should be installed at well cluster P-10 to allow for vehicle access to the wells.
6) Appropriate backfill material should be used in well P-12M to fill the 88 feet of space. The inside diameter of the conductor casing is 10 inches. the outside diameter of the ABS well casing is 4-3/4 inches.
7) Wells that may require vault repairs or alterations in the future are listed (Table 7).

5. STATUS OF STUDY

This study has been completed.

6. STUDY SCHEDULE

The well inventory and repairs were conducted by Hargis & Associates during February and March of 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program Quality Report
Author: Hargis & Associates
Doc No: CAFB-X30
Submittal: April 1992

1. STUDY OBJECTIVES

In March 1991, the Environmental Systems Division of Jacobs Engineering Group Inc. (Jacobs) was contracted to perform quarterly groundwater monitoring activities at Air Force Plant 4 (AFP4), Fort Worth, Texas. These activities are being carried out for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP).

The objectives of quarterly sampling at AFP4 are to:

1) monitor changes in groundwater over time in the Upper Zone and Paluxy aquifers,
2) monitor and map contaminant plumes,
3) assess the potential for movement of plumes across Air Force facility boundaries,
4) monitor changes in water levels,
5) check for and monitor free product thicknesses in wells where it occurs,
6) monitor offsite water quality by collecting groundwater and surface water samples from municipal water supply wells, streams, and other locations; and
7) try to detect possible contaminants entering surface waters as seeps from the Upper Zone.

This Quarterly Sampling Letter Report discusses sampling activities and analytical results from the second sampling round carried out between 27 January 1992 and 6 February 1992. During this period, a total of 25 groundwater monitoring wells and 7 surface water sites were sampled on AFP4 property and Carswell Air Force Base (Figure 1). Also discussed in this letter report are proposals for locations to be sampled during the third round scheduled to begin in April 1992.

2. STUDY ACCOMPLISHMENTS

During an initial inspection on 27 January, it was noted that Meandering Road Creek and Farmers Branch and its tributaries were in near-flood stage. Monitoring well water levels throughout the sampling period were also observed, in general, to be above levels measured during the first round in October 1991. Wells P-11US and P-13US were dry. AFP4 well P-8US and Carswell AFB well FT08-11B were therefore substituted after receiving verbal approval from the Technical Project Manager.

Surface waters were sampled on 1 February 1992, when flows were the lowest observed during the sampling period. However, these flows were still considerably higher than the late season flows observed early in the October 1991 sampling round. As in the first quarter, a variety of wells were sampled which necessitated the use of several different sampling and purging devices. Non-volatile samples were collected using either a 2-inch-diameter Teflon bailer, dedicated Triloc pumps, or dedicated submersible pumps.

Samples to be analyzed for volatile organic compounds (VOCs) were collected using a bottom-emptying device attached to a 2" diameter Teflon bailer. A bottom-emptying device and 1/2-inch-diameter stainless steel bailer were used at wells that have been constructed in such a way that they will not admit a standard 2-inch-diameter bailer. The wellhead construction at Middle Paluxy well P-6M does not allow the use of either bailer, and it was necessary to collect a VOC sample using the dedicated submersible pump installed on the well.

In general, sampling was carried out in the following order:

1) the breathing zone and wellhead area were checked for levels of total organic vapors using a portable HNU Photoionization Detector;
2) water level was checked using either a Slope Indicator or Keck interface probe depending on which tool could be lowered into the well;
3) if possible, total depth of the well was sounded using either of the above mentioned tools;
4) a purge water volume calculation was made based on water level, total well depth and casing diameter;
5) at least three casing volumes were purged while field parameter measurements (pH, specific conductivity and temperature) were made;
6) environmental samples, ambient condition blanks and duplicates were collected as necessary, labeled and stored immediately in coolers;
7) sampling equipment was decontaminated;
8) one equipment rinsate blank was collected each sampling day and stored in a cooler;
9) chain-of-custody forms were

3. DATA/INFORMATION DEVELOPED

All analyses during the second quarter were performed by Brown and Caldwell Analytical located in Glendale, California. Methods SW8015 and E524.2 were used to detect volatile organic compounds (VOCs) in samples from Middle Paluxy wells and most surface locations. VOC method SW8240 was applied to samples from Paluxy Upper Sand wells, Upper Zone wells, and two surface locations (LF05-S7, EGL-1). Table 2 summarizes sample locations and analyses performed during the second quarter.

A full suite of analyses was run for eight Upper Zone wells around the CAFB landfill sites and two surface locations adjacent to Meandering Road Creek (SSO, OF3) to characterize these areas more fully. The "Full suite" of methods includes

- Volatile Organic Compounds method SW8240(SW801 5/E524.2 at SSO and OF3)
- Semivolatile Organic Compounds method SW8270
- Oil and Grease method E413.2
- Total Petroleum Hydrocarbons (TPH) method E418.1
- ICP Metals Screen method SW6010.

The results of the sample analysis were as follows:

Semivolatiles

Semivolatile compounds were not detected in any of the 10 samples analyzed. The lab reported Oil and Grease compounds at or slightly above detection limits in samples from 9 of the 10 locations, generally 0.2 mg/L to 0.3 mg/l. TPH compounds were reported in similar concentrations, in all cases less than 0.5 mg/l. In one sample, from CAFB well LF05-19, no TPH or Oil and Grease compounds were detected.

Oil and Grease compounds were found in concentrations above detection limits at several sample locations. At the storm sewer outfall (SSO), runoff water from the large parking lots on the west side of AFP4 had concentrations of 0.9 mg/l. Also in the West AFP4/ Meandering Road Creek area, sample OF3 (1.2 mg/l) was taken from a seep at the contact of the Upper Zone and the underlying, less permeable Walnut Formation, immediately adjacent to Outfall 3. The water at that location probably originates from the parking lots via a large collection sump with 2 to 4 inlet pipes located immediately across Bomber Road. The water in the sump had a strong petroleum odor and any leakage could provide a source of Oil and Grease compounds to groundwater. Runoff from Bomber Road could also be a source, since it is only a few feet away from the OF3 seep.

Finally, areas of soil stained with non-volatile petroleum products were observed at a partially dismantled loading or storage area near FT09 12A. These stained areas could be part of the FT09 site and the source of Oil and Grease compounds at FT09-12A (0.9 mg/l).

Metals

Of the metals to which EPA has assigned primary MCLs, only barium was detected during the second quarter. Barium concentrations were below the MCL (1 mg/l) for all samples. Chromium and lead were not detected in any of the 10 samples analyzed during this round. Concentrations of aluminum, iron, and manganese were above Secondary MCLs in a number of samples. Note that the MCL for lead was revised downward from 0.05 to 0.015 mg/l by the U.S. Environmental Protection Agency, effective 6 November 1991. This puts the current MCL below the laboratory MDL.

Metals analyses were performed on samples from the CAFB landfill wells to monitor for chromium or other metals that could potentially be leaching from the landfill sites. However, no unusual concentrations of metals were measured in either the upgradient or downgradient wells.

Volatile Organic Compounds

Middle Paluxy Wells:

VOCs were not detected in P-24M. Low concentrations of TCE, TCE-derived compounds, and other chlorinated hydrocarbons were measured in samples from P-6M, P-12M, and P-22M (Table 3). P-22M also contained 24 ug/l toluene, which has been consistently detected there in the past (Hargis & Associates, 1989a; CNG, 1990). The TCE, DCE, vinyl chloride, and toluene values compare well with measurements made during the first quarter (Table 4).

Based on results from the first and second quarters, it is apparent that low concentrations of TCE, DCE and other compounds are present in the Middle Paluxy aquifer.

Paluxy Upper Sand Wells:

All available Paluxy Upper Sand wells were sampled during the second quarter to identify the extent of the TCE plume at that interval. TCE and TCE-derived compounds (DCE, vinyl chloride) were not detected in P-12US, P-17US, or P-18US. Wells P-11US and P-13US were dry and were not sampled. Paluxy Upper Sand results are illustrated in Figure 2.

The five Paluxy Upper Sand wells sampled in the Window Area had concentrations of TCE and cis-1,2-DCE ranging from 200 ug/l TCE and 32 ug/l cis-1,2-DCE in well P-8US (edge of Window Area) to 2100 ug/1 TCE and 160 ug/l cis-1 ,2-DCE in well P-14US (Table 3).

The highest concentrations (8400 ug/1 TCE and 620 ug/l cis-1,2-DCE) were measured in the sample from AFP4 flight line well P-19US, which is several hundred yards downgradient from the Window Area. These are unexpectedly high values, considering its distance from the currently defined Window Area and the tact that Geotech described it as "clean; sometimes dry" (CNG, 1990). Although the well was observed to be in generally good condition, leakage of Upper Zone water is a potential source for the high contaminant levels. The well has been proposed for sampling in the third quarter to confirm the second quarter value (see "Recommendations" section).

The results for P-9US and P-16US compare well with those obtained during the first quarter, although TCE and cis-1,2-DCE levels in P-16US are approximately twice as high as those reported during the first quarter (Table 4).

Upper Zone Wells:

AFP4 Flightline and Carswell AFB. Upper Zone wells were sampled to update the extent of the northern end of the TCE plume in the north flightline area and characterize contaminant concentrations upgradient and downgradient from Carswell AFB landfills LF04, LF05, and WP07. VOCs were not detected in AFP4 fight line well HM-98. Although it is ideally positioned to monitor changes at the plume boundary as it leaves AFP4, the well integrity at HM-98 was very poor (see "Problems" section) and it will not be included in future sampling rounds.

Second quarter results from CAFB north flightline well HM-119 are twice as high as in previous measurements (CNG, 1990) and suggest that the plume is moving north along the structural low of the eroded Cretaceous limestone surface toward Lake Worth. It is suggested that monitoring continue in this area during future sampling rounds.

Results for CAFB landfill wells compare well with those obtained during the first quarter. Effective detection limits (after lab dilution) for trans-1,2-DCE and vinyl chloride were 5 ug/l for LF05-5A and 10 ug/l for LF04-04, and may have masked levels of those compounds that were detected in those wells during the first round (Table 4).

No TCE or TCE-derived compounds were detected in CAFB landfill wells FT08-11A and FTO9-12A, apparently due to their positions upgradient or crossgradient from the landfill sites and outside the lateral margins of the AFP4 TCE plume as it enters the CAFB landfill area.

VOC results from wells downgradient from the CAFB landfill sites were generally higher than upgradient wells, suggesting that the CAFB landfills are contributing TCE and DCE to the AFP4 plume. However, it would be difficult to quantify this contribution without additional data from upgradient wells. This subject is more fully addressed in the final "Remedial Investigation Report for the Flightline Area" (Radian, 1991).

AFP4 and Carswell AFB Surface Locations. Given the more variable nature of surface water flows and inputs, the results from surface water samples compare well with those obtained during the first quarter (Table 4). No TCE or TCE-derived compounds were detected in samples from OF3 (seep adjacent to Outfall 3) or EGL-1 (aqueduct entrance). However, CAFB surface location EGL-2 (aqueduct outlet) contained 13 ug/l TCE and 6.4 ug/1 cis-1,2-DCE, suggesting that contaminated groundwater is seeping into surface water in the aqueduct where it is intersected by the plume.

Meandering Road Creek locations SW-05 and SW t)8 were sampled during the second quarter, and the results compare well with those obtained during the first quarter (Table 4). The consistently higher concentrations reported at SW-08 (relative to SW-05) may be explained in part by the input of parking lot runoff from storm sewer outfall location SSO, which enters Meandering Road Creek downstream from SW-05, but upstream from SW 08.

The high concentrations of TCE and DCE isomers reported for surface sample LF05-S7 (Table 3) support Radian's description of the unnamed tributary as "the principal pathway for offsite and off-base migration" (Radian, 1991). For this reason, and because of its proximity to residential areas, it is suggested that monitoring continue at this location in future sampling rounds.

4. RECOMMENDATIONS

Recommendations to correct the continuing corrosion and VOC sampling problems in Middle Paluxy wells were discussed in detail in the first quarterly report and will not be addressed here. Well P-6M remains a high priority for modification due to the continued low levels of TCE-derived compounds reported there.

Third Quarter Sampling Suite

Jacobs proposes the following 32 locations for the third sampling round to take place in April 1992 (Figure 3). Sampling during this round will focus on: 1) Middle Paluxy wells that have shown contamination in the past and Middle Paluxy offsite and boundary wells; 2) Upper Zone wells at plume perimeters; and 3) surface locations along Meandering Road Creek and on Carswell AFB.

1) Middle Paluxy wells P-5M, P-6M, P-10M, P-12M, P-22M, P-25M, P-26M, P-30M, WS-2, and WS-12 are proposed for sampling in the third quarter based on the following criteria:

   * Wells P-6M, P-12M, and P-22M contained low concentrations of TCE, TCE-derived compounds, and other VOCs in one or both of the first two quarters, and should continue to be monitored
   * VOC results for P-5M were below detection limits in the first quarter and P-25M has not been sampled by Jacobs, but previous contractors have reported chlorinated hydrocarbons in both.
   * P-10M, P-26M, P-30M, and White Settlement water supply wells WS-2 and WS-12 will be sampled to monitor any water quality changes in the Middle Paluxy aquifer at AFP4 boundaries and in public water supply wells.
   * Due to the limited number (six) of E524.2/SW8015 analyses budgeted for each quarter, samples from wells P-5M, P-6M, P-12M, and P-22M will be analyzed by VOC method SW8240 (Table 5).

2) Eight Upper Zone wells are proposed for sampling during the third quarter to monitor changes along the periphery of the Upper Zone TCE plume.

   * Wells HM-120 and HM-121 are recommended to monitor changes at the north end of the runway where the erosional channel in the Cretaceous limestone surface extends to the north toward Lake Worth. VOCs have not been detected in HM-120 in the past (Hargis & Associates, 1989b), but the TCE concentration in nearby well HM-119 was approximately twice as high during the second quarter than in previous measurements.
   * HM-31 and HM-104 are boundary wells at the south end of the AFP4 production building where the same erosional channel leaves AFP4 property and continues offsite (Hargis & Associates, 1989a, Fig. 4). In the past, concentrations of TCE have been moderate in HM-31 and below detection limits in HM-104, reflecting their respective positions in the central part of the channel or on the periphery. Monitoring these wells periodically will update data regarding plume concentrations and extent in this area.
   * Sampling the four remaining Upper Zone wells (HM-24, HM-30, HM-32, and HM-100) will help characterize the nature and extent of the plume at the southwest corner of the AFP4 complex, upgradient from AFP4 Landfill 2. Information on HM-100 was not found, but previous results for the other wells indicate: intermittent low concentrations of TCE in HM-24; moderate to high concentrations in HM-30; and no TCE compounds detected in HM-32. As such, these wells defined the plume boundary in this area, which will be updated by sampling them in the third quarter.

3) Thirteen surface water locations are proposed to monitor water quality changes and assess the potential for offsite migration of contaminants. When possible, locations established by previous contractors have been selected.

   * The Farmers Branch aqueduct inlet, EGL-1, and the outlet, EGL-2, will be sampled again this quarter to monitor changes resulting from leakage from the AFP4 Upper Zone TCE plume where it intersects the aqueduct. LF05-S7 and LF05-S5 will be sampled to monitor concentrations in the unnamed tributary and its contribution to Farmers Branch. A new site, which will be labelled LF05-SS1, will be established in a small stream that flows from seeps in the vicinity of CAFB Landfill 5 and runs into 2 ponds near a small golf course maintenance building.

* The remaining 8 surface samples will be collected along Meandering Road Creek, from where it enters AFP4 property (SW-02) to where H enters Lake Worth (C-5). The proposed sample locations have been chosen on the following basis:
  - SW-02 "Background" measurement (surface water entering AFP4 site).
  - SW-03 Downstream from AFP4 Landfill 4.
  - SW-03A Downstream from AFP4 Landfill 2 (new location).
  - SW-08 Repeated sample location for comparison with measurements from first two quarters and other previous data.
  - C-2 Downstream from AFP4 Landfills 1, 3.
  - C-5 Final Meandering Road Creek sample location before it enters Lake Worth, a public water supply.
* In addition, the effluent from Outfalls 4 and 5, which enters Meandering Road Creek a short distance (200 300 ft.) upstream from C-5, will be sampled to any contaminants present.

Finally, for the reasons stated in the "Summary of Analytical Results" section of this report, the reported concentration of 8400 ug/L TCE in Paluxy Upper Sand well P-19US was much higher than expected, and it is proposed that it be sampled during the third quarter to verify this value.

Table 5 summarizes the proposed wells, surface water sampling sites and their associated analytical suites for the third round. The suggested analytical suites are reduced relative to the first two rounds and are based on contaminants, or lack thereof, that have been previously detected at the proposed locations. Carefully tailoring analytical suites in this way will reduce analytical cost per sample.

5. STATUS OF STUDY

Quarterly monitoring was initiated in October 1991 and continues to date.

6. STUDY SCHEDULE

This Quarterly Sampling Letter Report discusses sampling activities and analytical results from the second sampling round carried out between 27 January 1992 and 6 February 1992. The report was submitted in April 1992.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Remedial Investigation/Feasibility Study
Landfill No.s 4 and 5
Appendices A-C
Author: U.S. Corps of Engineers
Doc No: CAFB-X31
Submittal: August 1993

No objectives, accomplishments, results or recommendations are presented in this summary as this report provides supporting documentation for the main report body.

Appendices A through C provide the laboratory analytical data collected during the Phase II remedial investigation at landfill Nos 4 and 5. The individual appendices include:

Appendix A: Drilling Logs, Construction Diagrams, and Monitor Well Development Forms
Appendix B: Step-Drawdown Test Data
Appendix C: Sample Collection Logs

Appendix A - Drilling Logs, Construction Diagrams, and Monitor Well Development Forms

Appendix A contains the drilling Logs, construction Diagrams, and monitor well development forms for wells CAR RW-1, CAR RW-2, CAR RW-3, CAR RW-4, CAR RW-5, CAR RW-6, CAR RW-7, and CAR RW-8.

Appendix B - Step-Drawdown Test Data

Appendix B contains the results of the step-drawdown tests for wells CAR RW-1, CAR RW-2, CAR RW-3, CAR RW-4, CAR RW-5, CAR RW-6, CAR RW-7, and CAR RW-8.

Appendix C - Sample Collection Logs

Appendix C contains the sample collection logs for the groundwater samples collected from wells CAR RW-1, CAR RW-2, CAR RW-3, CAR RW-4, CAR RW-5, CAR RW-6, CAR RW-7, and CAR RW-8 on May 11, 1993.

Title: RCRA Permit, Part B, Number HW50289
RFI Work Plans
Volume 1: Appendices A-C
Author: Radian Corporation
Doc No: CAFB-X32
Submitted: May 1991

1. STUDY OBJECTIVES

The purpose of the RFI Work Plan is to support activities associated with the RCRA Permit, Part B, Number HW50289, issued for Carswell in February 1991. The work plans address each of the sites cited in the permit. All of the sites cited in the permit are IRP sites. The areas targeted, along with their corresponding solid waste management units (SWMU) number.

Site Name	IRP No.	SWMU No.
Landfill 1	1	28
Landfill 4	4	22
Landfill 5	5	23
Waste Burial Area	10	24
Fire Department Training Area 1	11	18
Fire Department Training Area 2	12	19,20,21
Flightline Drainage Ditch	13	53
Entomology Dry Well	15	63
Unnamed Stream	16	64,67
POL Tank Farm	17	68
Weapons Storage Area	WSA	65

Volume 1 of this document contains Appendix A (Work Plan), Appendix B (Quality Assurance Project Plan), and Appendix C (Health and Safety Plan).

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

The information provided in the individual appendices is as follows:

Appendix A - Work Plan

The Work Plan is divided into three parts designed to 1) address the field investigation, 2) the evaluation-related tasks, and 3) the feasibility study tasks. The purpose of the hydrogeologic assessment is to develop a complete understanding of the groundwater system on-and off-base by integrating the available data from earlier investigations and by conducting additional field studies to fill data gaps or provide additional detail where necessary. The hydrogeologic assessment will draw on the results of all previous groundwater investigations conducted at Carswell AFB. In addition to those sources, previous studies will now be updated with any regional and area studies by federal, state, and local agencies and other published and unpublished information will be used.

Field-Related Tasks

The field investigation will include the following tasks:

1) Soil Gas Surveys. Soil samples will be collected in order to measure the organic vapor concentration in the soil at the individual sites.

2) Geophysical Surveys. Magnetometer surveys will be performed at SWMU 64. of the total magnetic field and magnetic gradient will be taken at appropriate locations using an EDA PPM 500 proton magnetometer (or equivalent).

3) Subsurface Soil Surveys. No boreholes will be drilled for this investigation. The existing monitoring wells will be utilized to provide the chemical data. Air monitoring during all well drilling and soil boring work will be accomplished with an organic vapor analyzer utilizing a photoionization detector (PID) or flame ionization detector (FID) to identify the presence of potentially hazardous and/or toxic vapors or gases. The air monitoring results will be noted in the boring logs. If soil encountered during well drilling is suspected to be hazardous because of abnormal discoloration, odor or air monitoring levels, the drill soil cuttings will be containerized in new, unused drums. A different drum will be used for each boring where soil encountered is suspected to be hazardous. The field log will reflect the boring logs depth(s) from which the suspected contaminated soil cuttings were collected. Composite drill cutting samples will be obtained for chemical analysis in accordance with the EPA publication SW-846, per Table I of Appendix B.

4) Monitoring Wells. The objective of the investigation at Carswell AFB is to define the presence, magnitude, direction, rate and extent of movement of any identified contaminants. To accomplish this task, four monitoring wells will be installed.

   The field team will use a hollow-stem auger rig to drill the upper zone monitoring wells. This method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for formation samples. The hollow-stem auger can be used as a temporary casing to prevent the borehole from caving during drilling and completion of test wells. For the depths and geology involved, this drilling method will provide fast, efficient performance at a relatively low operating cost.

   Each new monitoring well will be developed as soon as practical after completion. The monitoring wells will be developed by a submersible pump, and/or bailer. Monitoring well development will continue until the discharge water is clear and free of sediment to the fullest extent possible. All water during development will be collected and disposed of through an existing oil/water separator connected to a base sanitary sewer. The development water production (rates), pH, specific conductances and water temperature will be measured. These data will be included in the final report.

   Following the completion of drilling operations, each well will be screened above and below the water table surface with a minimum of 10 feet and maximum of 35 feet of screen. The screen will consist of 4-inch diameter PVC casing with up to 0.020-inch slots. The material lengths selected will be based upon site-specific groundwater conditions encountered. The screen will be capped at the bottom. All connections will be flush jointed and threaded. The screened section will be joined to a 4-inch diameter, Schedule 40 PVC, flush threaded casing. The casing will extend from the top of the screen to at least ground surface. To ensure the chemical integrity of the test wells, no glues, solvents, or thread compound will be employed during screen and casing installations. Prior to installation, the casing and screen sections will be thoroughly washed using a high-temperature, high-pressure sprayer, with Base potable water.

After the casing and screen have been installed for each well, a sand or gravel pack will be emplaced between the screen and the boring wall. The pack will consist of washed and bagged rounded sand or gravel with a grain size distribution compatible with the screen and the formation. The pack will be emplaced from the bottom of the borehole to 2 feet above the top of the screen. The auger flights will be used as the tremie pipe. Granulated or pelletized bentonite will be placed (in the well and measure it with a weighted tape) above the sand/gravel pack to a minimum thickness of 2 feet to provide an adequate seal. The bentonite seal will be wetted in the hole using 1-2 gallons of Base potable water to ensure that the seal is developed before cementing operations begin. Neat cement (Type I Portland cement) grout will be emplaced from above the top of the bentonite seal to land surface. No more than an eight percent gel mixture may be used. For water table conditions, grout will be emplaced through the augers and then the auger string withdrawn. If artesian conditions exist, a small diameter tremie pipe will be used to emplace the grout.

Two methods for the well surface completions will be employed at Carswell AFB depending on input from base officials. If well stick-up is of concern in an area, the well will be completed flush with the land surface. In the case of flush completion, the PVC casing will be cut 2 to 3 inches below land surface, and a watertight protective manhole with a locking cap will be installed. A locking system will be provided to discourage any tampering. When aboveground surface completion is used, the PVC well casing will be extended about 2 or 3 feet above land surface. An end plug or casing cap will be provided for each well. The extended PVC casing will be shielded with at least a 4-inch diameter steel guard pipe. The guard pipe will be placed over the PVC casing and cap and will be seated in a 24-inch by 24-inch by 4-inch concrete surface pad. The protective casing will be installed with a lockable cap or lid to discourage vandalism. In the case of an aboveground completion, three 3-inch diameter steel guard posts, will be installed radially from each well head. The guard posts will be placed approximately 2 to 3 feet into the ground and extend 5 feet above the ground surface. At some sites, the guard posts may be removable to facilitate access for sampling activities. In these cases, a locking mechanism will be provided to prevent unauthorized removal.

All monitoring wells and boreholes will be surveyed for elevations and 24 locations. A registered professional land surveyor will be retained to survey the vertical elevations of the wells and the tops of the boreholes. This survey will have an accuracy for vertical elevations of +0.01 foot for all monitoring wells and +0.1 foot for boreholes. Horizontal locations will be accurate to +1 foot. All surveying will use an established U.S.C & G.S. or U.S.G.S. benchmark as point of origin. All surveyed points and benchmarks used will be recorded on site maps.

5) Aquifer Tests. Slug tests will be conducted on three selected monitoring wells after the completion of groundwater sampling. The slug test provides an indication of aquifer characteristics such as hydraulic conductivity. Also, this test is ideally suited for low-producing formations that cannot be pumped. Monitoring wells will be selected with the hydrogeologic characteristics that will optimize slug testing. The resulting data will be used in conjunction with the groundwater geologic data. The slug test equipment will be decontaminated to prevent any well contamination.

Following completion and development of the monitoring wells, but prior to sampling activities at each site, a round of water level measurements will be conducted on the monitoring wells. Water levels will be measured to the nearest 0.01 foot from the top of the marked casing using an electric line water level indicator. When the electrode of the water level meter comes in contact with the water, a meter reacts or a tone sounds. Additionally, the surface of the water will be examined for the presence of hydrocarbons. If hydrocarbons are present, the thickness of the layer will be measured and recorded.

6) Groundwater Sampling. Each monitoring well will be purged immediately prior to sample collection to ensure that fresh formation water is collected. Purging will occur at least three days after completion of monitoring well development. when possible, sampling will begin at upgradient monitoring wells and/or low contamination areas then move to downgradient and/or higher contamination areas.

Purging operations will be conducted using a submersible pump or a bailer. Purging operations will be considered complete when three wetted well casing volumes have been removed or when the pH (+0.1 unit), temperature (+0.5 degrees C), specific conductance (+10 micromhos), color and odor of the discharge are stabilized. After purging the wells, groundwater samples will be collected from the discharge line of the submersible pump or with a Teflon bailer or 2-inch stainless steel Kemerer sampler. This latter sampler can provide non-aerated groundwater samples at discrete depths which aids in ensuring the integrity of any volatiles in the groundwater.

The methods for obtaining the water data are as follows. All downhole equipment used during the purging of the monitoring wells will be carefully washed to prevent cross-contamination. Details of the decontamination process are provided in the Quality Assurance Project Plan (QAPP) in Appendix C. As an additional step to prevent cross-contamination of the wells, purging/sampling operations will progress from areas suspected to contain little or no contamination to areas assumed to have higher contamination levels. The purged groundwater will be disposed through an oil/water separator connected to a sanitary sewer.

a) Temperature. Measurements of the sample temperature will be taken using a mercury thermometer. The field measurement represents the temperature of the groundwater at a particular location and time.
b) pH. The pH of each sample will be measured by a Myron L pDS (Model EPll/pH) meter or equivalent. The pH of the sample will be measured as quickly as possible after collection.
c) Specific Conductivity. The specific conductivity of each sample will be measured with a Myron L pDS meter (Model EPll/pH) or equivalent. Elevated specific conductivities indicate the presence of conductive ions in the groundwater.

Water samples collected from the wells will be placed in laboratory prepared containers, preserved as appropriate, chilled to 4 degrees C and shipped to the Southwestern Division Laboratory. The groundwater samples and type of analysis will be summarized per Table I of Appendix B. Also, the table will show data for surface water sampling. Chain-of-custody documents will accompany all samples. Analytical methods, preservations and holding times are provided in detail in the QAPP (included in Appendix C).

When split samples are required, the sample will be divided such that all the containers have a representative portion. In the case of solid samples (soil and formation), samples will be split longitudinally when possible and any loose material will be divided as equally as possible among the containers. Samples for volatile contaminants will be placed directly into the sample container with minimal disturbance. Water samples will be split by pouring an equal volume of liquid among the containers for each collection. The containers will then be labeled onsite and the samples recorded in a log book.

During the borehole and monitoring well drilling activities, cuttings that are suspected of being hazardous because of abnormal discoloration, odor or air monitoring levels will be containerized as discussed previously in Subsection 5.2, Subsurface Soil Surveys. To determine the final disposition of the cuttings in the drums, a composite sample will be obtained from each drum identified using a stainless steel scoop. Up to two composite samples will be collected for chemical analysis. Each composite sample of the drill cuttings will be analyzed for TCLP

concentrations of metals, pesticides, herbicides, volatiles and semivolatiles to determine if the soil cuttings must be disposed of as a hazardous waste.

Data Evaluation

The objectives of the data evaluation process are to summarize the existing information on the hazardous waste sources, pathways, receptors, and to evaluate potential impacts on the base and public health, and the environment. Site-specific analytical data resulting from the field investigation at the Base as well as regional information are considered in the evaluation process.

The field investigation will generate large amounts of data on the hydrogeology and chemistry about the study sites. A computerized data system will be used to convert the raw field data and analytical data into a usable form for reporting. Therefore, the computerized data system will be designed to support the following activities.

* Archive, analyze and manipulate physical, chemical, biological and geological data collected.
* Analyze data with respect to trends or violations of environmental protection guidelines.
* Produce subsets of data to form summary reports and data files which can be analyzed by environmental models and statistical algorithms.
* Interpret relationships between contaminant migration and biogeochemical relationships existing at a particular site.

Feasibility Study

The objectives of the feasibility study is to select preliminary alternative remedial action for the various sites. The objectives will be accomplished through the following general elements:

* Identify general response actions;
* Identify potential remedial technologies and alternatives;
* Initial screening of technologies and alternatives; and
* Develop remedial alternatives for remaining technologies.

Appendix B - Quality Assurance Project Plan

The Quality Assurance project Plan (QAPP) plan focuses on specific QA/QC activities, including inspection, testing, and verification procedures, for contractual elements required to implement the permitting study. The QAPP primarily establishes elements of the program.

Appendix C - Health and Safety Plan

The Health and Safety Plan (HASP) establishes the work practices necessary to help ensure protection of personnel during the permitting field investigation. The objective of the plan is to provide a mechanism for the establishment of safe working conditions at the site. The safety organization and procedures have been established following an analysis of potential hazards at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of occupational illnesses, accidents, and injuries.

All site operations will be performed in accordance with applicable state, local and IT corporate regulations and procedures, OSHA requirements, and client requirements.

4. RECOMMENDATIONS

No recommendations were presented in this document..

5. STATUS OF STUDY

The work plan was utilized in the performance of is HASP of the permit investigation. The results of that investigation are not available.

6. STUDY SCHEDULE

The work plan was submitted in May 1991.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Remedial Investigation/Feasibility Study
Work Plan
Base Service Station (Site ST16)
Author: U.S. Army Corps of Engineers, Fort Worth District
Doc No: CAFB-X34
Submittal: March 1993

1. STUDY OBJECTIVES

This Work Plan was designed to provide a guideline for the investigation into the affects of a subsurface release of refined petroleum products (gasoline) at the Base Service Station (IRP Site No. 16). The fuel was released over an unknown period of time from the four 10,000-gallon fiberglass-reinforced plastic underground storage tanks (UST) located north of the pump islands. The investigation was prompted by the issuance of a Notice of Violation (NOV). In January 1993, the Fort Worth District Corps of Engineers drilled three exploratory borings in the vicinity of the Base Service pumping islands. Results of sampling from the borings showed high concentrations of petroleum hydrocarbons. Because of this, it was recommended that additional investigations be performed.

2. STUDY ACCOMPLISHMENTS

This volume presents methodology for conducting additional assessments.

3. DATA/INFORMATION DEVELOPED

This volume presents methodology for conducting additional assessments.

4. RECOMMENDATIONS

The investigation is designed to determine the current conditions at the site and assess the likely environmental impact of suspected past disposal practices. The following activities are recommended:

* Locate three exploratory borings to determine the potentiometric values and groundwater direction. The borings will also provide subsurface soil information.
* Locate a maximum of five exploratory borings to determine the potentiometric values and groundwater direction. The borings may qualify for the placement of monitoring wills. Install five wells near the site in order to assess the degree of groundwater contamination. The wells will be installed with long screens extending above the water table to intercept floating hydrocarbon product (if any). From these wells, conduct two rounds of groundwater sampling and analyze for general water quality parameters, petroleum hydrocarbons, metals and purgeable organic compounds.
* Perform a soil gas survey on approximately 97 points in the area downgradient from the service station.

5. STATUS OF STUDY

This study is ongoing.

6. STUDY SCHEDULE

This study is ongoing.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Installation Restoration Program
Phase I - Records Search
Author: CH2M Hill
Doc no: CAFB-X35
Submittal: February 1984

1. STUDY OBJECTIVES

The records search was designed to identify potential problems to be addressed during the Phase II investigation. The Carswell AFB records search included a detailed review of pertinent installation records, 10 DOD agency contacts for documents relevant to the records search effort, and an onsite base visit. Prior to the site visit, the base Public Affairs Office dispatched a press release calling for individuals who may be knowledgeable of past disposal practices at the installation. Those individuals who answered this request were interviewed along with current employees. The site visit also included a tour of the grounds and operations, a helicopter overflight, and a detailed search of relevant installation records. In addition to the main Carswell facility, the offbase Weapons Storage Area and the ILS Marker Beacon were targeted for study during the records search.

2. STUDY ACCOMPLISHMENTS

The major findings of the records search were the following:

1) The total quantity of waste oils, recoverable fuels, spent solvents, and cleaners generated at Carswell AFB was estimated to be approximately 55,000 gallons/year. This estimate was derived from a review of shop files and the best recollection of interviewees and is considered to be representative of the 1970s to 1983. The waste quantities were estimated to be less prior to the 1970s because fewer aircraft were maintained at the base.
2) Several procedures for the disposal of the majority of industrial wastes were identified, including the use in fire department training exercises from 1942 to 1970; by contractor removal, either direct or through DPDO, from 1970 to 1982; and by contractor removal through DPDO since 1982. Recovered fuels were determined to have been disposed of primarily through fire department training exercises, however, beginning in 1979, recovered JP-4 was recycled for reuse on base.
3) Interviews with past and present base employees lead to the identification of 22 potential disposal or spill sites, 17 of which were on Carswell AFB property and five within the borders of the Weapons Storage Area.

3. DATA/INFORMATION DEVELOPED

The major conclusions of the records search study were the following:

1) Information obtained through interviews with past and present base personnel, base records, shop folders, and field observations indicated that hazardous wastes have been disposed of on Carswell AFB in the past.

2) Based on the evidence gathered during the study, 22 potential disposal or spill sites were identified at the Carswell AFB and its associated installations. Of this total, 10 were distinguished for being of significant environmental concern. All 10 sites were located on the main Carswell property and included the following (in descending order of their inferred level of concern):

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

3) Evidence of minor environmental stress was noted and attributed to past disposal/spills of hazardous wastes at Carswell AFB. Vegetation was absent in fuel, or oil, saturated areas adjacent to the aboveground and belowground tanks at the fire department training area No. 2 (Site No. 12). Vegetation was also missing along the edge of the Flightline Drainage Ditch (Site No. 13).

4) The potential for migration of hazardous contaminants into local surface water bodies was considered high primarily due to the proximity of identified sites to the Farmers Branch, the West Fork Trinity River, and Lake Worth. In addition, potentially impacted shallow groundwater represented a threat to these surface water bodies through hydraulic interchange.

5) The potential for potential for vertical migration of impacted groundwater from the shallow alluvial aquifer to the deeper aquifer may exist because of the variable nature of confining beds.

6) No direct evidence was found to indicate that migration of hazardous contaminants exists beyond the Carswell AFB boundary. Indirect evidence of contamination and/or contaminant migration within the installation boundary was found at three sites:

   * Flightline Drainage Ditch (Site No. 13): Aircraft soap from the washracks and fuel were observed in the ditch during the base visit.
   * Fire Department Training Area No. 2 (Site No. 12): Unburned fuels were observed on the ground at the site of the existing fire department training area.
   * Unnamed Stream (Site No. 16): An oil sheen and a POL odor were noted at this site during the base visit.

7) The remaining sites (Sites Nos. 2, 14, 6, and 3 and the unrated Sites Nos. 7, 8, and 9) were not considered of significant concern for adverse effects on the health the environment.

8) One offbase site (Inspection Shop Site), located at the Weapons Storage Area, was considered to present a significant potential for environmental concern and was included in Phase II monitoring recommendations.

4. RECOMMENDATIONS

The following recommendations were based on the evidence and observations made during the records search:

1) The following sites were targeted for a Phase II monitoring program:

   * A zone consisting of Landfills No. 4 and 5 (Site Nos. 4 and 5, respectively), the Waste Burial Area (Site No. 10), and the Fire Department Training Areas No. 1 and 2 (Site Nos. 11 and 12, respectively).
   * The Flightline Drainage Ditch (Site No. 13).

* The POL Tank Farm (Site No. 17).
* The Unnamed Stream (Site No. 16).
* The Entomology Dry Well (Site No. 15).
* Landfill No. 1 (Site No. 1).

2) Locate and remove solvent drums reportedly buried at Site No. 10, the Waste Burial Area.

3) Other environmental recommendations included: (1) repair the ruptured JP-4 pipeline then discharging into the Flightline Drainage Ditch (Site No. 13) and line the ditch with concrete; (2) clean the oil/water separator at the Unnamed Stream (Site No. 16), routinely inspect/clean the separator, and analyze the stream on a quarterly basis until it is consistently free of contamination; and (3) locate and properly close all abandoned wells on base.

5. STATUS OF STUDY

The recommendations developed by the findings of the records search were used to formulate the work plans which were eventually implemented during Phase II.

6. STUDY SCHEDULE

The records search was performed during 1983, the final report was submitted in February 1984.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the data base.

8. DISCREPANCIES

No discrepancies noted.

Title: Preliminary Phase II Report
Groundwater Sampling and Subsurface Soil Sampling Delineation
Author: Geo-Marine, Incorporated
Doc no: CAFB-X36
Submittal: October 1993

1. STUDY OBJECTIVES

Geo-Marine, Inc. (GMI) performed the Phase II groundwater sampling program at Carswell AFB under Contract No. DACA63-91-D-0061. The Phase II included the drilling of boreholes across the Carswell facility. The 145 borings were drilled in order to collect soil and groundwater samples from the shallow groundwater aquifer (Upper Zone) for chemical analysis. Analytical data would be used to provide the limits and overall dimensions of the trichloroethene (TCE) plume previously identified in the area. Soil samples would also be used for determination of lithology. The investigation would be used to formulate the final remedial action plan under the Air Force Installation Restoration Program (IRP).

2. STUDY ACCOMPLISHMENTS

A total of 145 borings were drilled during the Phase II investigation. The boring locations were selected by Corps representatives and divided between three discrete areas (designated north, south, and west). Five boreholes were drilled with a truck-mounted drill rig, and the remaining 136 were drilled with a cone penetrometer. The following activities were performed at each borehole:

1) Subsurface soil information was obtained for correlation of the lithology across the site. At the drilled borings, soil samples were collected at regular depth intervals and analyzed by the onsite geologist. At the cone-pushed borings, the penetrometer recorded the soil type throughout the length of the boring.
2) The relative elevation of the land surface at each boring was measured so that the elevation of the groundwater at each boring could be determined. This was done in order to determine the gradient and direction of groundwater flow in the Upper Zone aquifer across the site.
3) Groundwater samples were collected from the majority of the borings and analyzed at an onsite mobile laboratory for the concentration of purgeable halocarbons and /or light hydrocarbons. This was done in order to determine the general limits and overall dimensions of the TCE plume across the site.

3. DATA/INFORMATION DEVELOPED

Although only a limited percentage of the groundwater samples had been analyzed at the time of submittal of the report. The results indicated the following:

* In the north area, the TCE plume has been delineated to the north, east, and south. The areas to the west and southwest is largely inaccessible because of concrete aprons and runways.
* In the south area, the TCE plume has been delineated to the north and east. The area to the northwest is largely inaccessible because of concrete runways, whereas the areas to the west and southwest overlap other sampling data.
* In the west area, the TCE plume has been delineated to the south and east. The area to the north overlaps other sampling data, and the area to the west borders Plant No.4.
* Two other halocarbons (cis-1,2 DCE and trans-1,2 DCE) were identified in the three sampling areas. Distribution is similar to TCE, but values are lower and concentration highs are offset in the downgradient direction.

* Sample areas which overlap data produced by GMI or others do not duplicate sample results; however, the patterns of relative high and low values are similar.
* BTEX components were present only in the south area near the POL Tank Farm and Flightline Drainage Ditch.

The groundwater elevation data indicated that the local groundwater flow direction in the north area is to the east, in the south and west areas is to the east-southeast.

4. RECOMMENDATIONS

With regards to future groundwater investigation work, the following recommendations were made:

* The choice of equipment to obtain the soil and or groundwater samples should be dependant upon the sampling area (i.e. in the vicinity of White Settlement Road, a drill rig should be used for greater depth, while in the other areas the penetrometer truck could be used.
* An onsite mobile laboratory should be used for reconnaissance plume delineation because rapid sample results maximize the usefulness of each sample site location.
* Each water sample should be analyzed for a variety of contaminants, regardless of the immediate objective of a project, because of the diverse and widespread problems at Carswell AFB.

5. STATUS OF STUDY

The analytical results were incomplete at the time of submittal of the report.

6. STUDY SCHEDULE

The field investigation was performed during the months of July through September of 1993. The report was submitted in October 1993.

7. INFORMATION IN IRPIMS?

The data derived during this investigation does not appear in the database.

8. DISCREPANCIES

No discrepancies noted.

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