FINAL REPORT
INSTALLATION RESTORATION
PROGRAM
PHASE II, STAGE 2 - SURVEY
EDWARDS AFB, CALIFORNIA

PREPARED FOR
U S AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL
HEALTH LABORATORY
BROOKS AFB, TEXAS

AUGUST 1984
A Phase II Stage 2 evaluation was conducted at Edwards AFB CA under the Installation Restoration Program (IRP). Nine sites were investigated during this study to further define the magnitude and extent of contamination. This study involved the installation of lysimeters, groundwater monitoring wells and soil borings; samples of groundwater and soil were analyzed for several potential contaminants. The study concluded that groundwater is not contaminated at Sites 1A, 1B, 1C, 1D1 and 1D2. Limited soil contamination exists at Sites 1C and 1D1. Site 8 has soil contamination but no significant groundwater contamination. Extent of contamination at Site 5 is unclear, and further monitoring is recommended. The lysimeters at Sites 2 and 3 should also be monitored on a regular basis.
This report has been prepared for the United States Air Force by Engineering-Science for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the United States Air Force or the Department of Defense.
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EXECUTIVE SUMMARY
EXECUTIVE SUMMARY

Engineering-Science, Inc. performed explorations and studies which resulted in a report entitled Installation Restoration Program, Phase II - Confirmation, Edwards AFB, California. This report was submitted in September 1982. As a result of the findings of that report, ES was asked to perform further explorations and studies. This report presents the results of the supplementary work performed.

SCOPE

The supplementary program, Stage 2, consisted of the following:

* Installation of a monitoring well down gradient of Sites 1A, 1B, 1C, 1D1, and 1D2. Analyses of soil samples taken during construction of that well and initial analyses of water samples from the monitoring well.

* Installation of three shallow borings located radially from Site 1D1 to determine the extent of gaseous contamination of soils.

* Installation of one lysimeter each at the periphery of Sites 2 and 3.

* Locating and sampling for fuel at existing Well No. 9N/9W-6C1 (MB-1) near Site 5.

* Redevelopment of existing well 9N/9W-6E1 and sampling for fuel.

* Installation of two monitoring wells down gradient from the POL (petroleum, oil, and lubricants) tanks at Site 5 and analysis of initial samples taken from that well.

* Installation of one monitoring well down gradient from the industrial waste pond, Site 8. Analysis of initial samples taken from that well.
Background soil sample taken about two miles to the north and east of the principal area of Base activities and analyzed for metals, residual pesticides, and polychlorinated biphenyls (PCB).

FINDINGS

North Base (Sites 1A, 1B, 1C, 1D1, 1D2)

- A monitoring well has been installed at the site (Well 12).
- At the time of this work, groundwater samples showed no significant contamination.
- Nitrate contamination due to disposal of nitric acid wastes seems to be limited to the disposal pit and the soils below the surface. No horizontal migration of nitrate was observed at Well 12, approximately 60 feet from the acid pit.
- Gaseous migration of chloroform and trichlorofluoromethane is limited to a radius of less than 200 feet from disposal trench 1D.

Main Base (Site 8)

- A monitoring well has been installed at Site 8 (Well 15).
- At the time of this work, no significant contamination of the groundwater was observed.
- Soil samples taken while drilling Well 15 indicated relatively high levels of chromium, arsenic, lead, and selenium. These limits were not so high as to produce an imminent health hazard; however, they were slightly high as related to California Assessment Manual criteria for soils. It must be noted, however, that a background soil sample taken at another part of the Base was similarly high in chromium, arsenic and selenium; thus these findings may simply reflect the normal background condition of the soils at Edwards AFB.
South Base

- Monitoring wells were installed down gradient of Site 5 (Wells 13 and 14).

- At the time of this work, no fuel contamination of the groundwater was observed.

- One of the POL waste tanks at South Base (Site 5) leaked at one time. It has subsequently been emptied and is no longer used. This leaking condition has produced a layer of oil/fuel contaminated soil which is located at a depth of 45 feet and reaches a distance of at least 400 feet from the POL tank. The water table was found at 52 feet; it could be inferred that the tank leakage occurred when the water table was higher, leaving the contaminated soil behind as the water table dropped.

Site 2 and Site 3

- Lysimeters were installed at these sites for future monitoring.

RECOMMENDATIONS

A monitoring program is recommended to sample the lysimeters and wells which were installed during this work.

A program of study is recommended to develop a better understanding of the extent, nature, and potential for problems which might be caused by the contaminated soils found at the waste POL tanks, Site 5.
CHAPTER 1

INTRODUCTION
The overdrafting of the groundwater within Antelope Valley and specifically around Rogers Dry Lake near the aquifer boundaries has created unique hydrological conditions, with fluctuating water levels and continuously changing regimes of confinement, semiconfinement, and nonconfinement of the groundwater.

Groundwater in the major part of Antelope Valley, including the southern part of Rogers Dry Lake, occurs under confined conditions, even though in some cases the confinement is no longer effective to produce artesian flow due to overdraft. Along the "shores" of Rogers Dry Lake and north of the lake bed, groundwater occurs mainly under unconfined conditions.

The location and extent of water-bearing material is mainly dependent on the geologic history of an area. Antelope Valley is a triangular closed basin bordered by the active Garlock Fault to the northwest and the active San Andreas Fault to the south. Movement along these two faults, emplacement of granitic rocks, and regional uplift created the closed basin that exists today. During and following the uplift of the mountains, erosional processes were intensified. Precipitation resulted in runoff; the greater the surface gradient, the higher the velocities of the runoff, and therefore the higher the erosion potential. Eroded material from the mountains surrounding Antelope Valley was brought to the basin floor, including the Rogers Dry Lake area, by local streams. During times of heavy precipitation the eroded material consisted of mixed gravel and sand; the gravel and sand layers that are encountered today in the subsurface material have a relatively high porosity and excellent water-bearing capabilities. These layers constitute the main aquifers. Overlying and interfingerling the sand and gravel are silt and clay lenses and layers which were deposited during times of little precipitation within the ancient lake that once covered the major part of Antelope Valley. These finer-grained materials have low porosity (45 to 50 percent) and permeability (0.0001 to 0.1 gallons/day/square foot). In many places, the clay and silt act as confining layers, preventing water within the lower-lying sand and gravel layers from rising to its potentiometric level. Figure 2.1 depicts a conceptual drawing of the transition zone between lake deposits and bedrock/
CHAPTER 2
ENVIRONMENTAL SETTING

GENERAL GEOLOGIC REGIME

Antelope Valley and the area surrounding Rogers Dry Lake have been the subject of geohydrological investigations since as early as 1911, when Harry R. Johnson authored "Water Resources of Antelope Valley" in U.S. Geological Survey (U.S.G.S.) Water-Supply Paper 278 (Johnson, 1911). Around the turn of the century it was discovered that the valley contained large quantities of groundwater that, when extracted through wells, could be used for irrigation, transforming the valley into productive agricultural land.

Hundreds of wells have been installed to tap valuable water resources, which in the early days were thought to be practically inexhaustible. Some people, however, recognized the fact that even though "water keeps spouting out from wells developed in areas of artesian groundwater conditions," the resource was indeed limited. In the 1911 report, Mr. Johnson cautioned that "even though the groundwater appears to be inexhaustible, it is indeed finite," and the continued unmanaged use of the resource could lower the level of the water table and eventually dry out the groundwater reservoir.

The same view was presented in the later U.S.G.S. Water-Supply Paper 578 (Thompson, 1929). That paper advocated conservation of the water supply if maximum use is to be obtained. However, during the past 70 years, extraction of groundwater has continued at a rapid pace with resulting declines in water tables and decreases in the areal extent of artesian conditions. The results, at least on the surface, have been to transform the nonirrigated lands from a semiarid grassland to a desert-like environment.
CHAPTER 2

ENVIRONMENTAL SETTING
(Stage 2). The result of that Stage 2 effort is the subject of this report. A copy of the ES Scope of Work has been included as Appendix A to this report (underlined portions are this Stage 2).

The supplementary program, Stage 2, consisted of the following:

- Installation of a monitoring well down gradient of Sites 1A, 1B, 1C, 1D1, and 1D2. Analyses of soil samples taken during construction of that well and initial analyses of water samples from the monitoring well.
- Installation of shallow borings radially located from Site 1D1 to determine the extent of gaseous contamination of soils.
- Installation of monitoring lysimeters at the periphery of Sites 2 and 3.
- Locating and sampling for fuel at existing Well 9N/9W-6C1 (MB-1) near Site 5.
- Redevelopment of existing well 9N/9W-6E1 and sampling for fuel.
- Installation of two monitoring wells down gradient from the POL tanks at Site 5 and analysis of initial samples taken from that well.
- Installation of one monitoring well down gradient from the industrial waste pond, Site 8. Analysis of initial samples taken from that well.
- Background soils sample taken about two miles to the north and east of the principal area of Base activities and analyzed for residual pesticides, PCBs, and metals.
<table>
<thead>
<tr>
<th>Site</th>
<th>Recommended Action and Monitoring</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>* Install one groundwater monitoring well immediately down gradient from the site;</td>
<td>* Determine leakage from pond into the groundwater</td>
</tr>
<tr>
<td></td>
<td>sample groundwater for metals and organic solvents.</td>
<td>* Monitor potential future leakage from pond into groundwater</td>
</tr>
<tr>
<td></td>
<td>* If the groundwater shows no contamination, sample installed monitoring well annually.</td>
<td>* Reduce the potential for groundwater contamination; sampling of</td>
</tr>
<tr>
<td></td>
<td>* If groundwater samples show contamination, the pond water could be treated in situ.</td>
<td>groundwater monitoring well will allow for determination of water</td>
</tr>
<tr>
<td></td>
<td>Sample monitoring well semiannually.</td>
<td>treatment effectiveness</td>
</tr>
<tr>
<td>10</td>
<td>* Install vapor detection pipes around the perimeter of suspected contaminated area.</td>
<td>* Identify lateral extent of contaminated area and monitor evaporation</td>
</tr>
<tr>
<td></td>
<td>* Institute land use restrictions.</td>
<td>of fuel over time</td>
</tr>
<tr>
<td>11</td>
<td>* Install one monitoring well immediately down gradient from the hydrant.</td>
<td>* Prevent future excavation and construction in the area while fuel is</td>
</tr>
<tr>
<td></td>
<td>Sample well water semiannually for fuels (the entire casing of the well should be perforated and the well sampled semi-annually for gas vapors).</td>
<td>still present in the soil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Determine if fuel is present on top of the groundwater</td>
</tr>
<tr>
<td>Site</td>
<td>Recommended Action and Monitoring</td>
<td>Rationale</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------</td>
<td>-----------</td>
</tr>
</tbody>
</table>
| 2 (Cont'd) | * Install monitoring well if contaminants are detected in seasonal flow; sample annually for metals and suspected contaminants.  
* Construct an impermeable mound across the site.  
* Institute land use restrictions. | * Monitor potential migration of contaminants into groundwater  
* Prevent mobilization of contaminants by surface runoff  
* Prevent construction and excavation at future dates |
| 3 | * Install a lysimeter down gradient from the site; if seasonal groundwater flow exists, sample for metals and organics.  
* If contaminants are identified, install down-gradient monitoring well. | * Determine existence of seasonal groundwater flow; if flow exists, water sample analysis will identify potential contaminant migration  
* Monitor potential migration of contaminants into groundwater |
| 5 | * Locate existing wells 9N/9W-18C1 and 9N/9W-6L1; take groundwater samples and water level measurements if possible, and analyze for fuel and oil.  
* If the wells 18C1 and 6L1 can be located, they should be abandoned by grouting.  
* Redevelop existing well 9N/9W-6E1 and sample for fuel.  
* Install 3 monitoring wells down gradient of site; sample for fuel. If no fuel is detected in the soil or groundwater, the new wells should be monitored semiannually; if fuel is detected, install 3 to 6 additional wells.  
* Monitor underground storage tanks regularly. | * Establish boundaries for the lateral extent of potential fuel migration  
* Eliminate possibility of potential contamination migration through the well into deeper aquifers  
* Verify fuel contamination in well 6E1  
* Identify lateral extent of potential fuel migration  
* Determine the potential for future leakage. |
TABLE 1.2
RECOMMENDED ACTIONS AND MONITORING
EDWARDS AFB, CALIFORNIA

<table>
<thead>
<tr>
<th>Site</th>
<th>Recommended Action and Monitoring</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| 1A, 1B, 1D1, 1D2 | - Remove all waste containers from sites and dispose at permitted location.  
- Monitor down-gradient wells semiannually for organic constituents.  
- Install one down-gradient monitoring well and sample soils at the soil/water interface. Also sample groundwater for gaseous constituents.  
- Complete 10-foot deep soil borings at compass points around the sites and sample for gaseous constituents. | - Prevent further soil contamination  
- Identify potential migration of contaminants within the groundwater  
- Define vertical extent of soil contamination  
- Define lateral extent of soil contamination |
| 1C | - Construct impermeable mound across the nitric acid pits.  
- Institute land use restrictions.  
- Monitor down-gradient wells. | - Prevent mobilization of nitrates  
- Prevent construction and excavation at future dates  
- Identify potential migration of contaminants within the groundwater |
| 2 | - Locate and remove buried waste containers (if present) and dispose at permitted location.  
- Install two lysimeters down gradient from the site. If flow exists, collect water samples and analyze for metals and suspected contaminants. | - Prevent potential leaching of contaminants into groundwater  
- Determine existence of seasonal groundwater flow; if flow exists, laboratory analysis of water samples will identify potential contaminant migration |
were found throughout the entire soil column sampled at Site 1C. At Sites 1A, 1B, 1C, and 1D, soil samples from the greatest depths (55 feet to 61 feet) showed chemical constituents present in detectable concentrations, but the levels of soil contamination identified at these sites would be unlikely to constitute an immediate health hazard. Groundwater was not encountered in any of the soil borings.

At Site 2, chromium and tetraethyl lead were detected throughout the soil column. Contamination of the groundwater from leachates originating at Site 2 is considered unlikely. Soil samples from Site 3 contained constituents, particularly pesticides, with concentrations higher than normally would be expected. The concentration levels in the soil samples were all lower than the established California threshold limit concentrations. The potential for environmental health hazards from this site is considered minimal, primarily due to the absence of a permanent water table under the area. Groundwater samples from Phase II monitoring wells installed around Site 5 indicated no contaminants present in any of the samples; this could be a result of shallow groundwater flow in a direction different from the expected regional flow regime.

Results of analyses of the water and sediment samples collected from Site 8 indicate the presence of metals. However, groundwater contamination from this site is considered unlikely due to the low permeabilities of the underlying deposits and the probable impermeability of the bottom sediment. In the soil borings at Site 10, fuel was found to be present within the soil column. Near Site 11, fuel was identified in the groundwater at one monitoring well, while no fuel was identified in the other well. The likelihood of groundwater contamination from the fuel spill at this site is considered to be low.

Recommended follow-on actions and future monitoring for each site are summarized in Table 1.2.

SCOPE OF WORK

Based upon the foregoing recommendations, the Air Force elected to implement a supplementary exploration/confirmation/monitoring effort.
<table>
<thead>
<tr>
<th>Site</th>
<th>Activity</th>
<th>Waste Characteristics</th>
<th>General Subsurface Material</th>
<th>Depth to Groundwater</th>
<th>Distance to Closest Active Production Well (feet)</th>
</tr>
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<tr>
<td>1A</td>
<td>Drum storage (13 barrels) ABANDONED 1978</td>
<td>Motor oil, dry cleaning solvent, lube oil, miscellaneous solvents</td>
<td>Lakeshore deposits (sand)</td>
<td>1,300</td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>Drum storage (116 barrels)</td>
<td>Aniline</td>
<td>Playa deposits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td>Acid pits, open trenches (4)</td>
<td>Fuming red and white nitric acid, burnt waste fuels</td>
<td>Sand dune underlain by playa deposits</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>1D</td>
<td>Drum trenches (13) (hundreds of barrels) ABANDONED</td>
<td>Aniline, turffural alcohol, engine cleaner, ethyl alcohol</td>
<td>Playa deposits</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Toxic waste disposal ABANDONED 1960s</td>
<td>Cyanide, chromate, nitric acid, tetra-ethyl lead, hydrogen peroxide, fuels</td>
<td>Loose sand</td>
<td>No aquifer (closest aquifer 3,500 feet away)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Main Base sanitary landfill ABANDONED 1970s</td>
<td>Possibly hazardous wastes and banned pesticides</td>
<td>Sandy (younger fan deposits)</td>
<td>No aquifer, ground sloping toward arroyo draining into Rogers Dry Lake</td>
<td></td>
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<tr>
<td>5</td>
<td>South Base waste POL storage and disposal site, underground tanks and 70 barrels</td>
<td>Water-contaminated fuels and oils, synthetic water oil, jet fuel, hydraulic fluid</td>
<td>Young alluvium</td>
<td>85 feet 4,000</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Industrial waste pond ACTIVE</td>
<td>Runway runoff and washdown, fuel spills, hangar drainage</td>
<td>Lake shore deposits (thin)</td>
<td>Underlain by groundwater mound</td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 1.1

North Lake and Disposal and Storage Sites

KNOWN PAST AND CURRENT DISPOSAL AND STORAGE AREAS
EDWARDS AFB

REGIONAL LOCATION MAP
Phase II actions are required for these sites at this time. The eight sites studied in Phase II are shown in Figure 1.1 and are described in Table 1.1.

WORK CONDUCTED IN PHASE II

On the basis of the Phase I Assessment of the Potential for Groundwater Contamination performed in April 1981, the Installation Restoration Program, Phase II - Confirmation has been conducted. The purposes of this program have been to:

* Determine the extent and magnitude of environmental contamination resulting from previous waste disposal practices at Edwards AFB, California
* Recommend measures to alleviate impacts for identified contaminated areas
* Develop environmental monitoring programs to document environmental conditions resulting from past waste disposal activities at Edwards AFB

To accomplish these tasks the ES work program included the installation of monitoring wells and completion of soil borings for collection of water and soil samples as well as the collection of surface soil samples. The Installation Restoration Program, Phase II - Confirmation report presents the results of the first stage of the project, including development and implementation of the field program, the sampling procedures utilized to obtain data, data analysis, conclusions, and recommendations for future actions.

Findings and Recommendations - First Stage of Phase II

Laboratory analyses of soil samples taken from borings at Sites 1A, 1B, 1C, and 1D indicate that most of the chemical constituents suspected at each site were not present in detectable amounts. Generally, the analytical results from each of these sites except 1C showed the presence of volatile substances (chloroform and trichlorofluoromethane) within the soil column; small quantities of other constituents were detected at various sites and depths. Nitrates in high concentrations
as a basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

The Installation Restoration Program has been developed as a four-phased program. These phases are:

- **Phase I** - Installation Assessment
- **Phase II** - Confirmation
- **Phase III** - Technology Base Development
- **Phase IV** - Operations

Phase I, completed at Edwards Air Force Base in April 1981, includes the identification and prioritization of past disposal sites that may pose a hazard to public health or the environment as a result of contaminant migration. Phase II involves a comprehensive preliminary environmental and/or ecological survey to define and quantify the presence or absence of contamination that may adversely affect public health or the environment. During Phase III, a sound data base will be developed upon which to prepare a comprehensive contaminant control plan. This contaminant control plan and remedial measures will be implemented in Phase IV.

**PREVIOUS WORK**

The Phase I study completed in 1981 assessed the potential for groundwater contamination on Edwards AFB, California (Envirodyne Engineers, Inc., 1981). The study provided a general description of the existing climatological, geological, and hydrological regimes at the Base and in its immediate vicinity.

Twelve active and inactive waste disposal sites were identified and evaluated in the report on the basis of site characteristics, potential for contamination, waste characteristics, and waste management practices. The evaluation consisted of assigning to each site numerical values weighted on a subjective scale according to degree of severity for contamination potential. Based on this evaluation, four of the twelve sites were subsequently dropped from further consideration; no
CHAPTER 1
INTRODUCTION

PREFACE

Engineering-Science, Inc. performed explorations and studies which resulted in a report entitled Installation Restoration Program, Phase II - Confirmation, Edwards AFB, California. This report was submitted in September 1982. As a result of the findings of that report, ES was asked to perform further explorations and studies. This report presents the results of later work performed.

In order for the user to be able to read this report without continuous reference to the earlier report, ES has elected to reproduce and excerpt sections of the earlier report and include them as a part of this document. ES hopes this will allow this supplemental study to stand alone.

BACKGROUND

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner. The Department of Defense (DOD) has issued Defense Environmental Quality Program Policy Memorandum 81-5 which requires the identification and evaluation of past hazardous material disposal sites on DOD property, the control of migration of hazardous contaminants, and the control of hazards to health or welfare that resulted from these past operations. This program is called the Installation Restoration Program (IRP). The IRP will serve
FIGURE 2.1
CONCEPTUAL SCHEMATIC DRAWING OF TRANSITION ZONE BETWEEN BEDROCK, ALLUVIUM, AND LAKE DEPOSITS AT EDWARDS AFB

- Site 2
- ES2*
- ES3*
- ES4**

Rogers Dry Lake Bed

Lake Deposits Silts and Clays

Bedrock

Sand

W

No Scale

(vertical scale exaggerated in relation to horizontal)

*ES Soil Boring Location
**ES Monitoring Well Location

ENGINEERING SCIENCE
alluvium material; as illustrated, recharge to the shallower water-bearing sands could occur through the "daylighting" layers (U.S.G.S., 1980).

GENERAL HYDROLOGIC REGIME

Water within the groundwater basin is derived from several sources. Some water is connate water, i.e., water trapped within the sediments from the time of deposition. Other water is provided through recharge into the water-bearing materials along the basin boundaries where sand and gravel layers "daylight"; still another source is from percolation through the valley floor. Figure 2.2 shows the surface geology at Edwards AFB and in the vicinity of Rogers Dry Lake; as can be seen, the lake is bordered by a variety of sand, gravel, and silt deposits consisting of younger alluvium (yielding water to wells when saturated), younger fan deposits (primarily located above the water table, yielding little water to wells), lakeshore deposits (above the water table), old windblown sand, and dune sand (yielding water locally to wells from perched water tables).

Groundwater recharge from the valley floor (Rogers Dry Lake) is quite limited. The lake bed surface consists of playa deposits, silt, and clay which have low permeabilities, retarding downward migration of water. Water ponding on the lake surface during the rainy season primarily evaporates; limited seepage may occur through cracks developed during the summer, but the contribution of rainwater to the aquifer system should be limited.

Groundwater flow and direction in the main water-producing aquifers near Edwards AFB are largely dominated by pumping wells, resulting in changes in the regional gradient from north to south. Figure 2.3 shows the groundwater table contours as of 1979 (U.S.G.S., 1980). A groundwater trough was located immediately south of the Main Base as a result of groundwater pumping; the groundwater table elevation at that time was estimated to be about 2,200 feet above mean sea level, or 100 to 120 feet below the ground surface. Groundwater in the vicinity of the trough is moving toward this depression from the north, south, and west; to the east is the boundary of the valley aquifer systems. It should be
FIGURE 2.2

LEGEND

- Younger Alluvium
- Younger Fan Deposits
- Playa Deposits
- Dune Sand
- Old Windblown Sand
- Lakeshore Deposits
- Location of Geologic Cross-Section

FIGURE 2.3
GROUNDWATER TABLE CONTOURS OF AQUIFERS
200 TO 500-FOOT DEPTH BELOW GROUND SURFACE
IN THE REGION OF EDWARDS AFB

noted, however, that these groundwater contours are based on water level measurements from wells penetrating to depths of 200 feet to 500 feet, and are therefore not indicative of shallow groundwater conditions (Moyle, 1982).

Along the northern shores of Rogers Dry Lake by the North Base, the groundwater movement is in a south-to-north direction; a trough exists immediately around this part of the Base due to local groundwater extraction. A groundwater barrier exists just north of the Main Base across the dry lake bed, consisting of a zone of material with low permeability; this barrier is possibly the extension of the Muroc Fault trending in a northwest-southeast direction. The elevation of the groundwater in the North Base area was about 2,190 feet in 1979. Groundwater level contours for this area are included on Figure 2.3.
CHAPTER 3

FIELD PROGRAM
CHAPTER 3
FIELD PROGRAM

NORTH BASE - GROUNDWATER MONITORING WELL (SITES IA, IB, IC, ID)

One groundwater monitoring well (Well 12) was installed down gradient adjacent to the nitric acid pits (Site IC) at North Base. The location of this well is shown on both Figures 3.1 and 3.2. Initially the well was to be drilled using the hollow-stem auger method; however, the sediments underlying the site made penetration at depth infeasible; as drilling progressed the drilled hole would not remain open, and the drill hole caved in. Thus it became necessary to complete the hole using rotary wash drilling.

During the augering phase, in-place soil samples were collected for laboratory analyses at depths of 10, 20, 45, 55, 65, and 103 feet. The samples were collected by a California Modified Sampler previously rinsed with methanol and deionized water; the sample was introduced into an acid-washed glass bottle and iced prior to shipment to the laboratory. These samples were analyzed for nitrates using an aqueous extraction followed by automated cadmium reduction.*

Well 12 was completed by rotary wash drilling, using water and super gel-x** as the drilling fluid to maintain an open hole. The well was drilled to a total depth of 148 feet. The geologic logs for all wells completed are contained in Appendix B. The well was constructed as explained in the well logs.

After completion of well construction and development by bailing, the water level in the well stabilized at 101 feet below ground surface.

* Standard Methods for The Examination of Water and Wastewater.
** Super gel-x, a commercial bentonite yielding high viscosity in drilling fluids.
FIGURE 3.1

LEGEND

△ WELL LOCATIONS

LOCATION OF WELLS
INSTALLED AT
EDWARDS AFB
IN AUGUST-SEPTEMBER
1983

ENGINEERING-SCIENCE
FIGURE 3.2
LOCATION OF SOIL BORINGS
AT SITE 1
EDWARDS AFB

SAND DUNES

NITRIC ACID TRENCHES
SUBSITE 1C

OPEN TRENCH
SUBSITE 1D2

DRUM STORAGE
SUBSITE 1B

OPEN TRENCH
SUBSITE 1D1

BARRELS

BURNING PIT

DRUM STORAGE
SUBSITE 1B

WELL 12

EXISTING WARNING SIGN

DRY LAKE BED

No Scale
The water-bearing materials were encountered at 135 feet. The water level was stable at 101 feet; the groundwater is assumed to be under confined conditions.

After development of Well 12, a groundwater sample was collected with a Teflon bailer. The sample was introduced into a polyethylene bottle and preserved with sulfuric acid, it was then iced, and brought to the laboratory for analysis.

NORTH BASE - SHALLOW SOIL BORINGS

In addition to the groundwater monitoring well at North Base, three shallow soil borings were completed in this area to confirm possible presence of chloroform and trichlorofluoromethane. The hollow-stem auger borings penetrated to a depth of 10 feet at the locations shown on Figure 3.2. An initial location for Bore 2 had to be abandoned, since refusal was met at a depth of 7 feet. It is unknown what material caused the refusal, but due to the possibility of buried wastes invalidating the data, the hole was abandoned.

The samples were collected at the base of the boring using the California Modified Sampler previously washed with methanol and deionized water. The brass tubes were capped with aluminum foil and plastic caps. The samples were iced and brought to the laboratory. Samples were analyzed for chloroform and trichlorofluoromethane, using EPA Method 601 modified for acceptance of solids.

MAIN BASE - SITE 8

Near the Main Base area, one groundwater monitoring well (Well 15) was installed down gradient from the industrial waste pond, Site 8. The location of the well is shown on Figures 3.1 and 3.3. The well was completed using the rotary wash method to a depth of 45 feet, after initial drilling by hollow-stem auger caused the bore to cave in. (The drilling log and well construction summary are contained in Appendix B.) The water level in the well after drilling stabilized at 27 feet below ground level. During auger drilling, undisturbed, in-place soil samples were collected by a California Modified Sampler. The sample was introduced into an acid-washed polyethylene bottle, iced, and brought to the
FIGURE 3.3
SITE 8
INDUSTRIAL WASTE POND
EDWARDS AFB
laboratory for metals analysis. After the well was developed, a ground-
water sample was collected using a Teflon bailer. The sample was trans-
ferred to an acid-washed polyethylene bottle, iced, and brought to the
laboratory for metals analyses. The analytical method consisted of acid
digestion of the soils followed by atomic absorption spectrophotometry.

MAIN BASE - SITES 2 AND 3

Two lysimeters were installed near the Main Base; one near Site 2
(the Main Base toxic waste disposal site), and the other near Site 3
(the abandoned sanitary landfill). Figure 3.4 shows the location of the
two lysimeters. Description of the lysimeters and sampling methodology
are contained in Appendix C. The lysimeter holes were drilled with a
hollow-stem auger, eight inches in diameter. Since no water was ini-
tially present in the soil, the lysimeters were not sampled. (Edwards
Hospital Bioenvironmental Engineering Section will monitor the lysim-
eters and sample if any water appears.)

At Site 2 the lysimeter was installed at a depth of 5.5 feet in
weathered granite. A soil slurry, consisting of native soil and tap
water, was backfilled around the porous cup, and the tube extending the
entire length of the lysimeter was marked with red tape. The first
sampling of the lysimeter may contain some water from the soil slurry
around the porous cup.

At Site 3, the lysimeter was installed in the same manner as the
lysimeter at Site 2. It was located at the south side of Mojave Boule-
vard at a depth of 10 feet in weathered granitic material. An attempt
was made to install the lysimeter on the north side of Mojave Boulevard;
however, at a depth of one foot, landfilled material was encountered,
and the hole was abandoned. A new hole was drilled across the roadway
to avoid direct contact with landfilled material.

Background Sample

One background soil sample was collected at the location shown on
Figure 3.1. The sample was taken immediately downslope from Building
4789 on granitic bedrock overlain by about one inch of weathered mate-
rial. The sample was collected with a shovel, which had been rinsed in
methanol and deionized water. The sample was split; one portion was
occurred in both wells with the appearance of gravels and a change from damp to moist sediments in Well 14. This may be indicative of a seasonal perched water table on top of which fuel may migrate down gradient. It should be noted that during drilling, smells were noted from 22 feet to 52 feet in Well 13, and at 45 feet in Well 14. No fuel was detected above the detection limit (20 mg/l) in either of the groundwater samples, and no visual evidence of fuel was identified during water sampling.

Well 6E1 was well pumped and cleared (see Appendix D for data). A water sample collected from Well was analyzed, using the same methodologies as for MB-1. The sample showed no evidence of fuels at a detection limit of 20 ppm. It must be concluded that the oil found in the well in 1982 may have resulted from an unauthorized dumping incident.

Main Base Well No. 1 (MB-1) (6L1) is an old well with a yield so low that it was never used as a production well. Initially, this well was sampled for evidence of fuels; none was found. The well was then
FIGURE 4.1
SITE 5 - SOUTH BASE
EDWARDS AFB AND ENVIRONS
Scale 1" = 12,000'

LEGEND
+ Old Abandoned Wells
⊕ Active Well
□ Wells Drilled by ES During Stage 1, IRP Phase II
▲ Wells Drilled by ES During This Effort
SOUTH BASE

The problem of soil contamination and possible future groundwater contamination at South Base is due to leaking underground waste POL tanks. These tanks are referred to as Site 5. Site 5 and the many existing and recently drilled wells nearby are shown in Figure 4.1.

Prior to the IRP Phase II Study, it was thought, based on water level data, that the upper aquifers underlying Site 5 flowed in the same direction as the underlying useful aquifer, north to south. To investigate the impact of leakage from Site 5, wells were drilled up gradient (ES 6) and down gradient (ES 7, ES 8, ES 9) of the tank. These wells revealed two facts:

- The wells and soils sampled during the drilling were not contaminated with oil or fuel.
- The upper aquifer appeared to flow from west to east.

Based on these facts and the observation of oils in Well 6E1, it was decided to embark on the following program:

- Drill wells at 40 and 400 feet toward the east of the site to locate potential oil contamination: these are Wells 13 and 14, respectively.
- Investigate 6E1 to determine the source of the oil found there.
- Investigate 6L1 to determine evidence of oil contamination at that point.

FINDINGS AT SOUTH BASE

Table 4.6 contains the analytical results obtained from analyzing soil and water samples from Wells 13 and 14. Field observations on fuel smell from the soils during drilling and sampling are included in the geologic logs in Appendix B (fuel was smelled from 22 feet to 52 feet in Well 13, and at 45 feet in Well 14 during drilling).

The analytical results from both wells indicate that the soil contains fuels at a depth of 45 feet, with the higher concentration near the POL storage area. At about the 40-foot level lithological changes
<table>
<thead>
<tr>
<th>Compound</th>
<th>Level of Detectability (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>α BHC</td>
<td>2</td>
</tr>
<tr>
<td>β BHC</td>
<td>2</td>
</tr>
<tr>
<td>δ BHC (Lindane)</td>
<td>2</td>
</tr>
<tr>
<td>BHC</td>
<td>2</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>2</td>
</tr>
<tr>
<td>Heptachlor Epoxide</td>
<td>2</td>
</tr>
<tr>
<td>Aldrin</td>
<td>2</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>2</td>
</tr>
<tr>
<td>Endrin</td>
<td>5</td>
</tr>
<tr>
<td>Endosulfon I</td>
<td>2</td>
</tr>
<tr>
<td>Endosulfon II</td>
<td>5</td>
</tr>
<tr>
<td>Endosulfon Sulfate</td>
<td>10</td>
</tr>
<tr>
<td>p,p' DDE</td>
<td>2</td>
</tr>
<tr>
<td>p,p' DDD</td>
<td>5</td>
</tr>
<tr>
<td>p,p' DDT</td>
<td>5</td>
</tr>
<tr>
<td>p,p' Methoxychlor</td>
<td>10</td>
</tr>
<tr>
<td>Aroclor 1016</td>
<td>10</td>
</tr>
<tr>
<td>Aroclor 1248</td>
<td>10</td>
</tr>
<tr>
<td>Aroclor 1254</td>
<td>10</td>
</tr>
<tr>
<td>Aroclor 1260</td>
<td>10</td>
</tr>
<tr>
<td>2,4-D</td>
<td>2</td>
</tr>
<tr>
<td>2,4,5-TP (Silver)</td>
<td>2</td>
</tr>
<tr>
<td>2,4,5-T</td>
<td>2</td>
</tr>
<tr>
<td>Constituents</td>
<td>Concentration (mg/kg)</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.30</td>
</tr>
<tr>
<td>Chromium</td>
<td>6.1</td>
</tr>
<tr>
<td>Copper</td>
<td>3.6</td>
</tr>
<tr>
<td>Nickel</td>
<td>4.9</td>
</tr>
<tr>
<td>Silver</td>
<td>2.2</td>
</tr>
<tr>
<td>Zinc</td>
<td>25.9</td>
</tr>
<tr>
<td>Antimony</td>
<td>2.5</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.21</td>
</tr>
<tr>
<td>Lead</td>
<td>5.3</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.034</td>
</tr>
<tr>
<td>Selenium</td>
<td>6.4</td>
</tr>
<tr>
<td>Aroclor 1254</td>
<td>0.02</td>
</tr>
</tbody>
</table>

*Levels requiring extraction to determine if the material is hazardous.
presence of these substances does not imply downward flow. Probably as long as conditions remain unchanged at the surface (cleaning the pond bottom or drying up the pond would be such a change), migration will not likely occur. Also since the water rose to 27 feet after the well was completed, it appears that some type of aquifer is present above the useful groundwater, which is apparently confined, further protecting the water from local infiltration of contaminated materials.

MAIN BASE - SITES 2 AND 3

Lysimeters were installed as previously discussed to determine potential for contamination of percolating runoff moving through the sites. At the time of installation, no water was present and no other soils analysis was made. No conclusions can be drawn. The lysimeters are to be checked by Base personnel; should water become present, it will be analysed. Instructions for the use of the lysimeters are included as Appendix C.

BACKGROUND SAMPLE

The background surface soil sample was taken near the landfill (Site 3). The results of the analysis of this sample are presented in Table 4.4.

Table 4.5 lists the spectrum of pesticides and PCBs for which the sample was examined and the level of detectability used (EPA Method 608). Except for Aroclor 1254, a PCB, none of these were found. The CAM criteria for PCBs is 5 mg/kg; the level detected is insignificant compared to this criteria. The source of this trace of Aroclor 1254 is unknown.

It is interesting to note that chromium, lead, and selenium are all higher than the CAM criteria in the same level of magnitude as the soil sample taken at 15 feet near the industrial waste pond. This may infer the natural soils on the Base are higher than the CAM levels and thus the findings in Well 15 may be normal background.
TABLE 4.3
ANALYTICAL RESULTS OF SOIL AND WATER SAMPLES FROM WELL 15 MAIN BASE, EDWARDS AFB

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Soil Samples Depth</th>
<th>CAM* Criteria</th>
<th>Water Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 feet (mg/kg)</td>
<td>30 feet (mg/kg)</td>
<td>(mg/kg)</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.65</td>
<td>0.21</td>
<td>1</td>
</tr>
<tr>
<td>Chromium</td>
<td>11.3</td>
<td>1.7</td>
<td>5</td>
</tr>
<tr>
<td>Copper</td>
<td>6.7</td>
<td>0.95</td>
<td>25</td>
</tr>
<tr>
<td>Nickel</td>
<td>9.5</td>
<td>2.1</td>
<td>20</td>
</tr>
<tr>
<td>Silver</td>
<td>4.9</td>
<td>2.9</td>
<td>5</td>
</tr>
<tr>
<td>Zinc</td>
<td>22.8</td>
<td>7.4</td>
<td>250</td>
</tr>
<tr>
<td>Antimony</td>
<td>6.6</td>
<td>1.6</td>
<td>100</td>
</tr>
<tr>
<td>Arsenic</td>
<td>60.7</td>
<td>0.92</td>
<td>5</td>
</tr>
<tr>
<td>Lead</td>
<td>9.3</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.14</td>
<td>0.017</td>
<td>0.2</td>
</tr>
<tr>
<td>Selenium</td>
<td>9.7</td>
<td>1.0</td>
<td>1</td>
</tr>
</tbody>
</table>

*Levels requiring extraction to determine if the material is hazardous.
It can be concluded that lateral migration of chloroform and trichlorofluoromethane is considerably less than 200 feet from the disposal site.

MAIN BASE - SITE 8

Industrial wastes find their way to the pond at Site 8. In the IRP Phase II - Confirmation Study, the industrial waste pond was heavily laden with sediments containing significant quantities of a wide variety of metals. In order to determine whether or not these metals were migrating downward to the groundwater, a monitoring well (Well 15) was constructed down gradient from this pond. During drilling, soil samples were taken at 15 feet and 30 feet. Drilling continued to 45 feet. After drilling, water levels stabilized at 27 feet; soil samples were analyzed and a water sample was taken and analyzed. Table 4.3 gives the results of those analyses.

For comparative purposes, the Federal Drinking Water Standards and the California Assessment Manual (CAM) criteria for defining hazardous solid waste materials are also presented in Table 4.3. The CAM criteria have been developed to help deal with the problem of contaminated materials. They set levels below which the material is considered to be nonhazardous. Above the CAM criteria, the extraction test must be utilized to determine whether the offending substance is mobile or fixed, under the conditions of a standard extraction test.

For all the metals measured, the groundwater exhibits less than the level permitted by the Federal Standards for drinking water. At the time and place of sampling, no problem exists.

The soil samples in monitoring will show marginally high levels of chromium, arsenic, lead and selenium (see discussion of background sample). These levels do not pose an imminent health hazard; however, they do reflect a slight potential for groundwater contamination.

In ponds such as this, it is very likely that the initial use of the pond (when new), charged the underlying soils with the pond water. With time, the soils in the pond bottom clog and the outflow stops. The moisture held in the soil is retained and may then dry up leaving the offending metals behind as crystals. The important point is that the
10 mg/l. Since the value is low, it seems apparent that no continuous or recent migration of nitrate to the groundwater has or is occurring.

NORTH BASE - SHALLOW SOIL BORING

During the initial drilling and sampling in the proximity of Sites 1A, 1B, 1D1, and 1D2, chloroform and trichlorofluoromethane were found to be pervasive to the depths drilled (60 feet) at typical limits of 500 and 3,000 micrograms per kilogram, respectively. There was concern that these substances were migrating through the soil horizontally by gaseous diffusion. To test this hypothesis, three shallow borings (10 feet) were drilled around Site 1D1 at a distance of approximately 200 feet. Samples were carefully taken and analyzed (to minimize loss of gaseous substances). Analyses were performed for chloroform and trichlorofluoromethane at a detection level of 2.5 and 20 micrograms per kilogram, respectively; neither of these substances were detected. Soil samples from Well 12, the water monitoring well, were also taken at 10 and 20 feet. The sample at the 10-foot level showed chloroform at the level of detectability, 2.5 micrograms per kilogram. These results are shown in Table 4.2.

TABLE 4.2
RESULTS OF SOIL SAMPLE ANALYSES
NORTH BASE

<table>
<thead>
<tr>
<th>Location</th>
<th>Chloroform (μg/kg)</th>
<th>Trichlorofluoromethane (μg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore 1 (10 feet)</td>
<td>&lt;2.5</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Bore 2 (10 feet)</td>
<td>&lt;2.5</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Bore 3 (10 feet)</td>
<td>&lt;2.5</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Well 12 (10 feet)</td>
<td>2.5</td>
<td>&lt;10</td>
</tr>
<tr>
<td></td>
<td>(&lt;20 feet)</td>
<td></td>
</tr>
</tbody>
</table>

Detection limit 2.5 μg/kg
Detection limit 10 μg/kg
CHAPTER 4

DISCUSSION OF RESULTS
AND SIGNIFICANCE OF FINDINGS

NORTH BASE - GROUNDWATER MONITORING WELL

Table 4.1 presents the results of a nitrate analyses in the soil column at Well 12.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Nitrate Concentration (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.77</td>
</tr>
<tr>
<td>20</td>
<td>0.20</td>
</tr>
<tr>
<td>45</td>
<td>0.19</td>
</tr>
<tr>
<td>55</td>
<td>0.30</td>
</tr>
<tr>
<td>65</td>
<td>0.33</td>
</tr>
<tr>
<td>103</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Detection limit: 0.02 mg/kg.

In earlier borings (Phase II - Confirmation), slant borings directly under the nitric acid disposal pits revealed nitrates in the soil from 1,000 to 2,000 mg/kg. Here, a short distance away from the pit, there appears to be no notable nitrate concentrations. This would indicate that nitrate movement in the soil was essentially vertical and the area of soil contaminated is small though very deep.

A water sample of the underlying groundwater showed a concentration of 0.54 mg/kg. This is well below the Federal drinking water standard of
CHAPTER 4

DISCUSSION OF RESULTS
AND SIGNIFICANCE OF FINDINGS
then lowered into the well, and the well water was evacuated. Water level data were collected during pumping of the well and during recovery to provide rough estimates on aquifer characteristics.

After the well had been pumped and allowed to recharge, it was sampled with a Teflon/quartz bailer. The sampler was only lowered to intercept the top of the water to allow for sampling of potentially floating hydrocarbons. The sample was transferred to VOA glass bottles, iced, and transported to the laboratory for analysis. EPA Method 8015 was used.

SOUTH BASE - WELL 9N9W-6E1

Well 6E1 is located north of Site 5 in an area that does not appear to be affected by or affecting Site 5. The U.S. Geological Survey uses Well 6E1 to monitor water levels in the area on an annual basis. Recordings from previous years by U.S.G.S. show identification of fuel smell in this well. The Base personnel collected a water sample from this well in 1982, at which time leaded fuel was found in the water sample. The well has never been in active use since its installation in 1942.

During the field program, carried out in August and September of 1983, Well 6E1 was sampled for visual evidence of petroleum products, none was identified. The well was then pumped in the same manner as Well MB-1, described above. Over 600 gallons of water was removed, in excess of 10 well casing volumes. The well was then allowed to recharge prior to sampling.

After pumping and recovery, the well was sampled with a Teflon/quartz bailer. The sample was only lowered to intercept the top of the water where the presence of floating hydrocarbons would be most noticeable. The sample was transferred to VOA bottles, iced and transported to the laboratory for analysis. EPA Method 8015 was used.
transferred into acid-washed glass jars for metals analysis, and one portion was placed into a solvent-rinsed glass jar for pesticide and herbicide analyses. The method used for analysis consisted of acid digestion followed by atomic absorption spectrophotometry.

Pesticides and PCBs were analyzed using EPA Method 608, and herbicides were analyzed by soxhlet extraction followed by ASTM 509B for chlorinated phenoxyacid herbicides in water.

SOUTH BASE - MONITORING WELLS

Two groundwater monitoring wells were installed immediately down gradient from the underground POL tanks at Site 5 at the locations indicated. Well 13 is about 40 feet east of the fence surrounding the POL area, and about 400 feet south of the roadway. Well 14 is located about 400 feet to the east of Well 13 toward the lake bed. Both wells were constructed with hollow-stem auger drilling. The geologic logs and well completion summaries for both wells are contained in Appendix B.

Soil samples were collected by a split spoon sampler, and the sample was transferred to VOA glass bottles (25-ml glass vial with a Teflon-lined screw cap top), iced, and delivered to the laboratory for analyses for fuel. The analyses for fuels were completed using EPA test Method 8015 for evaluating solid waste for nonhalogenated volatile organics (by direct injection of a carbondisulfide extract), with a detection limit of 100 mg/kg for the soils, and 20 mg/kg for water.

SOUTH BASE - BASE WELL MB-1 (9N9W-6L1)

Main Base Well 1 (MB-1) is an old well that was found to contain an unknown contaminant (see IRP Phase II Stage 1 well log). The well is not currently in operation. It was constructed to a depth of 147 feet with perforations in the 14-inch casing at the interval 33 feet to 130 feet. The well is located down gradient from Site 5.

The well was sampled for presence of fuels. First, a Teflon/quartz bailer was used to preliminarily ascertain if any petroleum products were present on top of the water surface. There was no visual evidence of floating petroleum. A four-inch submersible stainless steel pump was
FIGURE 3.4
LOCATION OF LYSIMETERS AT SITES 2 AND 3
EDWARDS AFB

SITE 2

SITE 3
pumped and allowed to recharge. (See Appendix D for data.) The well was again sampled for evidence of fuels; none was found.

SUMMARY - SOUTH BASE

A layer of fuel-contaminated soil was found at about 45 feet below the surface. The layer extends at least 400 feet to the east of the tank. The contamination is heaviest near the tank (4,000 mg/kg). At 400 feet, the contamination is 300 mg/kg.

No evidence of groundwater contamination was found in the South Base area.
CHAPTER 5

ALTERNATIVE MEASURES
CHAPTER 5
ALTERNATIVE MEASURES

This report serves only to further confirm situations presented in the earlier Installation Restoration Program, Phase II - Confirmation report dated September 1982. That report presents alternative measures. The findings of this report do not affect those recommended alternative measures.
CHAPTER 6

RECOMMENDATIONS
CHAPTER 6

RECOMMENDATIONS

The supplemental Phase II field work completed in August and September of 1983 did not identify contamination of groundwater supplies at Edwards AFB at the locations of investigation.

RECOMMENDED MONITORING PROGRAM

It is recommended that a sampling program be established to monitor the groundwater quality in the area where the Phase II supplemental field work was completed. The recommended monitoring program is outlined in Table 6.1.

FURTHER STUDIES AT SITE 5

As a result of these investigations, it was determined that a layer of fuel-contaminated soil exists 45 feet below the ground surface extending horizontally at least 400 feet easterly of the POL tank at Site 5, South Base. Groundwater occurs approximately 20 feet below this layer.

The procedures used to analyze for fuels identified nonhalogenated volatile organics (EPA 8015). The main concern with such substances in water is in the area of taste and odor rendering the water nonpotable. Since the POL tanks held waste materials of unknown composition, the oily materials could contain substances of health concern. At this time, it appears that the oily contaminant is adsorbed to the soil matrix and thus remains suspended in the soil column. Should the water table rise and remobilize the oily materials, a problem could result.

Since, at this time, knowledge of the extent of the contaminated area, the expected variations in groundwater level and the potential
<table>
<thead>
<tr>
<th>Site</th>
<th>Pre-Sampling Preparation</th>
<th>Sampling Procedure</th>
<th>Constituents to be Identified in Analyses</th>
<th>Sampling Container</th>
<th>Sample Preservation</th>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Base</td>
<td></td>
<td></td>
<td>Nitrates</td>
<td>500-ml polyethylene bottle</td>
<td>1 ml of concentrated sulfuric acid. Place sample on ice.</td>
<td>Semiannually at regular intervals</td>
</tr>
<tr>
<td>Well 12</td>
<td>Evacuate 4 well volumes from the well with a submersible pump. Use a Teflon tubing as discharge line from the pump.</td>
<td>Sample directly from discharge tubing into sampling bottle.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Base</td>
<td></td>
<td></td>
<td>Cadmium, chromium, copper, nickel, silver, zinc, antimony, arsenic, lead, mercury, and selenium</td>
<td>1-L polyethylene acid-washed bottle</td>
<td>10 ml of concentrated nitric acid. Place sample on ice.</td>
<td>Semiannually at regular intervals</td>
</tr>
<tr>
<td>Well 15</td>
<td>Same as for Well 12</td>
<td>Same as for Well 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lysimeter, Site 2</td>
<td>None</td>
<td>Evacuate the porous cup with pump.</td>
<td>Chromium, cyanide, tetrathyl lead</td>
<td></td>
<td>5 ml of nitric acid. Place sample on ice.</td>
<td>Twice a year following major storm events</td>
</tr>
<tr>
<td>Lysimeter, Site 3</td>
<td>None</td>
<td>Same as for Site 2</td>
<td>Antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, pesticides and herbicides</td>
<td>For metals: 1-L acid-washed polyethylene bottle. For pesticides and herbicides: 2-L solvent-rinsed glass bottles w/ Teflon cap liners.</td>
<td>10 ml of concentrated nitric acid. Place sample on ice.</td>
<td>Twice a year following major storm events</td>
</tr>
<tr>
<td>South Base</td>
<td></td>
<td></td>
<td>Fuels</td>
<td>2 VOA bottles</td>
<td>Place sample on ice.</td>
<td>Semiannually at regular intervals</td>
</tr>
<tr>
<td>Wells 13 and 14, HS-1, 681</td>
<td>None</td>
<td>Lower bailer into wells to a depth where the sampler is intercepting the water table.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The presence of problem substances in the oily contaminant is limited, the following actions are recommended:

* Resistivity surveys should be conducted to estimate the areal extent of the contamination.
* A series of wells should be drilled to confirm the results of the resistivity surveys.
* Samples of the oily material should be taken while drilling the foregoing wells. The samples should be analyzed for potential problem contaminants. The contaminants to be considered for analysis should be determined based on Air Force information as to potential POL waste constituents.
* A water level monitoring program should be developed in the Site 5 area. The information obtained from this program will be useful in assessing the potential for migration of possible problem substances.
APPENDIX A

SCOPE OF WORK
APPENDIX A

SCOPE OF WORK

As a result of the investigation entitled Installation Restoration Program Phase II - Confirmation conducted at Edwards AFB, it was decided to perform certain additional explorations and investigations at the Base. The Air Force chose to administer these supplemental investigations utilizing a modification of the original contract documents. The scope of the original contract was modified to reflect this additional work. The following document is the modification of the original scope of work containing the desired modifications. The modifications covering this supplemental work are underlined for the convenience of the reader.
I. DESCRIPTION OF WORK

The purpose of this task is to determine the magnitude and extent of environmental contamination which has resulted from previous waste disposal practices at Edwards AFB, California; to make recommendations for actions necessary to mitigate adverse environmental effects of existing contamination problems; to suggest potential ways of restoring the environment to as near a normal level as is practical; and, to suggest a future environmental monitoring program to document environmental conditions at Edwards AFB.

The presurvey (Task Order 2) report incorporated background and description of the sites for this task. To accomplish this survey effort, the following steps will be taken:

A. Install one test hole downstream of the main toxic waste disposal area, Site 2. Perform analyses for toxic contaminants on two soil-moisture samples.

B. Install four groundwater monitoring wells, one well upgradient and three wells downgradient of the waste POL storage area, Site 5. Perform analyses for organic contaminants on eight water samples.

C. Monitor ambient air quality for total hydrocarbon at the sites described below after wells are installed.

D. Install a maximum of two monitoring wells downgradient from Sites 1B, C, and D. The wells will extend a maximum of 100 feet and consist of PVC, Schedule 40 casing, and screen. A maximum of eight in-place soil samples will be collected for analysis for nitrates, chloroform, and trichlorofluoromethane. Following well installation, the groundwater will be sampled for the same constituents.

E. Install test holes to remove subsurface soils for analysis as follows:
   1. one hole slant-drilled at Site 1A,
   2. one hole slant-drilled at the subsite south of the playa at Site 1B,
   3. two slant holes (1 per subsite) at Site 1D, and
   4. three soil samples from each hole above will be analyzed for organic contaminants.
   5. three 10-foot deep soil borings drilled radially away from Sites 1B, C, and D; collect one soil sample per boring and analyze for chloroform and trichlorofluoromethane.
6. one boring each at sites 2 and 3, installed to bedrock; install a lysimeter in each boring.

F. Install one test hole in the center of the main nitric acid pit at Site 1C. Remove five samples and analyze for nitrates.

G. Collect two surface soil samples downslope of the abandoned sanitary landfill, Site 3. Analyze for organic contaminants and heavy metals.

H. Collect one liquid sample and four sediment samples from the industrial waste pond, Site 8. Analyze for toxic organic contaminants.

I. Collect one background surface soil sample and analyze for heavy metals, pesticides and herbicides.

J. Install five monitoring wells in the vicinity of Site 8. The wells shall be installed to define the plume originating from the pipeline break between Buildings 1635 and 1810, and pipeline leak at Building 1724. Analyze two samples from each well (10 samples total) for organic contaminants.

K. Install a maximum of two groundwater monitoring wells immediately downgradient from Site 8. Collect one water sample from each well and analyze for organic contaminants and heavy metals.

L. Redevelop abandoned South Base well 9E/9W-6B1 and collect a groundwater sample after 10 well volumes have been removed. The sample will be analyzed for the presence of fuels. A pump test will be conducted to ascertain aquifer characteristic estimates.

M. Install a maximum of two groundwater monitoring wells downstream from Site 5. The design of the wells will be similar to that of the well in Item I.D above. A maximum of 11 soil samples will be collected and analyzed for presence of fuels. A maximum of two groundwater samples will be analyzed for fuels.

N. A maximum of four groundwater monitoring wells shall be installed during tasks described in Items I.D, I.K. and I.M. Total depth of wells installed shall be 400 linear feet. One groundwater sample per well shall be analyzed as described in the applicable Item.

O. Close all abandoned test wells and test holes from the above tasks in accordance with regulations of the California Water Quality Control Board.

P. A final report (Item VI below) will be prepared delineating the magnitude and extent of environmental contamination, to include recommendations required for cleanup or to mitigate the adverse effects of previous waste disposal practices. Recommendations for future environmental monitoring must also be included.

Q. A supplemental final report will be prepared after the completion of Items I.D, I.E.5, I.E.6, I.I, I.K, I.L, and I.M. Monitoring results and recommendations will be delineated as in Item I.P above.

F33615-80-D-4001/001805
II. SITE LOCATION AND DATE:

Edwards AFB CA
Building 3925
N/A

III. BASE SUPPORT: None

IV. GOVERNMENT FURNISHED PROPERTY: None

V. GOVERNMENT POINTS OF CONTACT:

1. Dr Dee Ann Sanders
   USAF OEH/ECQ
   Brooks AFB TX 78235
   (512) 536-3305

2. Mr James Baker
   USAF Hospital Edwards/SGPA
   Edwards AFB CA 93525
   (805) 227-3272/2982

3. Capt Richard Brewer
   HQ AFSC/SGPB
   Andrews AFB MD 20334
   (301) 981-5235

VI. In addition to sequence numbers 1, 6 and 11 listed in Atch 1 to the contract which are applicable to all orders, the sequence number listed below is applicable to this order:

<table>
<thead>
<tr>
<th>Sequence No.</th>
<th>Block 10</th>
<th>Block 11</th>
<th>Block 12</th>
<th>Block 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>One/R</td>
<td>83 Dec 10</td>
<td>83 Dec 31</td>
<td>84 Mar 30</td>
</tr>
</tbody>
</table>

*Twenty-five (25) copies of the Draft Supplemental Final Report are required. Fifty (50) copies plus the camera-ready of the Supplemental Final Report are required.
APPENDIX B

WELL LOGS
# Well Construction Summary

## Location
- **Location**: North Base Site 1C
- **Elevation**: Ground Level
- **Top of Casing Elevation**: Ground Level

## Drilling Summary
- **Total Depth**: 149 ft
- **Borehole Diameter**: 2.11
- **Driller**: Ston Hydronics, Orange, CA
- **Rig**: Mobile B-53
- **Bits**: Auger and roller bit (hollow stem auger rotary wash)
- **Drilling Fluid**: Super Gel-X (Karnite)
- **Surface Casing**: Black Iron

## Construction Time Log
<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>Start Time</th>
<th>Finish Date</th>
<th>Finish Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling</td>
<td>8/5/83</td>
<td>9/9</td>
<td>9/15</td>
<td>3/10</td>
</tr>
<tr>
<td>Geophysics Logging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Placement</td>
<td>8/11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cementing</td>
<td>8/11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>8/12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Well Design
- **Basis**: Geologic Log & Geophysical Log
- **Casing Strings**:
  - C1: 4.0 Pvc, SCH 40
  - C2: 4.0 Pvc, SCH 40
  - C3: 4.0 Pvc, SCH 40
  - C4: 4.0 Pvc, SCH 40
- **Screen**:
  - S1: 4.0 Pvc, SCH 40, Hands 1.9'4'
  - S2: 4.0 Pvc, SCH 40, Hand 1.9'4'
  - S3: 4.0 Pvc, SCH 40, Hand 1.9'4'
  - S4: 4.0 Pvc, SCH 40, Hand 1.9'4'

## Well Development
- **Railing**

## Comments
- The augering caused no trouble and every 10' casing not carried up after 10' 4:30 to pull auger up every 10' to clean out. After 10', surface cleared to rotary wash. Wet clay base @ 77'. Number of 135' w/t. Level rises to 110'. Samples 0 in. 20', 45', 75', 105', and 123' w/t. Cal. modified.
To recover a soil water sample, attach the pressure-vacuum access tube to the pressure port on the pump. Place the discharge access tube in a small collection bottle and open both pinch clamps. Apply a few strokes on the hand pump to develop enough pressure within the sampler to force the collected water out of the sampler and into the collection bottle.

Subsequent samples are collected by again creating a vacuum within the sampler and following the steps as outlined above.

**MAINTENANCE**

There are no maintenance requirements for the pressure-vacuum soil water samplers, other than protecting the access tubes from damage. Tube ends should be covered or plugged to prevent debris from entering the tubes and later contaminating the sample.

Freezing conditions will not damage the samplers. The samplers are normally left permanently in place throughout the year.

**INSTRUCTIONS FOR POTTING**

With our current design, we do not feel that potting of the neoprene plug is necessary to maintain a permanent pressure-vacuum seal; however, if you desire, the design has been arranged so that these elements can be potted with an epoxy resin.

1. **INSTALL ACCESS TUBES**

2. **INSTALL FIRST CLAMP WASHER**

3. **INSTALL NEOPRENE PLUG AND ADD EPOXY TO THE OUTSIDE DIAMETER**

4. **INSTALL SECOND CLAMP WASHER**

5. **SCREW CLAMP RING IN PLACE, AND POUR EPOXY INTO CAVITY TO COMPLETELY SEAL THE NEOPRENE PLUG AND ACCESS TUBES**
E hand pump is connected to the pressure-vacuum access tube. The pump is then stroked until a vacuum of perhaps 60 centibars (18" of mercury) is created within the sampler, as read out on the gauge connected to the pump.

(Fig.2) The pinch clamp on the pressure-vacuum access tube is then closed securely to seal the sampler under vacuum. The hand pump can then be removed for other uses. The sampler is allowed to set for a period of time under vacuum.

The vacuum within the sampler causes the moisture to move from the soil, through the porous ceramic cup, and into the sampler. The rate at which the soil solution will collect within the sampler depends on the capillary conductivity of the soil, the soil suction value within the soil (as measured with tensiometers), and the amount of vacuum that has been created within the sampler. In moist soils of good conductivity, at field capacity (10 to 30 centibars of soil suction as read on a tensiometer) substantial soil water samples can be collected within a few hours. Under more difficult conditions it may require several days to collect an adequate sample.

In general, vacuums of 50 to 80 centibars (15" to 25" of mercury) are normally applied to the soil water sampler. In very sandy soils it has been noted, however, that very high vacuums applied to the soil water sampler seem to result in slower rate of collection of the sample than lower applied vacuums. It is our feeling that in these coarse, sandy soils, the high vacuums within the sampler may deplete the moisture in the immediate vicinity of the porous ceramic cup and hence reduce the capillary conductivity, which creates a barrier to the flow of moisture to the cup under these circumstances. In loams and gravelly clay loams, users have reported collection of 300 to 500 ml of solution over a period of a day with applied vacuum of 15" of mercury (50 centibars) when soils are at field capacity. On waste water disposal sites, some users have obtained up to 1500 ml of sample within 24 hours after cessation of irrigation with 1" to 2" of waste water on sandy or clay loam soil.
ACCESS TUBES

TAMP SOIL

ADDITIONAL METHODS OF INSTALLING THE
PRESSURE-VACUUM SAMPLER

(Fig. 1) Core hole to desired depth, insert soil water sampler and backfill the hole with native soil, tamping continuously to insure good soil contact with the porous ceramic cup and complete sealing of the cored hole.

(Fig. 2) Core hole to desired depth, pour in a small quantity of crushed 200 mesh pure silica-sand of almost talcum powder consistency (commercially available under trade names of Super-Sil and Silica Flour). Insert soil water sampler and pour another layer of the 200 mesh silica-sand at least six inches deep around cup of the soil water sampler. Backfill the hole with soil free of pebbles and rocks, tamping continuously with a long metal rod to insure against surface water channeling down between the soil and the body tube of the sampler.

(Fig. 3) Core hole to desired depth, pour in a small quantity of wet bentonite clay. This will isolate the sampler from the soil below. Pour in a small quantity of 200 mesh silica-sand and insert soil water sampler. Pour another layer of 200 mesh silica-sand at least six inches deep around the cup of the soil water sampler. Backfill with native soil to a level just above the soil water sampler and again add a small quantity of bentonite as a plug, to further isolate the soil water sampler and guard against possible channeling of water down the hole. Backfill the remainder of the hole slowly, tamping continuously with a long metal rod. Again backfill should be of native soil free of pebbles and rocks.

There are other methods of installing the soil water samplers that may be used, largely dictated by the type of soil you are concerned with and the tools available. The primary concern in any method of installation is that the porous ceramic cup of the sampler be in tight, intimate contact with the soil, so that soil moisture can move readily from the pores of the soil through the pores in the ceramic cup and into the soil water sampler.
In rock-free uniform soils at shallow depths, use a 2" screw or bucket auger for coring the hole.

If the soil is rocky, a 4" auger should be used. The soil should then be sifted through a 1/4" mesh screen to free it of pebbles and rocks. This will provide a reasonably uniform backfill soil for filling in around the soil water sampler. The Model 230 Series Soil Augers can be used for this purpose.

**INSTALLATION OF PRESSURE-VACUUM SOIL WATER SAMPLER USING A SOIL SLURRY**

(Fig. 1) After the hole has been cored, mix a substantial quantity of soil from the bottom of the hole with water to make a slurry which has a consistency of cement mortar. This slurry is then poured down to the bottom of the cored hole to insure a good soil contact with the porous ceramic cup.

(Fig. 2) Immediately after the slurry has been poured, push the soil water sampler down into the hole so that the porous ceramic cup is completely embedded in the soil slurry.

(Fig. 3) Backfill the remaining area around the soil water sampler, tamping lightly with a small diameter rod. Backfill the remainder of the hole, tamping soil firmly, to prevent surface water from running down the cored hole. Backfill hole with native soil free of pebbles and rocks.
OPERATING INSTRUCTIONS for the
Model 1920
PRESSURE-VACUUM SOIL WATER SAMPLER

SITE LOCATION

The Model 1920 Pressure-Vacuum Soil Water Sampler can be installed in any location, at any depth up to a maximum of 50 ft. The access tubes from the sampler may be terminated directly above the sampler installation or, if conditions require, the access tubes may be laid in a trench and carried to a remote location, terminated above the soil surface. The access tubes should be located so that they will be free from damage by mechanical equipment and by livestock. The surface area directly above the sampler should not be covered in any manner that would interfere with the normal percolation of soil moisture down to the depth of the sampler. Once the depth and location for the pressure-vacuum soil water sampler has been decided, the length of the access tubes should be determined so that they can be cut and mounted into the soil water sampler.

INSTALLATION OF ACCESS TUBES IN THE SAMPLER

(Fig.1) The access tubes are normally made from 1/4" diameter copper or polyethylene tubing. When installing the tubes, one tube should be pushed through the neoprene plug so that the end of the tubing reaches almost down to the bottom of the porous ceramic cup. This "discharge" access tube should be marked at the other end in some fashion to identify it. The other "pressure-vacuum" access tube should be inserted into the neoprene plug so that it extends through the plug perhaps one inch.

(Fig.2) After the tubes are installed, tighten the clamp ring with a nail or similar object inserted through the holes provided in the clamp ring. Tighten only until it meets the body tube. See note on page 5 if potting is desired.
APPENDIX C

LYSIMETER OPERATING INSTRUCTIONS
<table>
<thead>
<tr>
<th>Depth</th>
<th>Time</th>
<th>Description</th>
<th>Graphic Log</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>Ed-brown sandy (20%) gravel, sand</td>
<td>GP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ed fine-sandy gravel, sand</td>
<td>SP</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Bm coarse-sandy (20%) clay, damp</td>
<td>CL</td>
<td>Small amount of oil</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Bm ten clayey sand</td>
<td>SC</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Bm clayey, fine sand</td>
<td>SP</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>Sandy (10%) clay</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Red sand, course, jet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td>T C 45'</td>
<td></td>
</tr>
</tbody>
</table>

**Location:** Edwards Industrial Waste Pond  
**Altitude (Datum):**  
**Method:** Hollow stem Auger  
**Driller:** Stang Hydromics  
**Well No.:** 15  
**Date:** 7/1/83  
**Size of hole:** 8"  
**Size of casing:** 4"
WELL CONSTRUCTION SUMMARY

LOCATIONS COORDS: Eduardo
ELEVATION: GROUND LEVEL
TOP OF CASING

DRILLING SUMMARY:
TOTAL DEPTH: 451
BOREHOLE DIAMETER: 8'
DRILLER: Stacey Hyman
RIG: Move to E-20
BITE: MPR and Rotary
DRILLING FLUID: None
SURFACE CASING

CONSTRUCTION TIME LOG:

<table>
<thead>
<tr>
<th>TASK</th>
<th>START</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRILLING: 0-15</td>
<td>9/17</td>
<td>10/10</td>
</tr>
<tr>
<td>15-45</td>
<td>9/21</td>
<td>10/30</td>
</tr>
<tr>
<td>45-55</td>
<td>9/30</td>
<td>10/15</td>
</tr>
<tr>
<td>GEOPHYS. LOGGING: Casing</td>
<td>4/20</td>
<td>4/20</td>
</tr>
<tr>
<td>FILTER PLACEMENT: CEMENTING: DEVELOPMENT: OTHER:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WELL DESIGN:
BASIS: GEOLOGIC LOG
GEOPHYSICAL LOG
CASING STRINGS: C: CASING S: SCREEN
26 - 36 5
0 - 26 C

CASING:
C1: 1-1/2" PVC SCREW HAMMERED
C2
C3
C4
SCREEN:
S1: 4-1/2" SCREEN SCREW HAMMERED
S2
S3
S4

CENTRALIZERS
FILTER MATERIAL: Sand 37 - 23'
CEMENT: 0 - 20

OTHER: bentonite 23 - 20

WELL DEVELOPMENT

COMMENTS:
Heavy rains 8/15 and 3/6
Drilled 27', 20' of Well is plugged out
11'19' recored to 45', bent
Kemp open hole eased to 31'
Rotary to 37'
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>TIME</th>
<th>DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>Silty coarse sand</td>
<td>SM</td>
<td>Alkalis</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Red-brown fine sand</td>
<td>SM</td>
<td>Moist, increasing coarse sand, occasional gravel</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>White-tan coarse sand</td>
<td>SW</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Red-brown (10%) clay (10%)</td>
<td>SM</td>
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<tr>
<td>50</td>
<td></td>
<td>Red-silt, more sand</td>
<td></td>
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</tr>
<tr>
<td>55</td>
<td></td>
<td>Sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>Sand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Location:** Edwardo, South Base, Site 5

**Method:** Hollow Stem Auger

**Driller:** Stallis Hydraulics, Orange

**Well No.:** 14

**Date:** 8/16/1983
# WELL CONSTRUCTION SUMMARY

**LOCATION or COORDS:** Edwards, South Base

**ELEVATION:** GROUND LEVEL

**TOTAL DEPTH:** 651 ft

<table>
<thead>
<tr>
<th>BOREHOLE DIAMETER</th>
<th>8&quot;</th>
</tr>
</thead>
</table>

**DRILLER:** Steve Hymer

**RIG:** Mobile R-53

**BIT(S):** 2" Gage

**DRILLING FLUID:** Water

**SURFACE CASING:** Metal cap

## WELL DESIGN:

**BASIS:** GEOLOGIC LOG

**CASING STRING(S):** C1 CASING S-Screen

**SCREEN:** Steel 5" x 65 ft, 10 ft slots

**CENTRALIZERS:**

<table>
<thead>
<tr>
<th>FILTER MATERIAL</th>
<th>4-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEMENT</td>
<td>0-5</td>
</tr>
</tbody>
</table>

**COMMENTS:**

- 47.94 ft, L grade
- 47.94 ft, Portland cement
- 47.94 ft, cement
- 47.94 ft, field

**CONSTRUCTION TIME LOG:**

<table>
<thead>
<tr>
<th>TASK</th>
<th>START DATE</th>
<th>START TIME</th>
<th>FINISH DATE</th>
<th>FINISH TIME</th>
</tr>
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<tbody>
<tr>
<td>DRILLING</td>
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<td>9:00</td>
<td>7/16</td>
<td>11:00</td>
</tr>
<tr>
<td>10-16 50</td>
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<td>11:00</td>
<td>7/16</td>
<td>12:00</td>
</tr>
<tr>
<td>GEOPHYSICAL LOGGING</td>
<td>7/14</td>
<td>9:00</td>
<td>7/14</td>
<td>10:00</td>
</tr>
<tr>
<td>CASEING</td>
<td>7/14</td>
<td>11:00</td>
<td>7/14</td>
<td>14:00</td>
</tr>
<tr>
<td>FILTER PLACEMENT</td>
<td>7/16</td>
<td>10:00</td>
<td>7/16</td>
<td>11:00</td>
</tr>
<tr>
<td>CEMENTING</td>
<td>7/16</td>
<td>11:00</td>
<td>7/16</td>
<td>11:00</td>
</tr>
</tbody>
</table>

**WELL DEVELOPMENT**

- [Add comments here]

- [Add comments here]
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>TIME</th>
<th>DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td>Red-brown sandy (30%) silty</td>
<td>ML</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Red-brown sandy (10%) mud-coarse sand</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Red-brown (5%) coarse sand, occasional gravel</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>Red-brown sandy (5%) coarse sand, occasional gravel</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Red-brown sandy (10%) silty gravel</td>
<td>MH</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Red-brown sandy (5%) coarse sand</td>
<td>CL</td>
<td>moist, fuel smell increasing, sand</td>
</tr>
</tbody>
</table>

**Location:** Edwards South Base, Site 5  
**Method:** Hollow Stem Auger  
**Driller:** Stan Hydronics  
**Date:** 8/14/83
## WELL CONSTRUCTION SUMMARY

**LOCATION & COORDS:** Eduardo South Base  
**ELEVATION:** Ground Level  
**TOP OF CASING:**

### DRILLING SUMMARY:
- **TOTAL DEPTH:** 151'  
- **BOREHOLE DIAMETER:** 8"  
- **DRILLER:** Staci Hydronics  
- **DRILLING FLUID:** Water  
- **SURFACE CASING:** Black iron  

### CONSTRUCTION TIME LOG:

<table>
<thead>
<tr>
<th>TASK</th>
<th>START</th>
<th>FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRILLING:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-42'</td>
<td>8/14 12:30</td>
<td>8/14 14:10</td>
</tr>
<tr>
<td>42'-65'</td>
<td>8/15 7:20</td>
<td>8/15 8:25</td>
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<tr>
<td><strong>GEOLOGY:</strong></td>
<td></td>
<td></td>
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<tr>
<td>LOGGING CASING</td>
<td>8/15 11:30</td>
<td>8/15 11:35</td>
</tr>
<tr>
<td><strong>FILTER:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLACEMENT</td>
<td>8/15 11:45</td>
<td>8/15 12:20</td>
</tr>
</tbody>
</table>

### WELL DESIGN:
- **BASIS:** Geologic Log  
- **CASING STRING:** Casing  
- **SCREEN:** Screen  
- **CENTRALIZERS:**  
- **CASEING:** 1 1/4" PVC Schedule 40 welded  
- **SCREEN:**  
- **Cementation:**  
- **COMMENTS:**
  - At 47' ng saturated with level after drilling.  
  - Sampled at 20' 20' 40' 65' w/ (2) w/ (2) vials

### WELL DEVELOPMENT:
- **Bailing:**

### FILTER MATERIAL:
- **Cement:**  
- **Other Filter:**
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>TIME</th>
<th>DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>COMMENTS</th>
</tr>
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<tbody>
<tr>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td></td>
<td>Bran-ton wellgraded coarse sand</td>
<td>SW</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>
**Location:** Northbase, Site 1C  
**Method:** Hollow Stem Auger  
**Size of hole:** 8"  
**Size of casing:** 4"  
**Driller:** Stanq Hydronics, Orange CA

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<th>COMMENTS</th>
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<tr>
<td>4</td>
<td></td>
<td>Lt brn md-coarse silty (5%) fn sand, dry</td>
<td>SM</td>
<td>Alkalis</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Lt tan silt, dry</td>
<td>PL</td>
<td>Alkalis</td>
</tr>
<tr>
<td>20</td>
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<td>Tan silty sand, dry</td>
<td>SM</td>
<td>Alkalis</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>Brn tan fine sandy silt, dry</td>
<td>HL/SM</td>
<td>Silt encrusted alkalis extremely hard pebbles</td>
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<tr>
<td>60</td>
<td></td>
<td>Lt brn silty fn sand</td>
<td>SM</td>
<td>15% coarse sand</td>
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<tr>
<td>80</td>
<td></td>
<td>Coarse w/lite alkali nodules</td>
<td></td>
<td>Occasional wet sand</td>
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<tr>
<td>100</td>
<td></td>
<td>Brn sandy clay, wet</td>
<td>CL</td>
<td>Coarse tip of auger</td>
</tr>
<tr>
<td>120</td>
<td></td>
<td>Brn clayey coarse sand</td>
<td>SC</td>
<td>Moist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brn sandy (15%) clay</td>
<td>CL</td>
<td>Moist</td>
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</table>

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600 Barcroft Way, Berkeley, California 94710 * 415/646-7870  
Offices in Principal Cities
ACCESSORY ITEMS REQUIRED FOR OPERATION OF THE PRESSURE-VACUUM SOIL WATER SAMPLER

3/16" I.D. X 1/8" WALL NEOPRENE TUBE, TWO 6" (MINIMUM) LENGTHS REQ'D FOR EACH SAMPLER.

MODEL 1901 PINCH CLAMP

MODEL 1920K1 SERVICE KIT, CONSISTING OF THE PRESSURE-VACUUM HAND PUMP, WITH THE VACUUM DIAL GAUGE ADAPTER MOUNTED ON PUMP.

ACCESS TUBES, 1/4" O.D. COPPER OR POLYETHYLENE TUBING

MODEL 1920 PRESSURE-VACUUM SOIL WATER SAMPLER

NOTE:
ALL ACCESSORY ITEMS ARE AVAILABLE FROM SOILMOISTURE EQUIPMENT CORP.

Soilmoisture Equipment Corp. P.O. Box 30025, Santa Barbara, Calif. 93105 U.S.A.
APPENDIX D

WELL PUMPING FIELD DATA AND FIELD PLOTS
### Aquifer Testing Data

**Project Name:** Edwards AFB  
**Project:** 263.59  
**Well:** MB-1 (Anaw G-1)  
**Location:** South East Site 5

- **Formation tested:** Shallow aquifer  
- **Ground elevation:** 2,282.26  
- **Elevation of casing:** —  
- **Distance from test well:** NA  
- **Depth of well:** 147.19 ft  
- **Screen interval:** 33-130 ft  
- **Date test began:** 8/10/1983  
- **Time test began:** 12:21 p.m.

**Water Level Indicator:** Slope indicator

**Remarks:**  
- Water surface  
- No odor

<table>
<thead>
<tr>
<th>Time</th>
<th>T.O.C. Depth To Water (ft)</th>
<th>Drawdown (residual) (ft)</th>
<th>Elapsed Time (min)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:00</td>
<td>47.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:13</td>
<td>47.70</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>12:21</td>
<td>47.75</td>
<td>0.05</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>12:31</td>
<td>47.94</td>
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<td>1.0</td>
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<td>12:41</td>
<td>47.96</td>
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<td></td>
</tr>
<tr>
<td>12:51</td>
<td>47.91</td>
<td>0.26</td>
<td>3.0</td>
<td></td>
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<td>13:01</td>
<td>47.98</td>
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<td>4.0</td>
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<tr>
<td>13:11</td>
<td>47.98</td>
<td>0.28</td>
<td>6.0</td>
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</tr>
<tr>
<td>13:33</td>
<td></td>
<td></td>
<td></td>
<td>Engine out of gas</td>
</tr>
<tr>
<td>13:33</td>
<td>47.88</td>
<td>0.18</td>
<td>82.8</td>
<td>103.5</td>
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<tr>
<td>13:34</td>
<td>47.83</td>
<td>0.13</td>
<td>83.0</td>
<td>83.0</td>
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<td>13:35</td>
<td>47.79</td>
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<td>84.0</td>
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<td>13:36</td>
<td>47.77</td>
<td>0.07</td>
<td>84.5</td>
<td>33.8</td>
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<tr>
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<td>13:40</td>
<td>47.73</td>
<td>0.03</td>
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<td>47.72</td>
<td>0.02</td>
<td>88.0</td>
<td>14.7</td>
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<tr>
<td>13:41</td>
<td>47.72</td>
<td>0.02</td>
<td>90.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>

**Remarks (continued):**  
- Water level indicator: Slope indicator  
- Time since pumping stopped: 13:33  
- Pump installed: 13:33

**Calculations:**

- \( \Delta h = 47.70 \) ft
- \( \Delta h = 47.70 - 47.70 = 0.00 \) ft

**Engine Volume Calculation:**

- \( V = \Delta h \times A \)
- \( A = \pi r^2 \)
- \( r = \frac{h}{2} \)
- \( h = 47.70 \) ft

- \( V = \pi \times \left( \frac{47.70}{2} \right)^2 \times 100 \) m³

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## AQUIFER TESTING DATA

**PROJECT NAME** Edwards AFB  
**RECOVERY**  
**PUMPING**  

**Well** 24339  
**Location** South base  
**Formation tested** Shallow aquifer  
**Ground elevation** 2,290.25'  
**Depth of well** 105.14' dia  
**Screen interval** 35'-96'  
**Distance from test well** NA  
**Time test began** 8/19/83  
**Time test began** 10:02 a.m.  
**Water level indicator**  

<table>
<thead>
<tr>
<th>TIME</th>
<th>DEPTH TO WATER (ft)</th>
<th>DRAWDOWN (residual) (ft)</th>
<th>ELAPSED TIME (min)</th>
<th>t/t</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:40</td>
<td>52.25</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:58</td>
<td>52.38</td>
<td>0.1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>10:01</td>
<td>52.18</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:02</td>
<td>52.18</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:12</td>
<td>54.75</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:22</td>
<td>56.21</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:32</td>
<td>56.21</td>
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<td>56.17</td>
<td>0.3</td>
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<td></td>
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<td>10:52</td>
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</tr>
<tr>
<td>11:02</td>
<td>56.08</td>
<td>0.3</td>
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<td>0.3</td>
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<tr>
<td>12:47</td>
<td>54.92</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**  
- Before pump installed  
- Pump installed  
- Pump started  
- 1st 10 min dark discharge  
- No odor  
- Pump off for 45 sec  
- Pump off  
- Tank pumped 633 gal  
- Leaking volume: 0.16 ft^3  
- \( R(0.6)^2(105-52.18) = 60 \text{ gal} \)

---

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### AQUIFER TESTING DATA

**PROJECT NAME:** Edwards AFB  
**RECOVERY:** X  
**PUMPING:** _

<table>
<thead>
<tr>
<th>TIME</th>
<th>DEPTH TO WATER (ft)</th>
<th>DRAWDOWN (residual) (ft)</th>
<th>ELAPSED TIME (min)</th>
<th>( t' = \frac{t}{m} + 198 )</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td>13:30</td>
<td>54.92</td>
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<td>148</td>
<td>198.5</td>
<td>397</td>
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<td>198.5</td>
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<td>199.5</td>
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</tr>
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<td>53.92</td>
<td>1.74</td>
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<td>206.0</td>
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<td>19</td>
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<td>52.42</td>
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<td>213.0</td>
<td>213.0</td>
<td>8.1</td>
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</tbody>
</table>

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APPENDIX E

ANALYTICAL RESULTS
**LABORATORY ANALYSIS REPORT**

- **Date Received:** 22 August 1983
- **Date Reported:** 26 October 1983
- **Job #:** 26339

For **Edwards Airforce Base**

<table>
<thead>
<tr>
<th>Source of Sample</th>
<th>Lab No.</th>
<th>Date Collected</th>
<th>Time Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall 15 15'</td>
<td>831082</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall 15 30'</td>
<td>831083</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>831084</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>831124</td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units*</th>
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<th>831083</th>
<th>831084</th>
<th>831124</th>
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<td>Cadmium</td>
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<td>0.21</td>
<td>0.30</td>
<td>&lt;.01</td>
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<td>Chromium</td>
<td>ppm</td>
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<td>6.1</td>
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<tr>
<td>Copper</td>
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<td>4.9</td>
<td>.15</td>
</tr>
<tr>
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<td>2.9</td>
<td>2.2</td>
<td>.012</td>
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<td>7.4</td>
<td>25.9</td>
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<td>Arsenic</td>
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<td>1.6</td>
<td>2.5</td>
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<tr>
<td>Antimony</td>
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<td>60.7</td>
<td>0.92</td>
<td>0.21</td>
<td>.01</td>
</tr>
<tr>
<td>Lead</td>
<td>ppm</td>
<td>9.3</td>
<td>0.5</td>
<td>5.3</td>
<td>.035</td>
</tr>
<tr>
<td>Mercury</td>
<td>ppm</td>
<td>0.14</td>
<td>0.017</td>
<td>0.034</td>
<td>&lt;.001</td>
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<tr>
<td>Selenium</td>
<td>ppm</td>
<td>9.7</td>
<td>1.0</td>
<td>6.4</td>
<td>.008</td>
</tr>
</tbody>
</table>

**COMMENTS:**

Method of analysis: Acid digestion followed by atomic absorption spectrophotometry (flame, graphite furnace, or cold vapor generation.)

---

These results were obtained by following accepted laboratory procedures. The liability of the corporation shall not exceed the amount paid for this report.

(Laboratory Manager)
LABORATORY ANALYSIS REPORT

For: Edwards Airforce Base  
Attention: Yane Nordhav

<table>
<thead>
<tr>
<th>Lab No.</th>
<th>Source of Sample</th>
<th>Date Collected</th>
<th>Time Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>831086</td>
<td>Well 12 10'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831087</td>
<td>Well 12 20'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831088</td>
<td>Well 12 45'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831089</td>
<td>Well 12 55'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>ANALYTICAL RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate</td>
<td>ppm</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.20</td>
</tr>
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<td></td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.30</td>
</tr>
</tbody>
</table>

COMMENTS: * Dry weight basis

Method of analysis: Aquous extract followed by automated cadmium reduction.

These results were obtained by following accepted laboratory procedures, the liability of the corporation shall not exceed the amount paid for this report.

Laboratory Manager
LABORATORY ANALYSIS REPORT

For: Edwards Airforce Base

Address: 600 Bancroft Way, Berkeley, California 94710 * 415/548-7970

Date Received: 8-18-83
Date Reported: 10-26-83
Job #: 26339

Job # 26339

For: Edwards Airforce Base

Address: 600 Bancroft Way, Berkeley, California 94710 * 415/548-7970

Date Received: 8-18-83
Date Reported: 10-26-83
Job #: 26339

Lab No. 831090 831091 831279

Source of Sample

Well 12 65' Well 12 103' Well 12

Soil Soil Water

Date Collected: 

Time Collected: 

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>831090</th>
<th>831091</th>
<th>831279</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate</td>
<td>ppm</td>
<td>0.33</td>
<td>0.34</td>
<td>0.54</td>
</tr>
</tbody>
</table>

ANALYTICAL RESULTS

Date Collected: 

Time Collected: 

COMMENTS: * Dry weight basis

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES
THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT

Laboratory Manager
LABORATORY ANALYSIS REPORT

Date Reported: 10-26-83
Job #: 26339

For: Edwards Air Force Base
Attention: Yane Nordby

Date Collected:
Time Collected:

<table>
<thead>
<tr>
<th>Analyses</th>
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<th>831092</th>
<th>831093</th>
<th>831094</th>
<th>831095</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuele</td>
<td>ppm *</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>4000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: *Wet weight basis. These results are only very rough estimates.

Method of analysis: EPA Test Methods for Evaluating Solid Waste #8015 - non-halogenated volatile organics (by direct injection of a carbondisulfide extract.)

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES
THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT

Laboratory Manager
# Laboratory Analysis Report

**For:** Edwards Airforce Base  
**Job #:** 26399  
**Attention:** Yan Nordhay  

<table>
<thead>
<tr>
<th>Lab No.</th>
<th>Source of Sample</th>
<th>Date Collected</th>
<th>Time Collected</th>
<th>Analyses</th>
<th>Units</th>
<th>Analytical Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>831096</td>
<td>Well 13 50'</td>
<td></td>
<td></td>
<td>Fuel</td>
<td>ppm</td>
<td>&lt;100</td>
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<tr>
<td>831097</td>
<td>Well 14 20'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;100</td>
</tr>
<tr>
<td>831098</td>
<td>Well 14 30'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;100</td>
</tr>
<tr>
<td>831099</td>
<td>Well 14 40'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;100</td>
</tr>
</tbody>
</table>

**Comments:**  
* see pg. 4

---

*These results were obtained following accepted laboratory procedures.*

*The liability of the corporation shall not exceed the amount paid for this report.*  

*Manager*

---
### Laboratory Analysis Report

**For:** Edwards Airforce Base  
**Attention:** Yane Nordhav

<table>
<thead>
<tr>
<th>Lab No.</th>
<th>Source of Sample</th>
<th>Date Collected</th>
<th>Time Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>831100</td>
<td>Well 14 65'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831101</td>
<td>Well 14 50'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831102</td>
<td>Gr 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>831103</td>
<td>Well 13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>831100</th>
<th>831101</th>
<th>831102</th>
<th>831103</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuels</td>
<td>ppm</td>
<td>300</td>
<td>&lt;100</td>
<td>&lt;20</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

**COMMENTS:** *See pg. 4.*

These results were obtained by following accepted laboratory procedures. The liability of the corporation shall not exceed the amount paid for this report.
LABORATORY ANALYSIS REPORT

For Edwards Airforce Base

Lab No. 831104 831119 831120

Source of Sample

Well 14 MB-1 Well 13
Water Water Water

Date Collected:

Time Collected:

Analyses Units ANALYTICAL RESULTS

Duale ppm <20 <20 <20

COMMENTS: *See pg 4.
LABORATORY ANALYSIS REPORT

For: Edwards Airforce Base  
Attention: Yane Nordhay

Address

Lab No.  831085
Source of Sample  Background

Date Collected:  
Time Collected:  

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>ANALYTICAL RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>aBHC</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>aBHC</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>aBHC (Lindane)</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>BHC</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Heptachlor Epoxide</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Aldrin</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Endrin</td>
<td>ppb</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Endosulfon I</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Endosulfon II</td>
<td>ppb</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Endosulfon Sulfate</td>
<td>ppb</td>
<td>&lt;10</td>
</tr>
<tr>
<td>p,p' DDE</td>
<td>ppb</td>
<td>&lt;2</td>
</tr>
<tr>
<td>p,p' DDD</td>
<td>ppb</td>
<td>&lt;5</td>
</tr>
<tr>
<td>p,p' DDT</td>
<td>ppb</td>
<td>&lt;5</td>
</tr>
<tr>
<td>p,p' Methoxychlor</td>
<td>ppb</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

COMMENTS: Dry weight basis.

Method of analysis: EPA method 608 for pesticides and PCB's.

These results were obtained by following accepted laboratory procedures. The liability of the Corporation shall not exceed the amount paid for this report.

Laboratory Manager

Page 8 of 11
LABORATORY ANALYSIS REPORT

Date Received: ______________
Date Reported: 10-26-83
Job # 26339

For Edwards Airforce Base Attention: Yane Nordhav

Address

Lab No. 831085

Source of Sample

Date Collected: ________________
Time Collected: ________________

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>ANALYTICAL RESULTS</th>
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</thead>
<tbody>
<tr>
<td>Aroclor 1016</td>
<td>pph</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Aroclor 1248</td>
<td>pph</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Aroclor 1254</td>
<td>pph</td>
<td>20</td>
</tr>
<tr>
<td>Aroclor 1260</td>
<td>pph</td>
<td>&lt;10</td>
</tr>
<tr>
<td>2,4-D</td>
<td>pph</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>2,4,5-TP</td>
<td>pph</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>2,4,5-T</td>
<td>pph</td>
<td>&lt; 2</td>
</tr>
</tbody>
</table>

COMMENTS: *Dry weight basis.

Method of analysis: Herbicides - soxlet extraction followed by ASTM #509B for chlorinated phenoxyacid herbicides in water.

THESE RESULTS WERE OBTAINED BY FOLLOWING ACCEPTED LABORATORY PROCEDURES. THE LIABILITY OF THE CORPORATION SHALL NOT EXCEED THE AMOUNT PAID FOR THIS REPORT.

Laboratory Manager
# LABORATORY ANALYSIS REPORT

For: Edwards Airforce Base  
Attention: Yane Nordhay

<table>
<thead>
<tr>
<th>Lab No.</th>
<th>Source of Sample</th>
<th>Date Collected</th>
<th>Time Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>83117</td>
<td>Well 12 10'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>83118</td>
<td>Well 12 20'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>83111</td>
<td>Bore 1 10'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>83112</td>
<td>Bore 2 10'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>Analytical Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform</td>
<td>pph</td>
<td>2.5</td>
</tr>
<tr>
<td>Trichlorofluoromethane</td>
<td>pph</td>
<td>≤10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;2.5</td>
</tr>
</tbody>
</table>

**COMMENTS:**  
Method of analysis: EPA Method 601 for purgable halocarbons, modified to accept solid samples.

**Signature:**  
Laboratory Manager

---

**Note:** These results were obtained by following accepted laboratory procedures. The liability of the corporation shall not exceed the amount paid for this report.
**LABORATORY ANALYSIS REPORT**

For: Edwards Airforce Base

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Units</th>
<th>Analytical Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform</td>
<td>pph*</td>
<td>&lt;2.5</td>
</tr>
<tr>
<td>Trichlorofluoromethane</td>
<td>pph</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

**COMMENTS:** Yes (as received) weight basis.

These results were obtained by following accepted laboratory procedures. The liability of the corporation shall not exceed the amount paid for this report.