690 0 FILE: 18G

TRAVIS AFB
CALIFORNIA

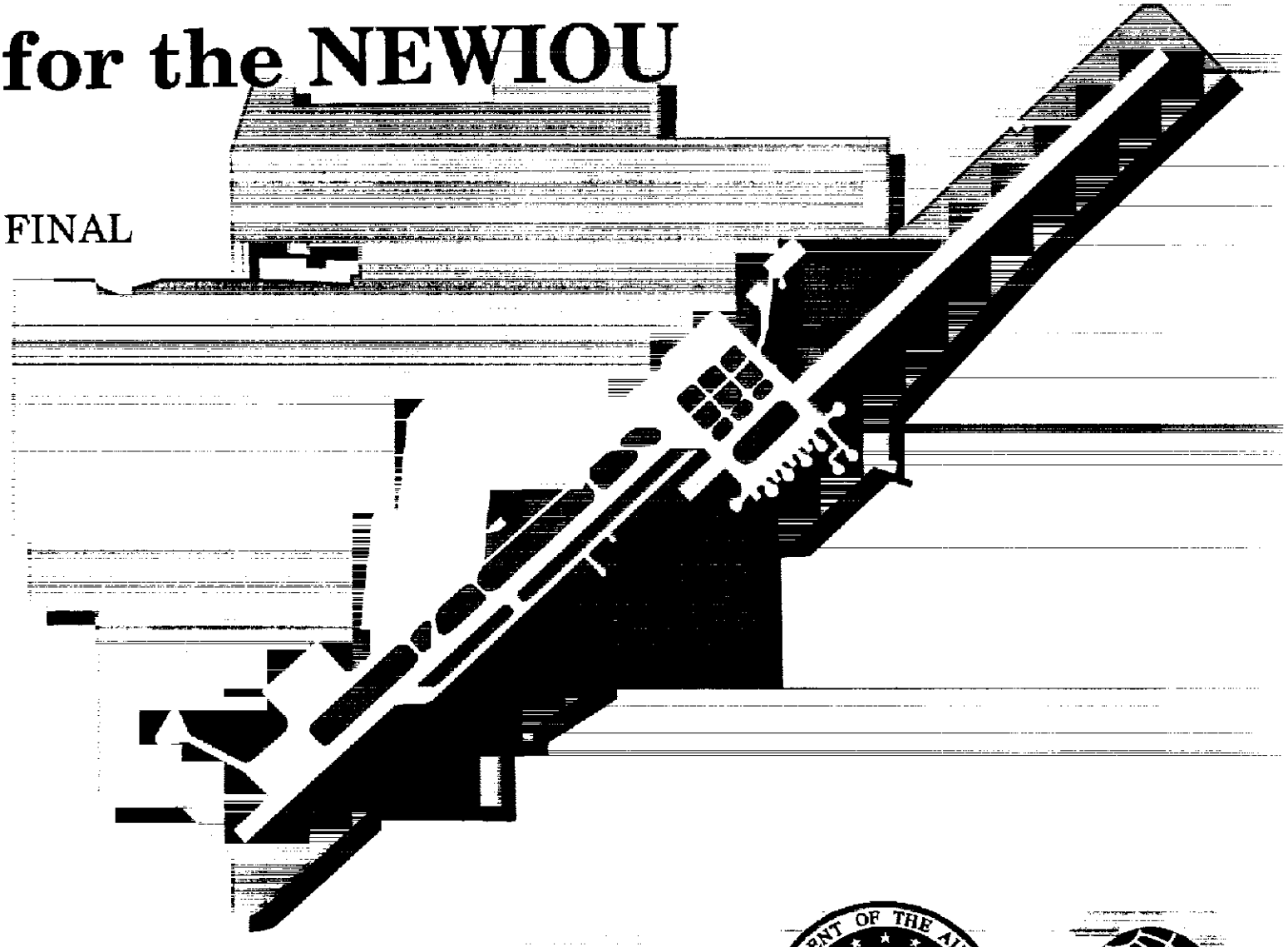
ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 690

Installation Restoration Program
Travis Air Force Base

Groundwater Interim Record of Decision for the NEWIOU

FINAL



December 1997

GROUNDWATER INTERIM RECORD OF DECISION

NORTH, EAST, AND WEST INDUSTRIAL OPERABLE UNIT

TRAVIS AIR FORCE BASE

Final

60th Air Mobility Wing
Travis Air Force Base, California

Contract Number F41624-94-D-8049/D.O. 0035

3 December 1997

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ARARs	Applicable or Relevant and Appropriate Requirements
BAAQMD	Bay Area Air Quality Management District
bgs	below ground surface
Cal-EPA	California Environmental Protection Agency
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFGC	California Fish and Game Code
COCs	Contaminants of concern
COPECs	Contaminants of Potential Ecological Concern
CPT	Cone Penetrometer Testing
CRP	Community Relations Plan
CTVs	Critical Toxicity Values
DAA	Detailed Analysis of Alternatives
DCA	Dichloroethane
DCE	Dichloroethene
DNAPLs	Dense Non-Aqueous Phase Liquids

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

DTSC	Department of Toxic Substances Control
EIOU	East Industrial Operable Unit
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FS	Feasibility Study
FTA	Fire Training Area
gpm	gallons per minute
HQ	Hazard Quotient
HRA	Health Risk Assessment
HWCL	Hazardous Waste Control Law
IRG	Interim Remediation Goal
IROD	Interim Record of Decision
IRP	Installation Restoration Program
ISA	Initial Screening of Alternatives
JFSA	Jet Fuel Spill Area
LLNL	Lawrence Livermore National Laboratories
LNAPL	Light Non-Aqueous Phase Liquid
MAC	Military Airlift Command

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

MAP	Management Action Plan
MATS	Military Air Transport Services
MCL	Maximum Contaminant Level
MEK	methyl ethyl ketone
µg/L	micrograms per liter
msl	mean sea level
MW	monitoring well
NAAP	Natural Attenuation Assessment Plan
NCP	National Contingency Plan
NEWIOU	North, East, and West Industrial Operable Unit
NOU	North Operable Unit
NPDES	National Pollution Discharge Elimination System
O&M	Operation and Maintenance
OSA	Oil Spill Area
OU	operable unit
OWS	Oil/Water Separator
P2 MAP	Pollution Prevention Management Action Plan
PAH	Polycyclic Aromatic Hydrocarbon
PCB	polychlorinated biphenyl

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PCE	tetrachloroethene
PCWQCA	Porter-Cologne Water Quality Control Act
POCOS	Petroleum-Only Contaminated Sites
POTW	Publicly Owned Treatment Works
PP	Proposed Plan
ppb	parts per billion
PRG	Preliminary Remediation Goal
RAB	Restoration Advisory Board
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SAC	Strategic Air Command
SARA	Superfund Amendments and Reauthorization Act of 1986
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SIP	State Implementation Plan
SSA	Solvent Spill Area

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

SSRW	Storm Sewer Right of Way
SVE	Soil Vapor Extraction
SVOC	semivolatile organic compound
SWRCB	State Water Resources Control Board
TARA	Tower Area Removal Action
TBC	To Be Considered
TCE	Trichloroethene
TPH	Total Petroleum Hydrocarbon
TPH-E	Total Petroleum Hydrocarbon - extractable
TPH-G	Total Petroleum Hydrocarbon - gasoline
TSDF	treatment, storage or disposal facility
USAF	United States Air Force
U.S. EPA	United States Environmental Protection Agency
USTs	Underground Storage Tanks
UV-OX	ultraviolet radiation and oxidation
VOC	volatile organic compound
WABOU	West/Annexes/Basewide Operable Unit
WIOU	West Industrial Operable Unit

Section Tab

PART 1

PART I: DECLARATION 690 16

Site Name and Location

Department of the Air Force
Travis Air Force Base
Fairfield, California 94535-5000

Statement of Basis and Purpose

This Interim Record of Decision (IROD) presents the interim remedial actions for groundwater in the North, East, and West Industrial Operable Units (NEWIOU) at Travis Air Force Base (AFB or the Base) Superfund site in Solano County, California. The Air Force will develop a separate Record of Decision (ROD) to address NEWIOU sites with soil, sediment, and/or surface water contamination. The Air Force selected the interim remedial actions evaluated in the Groundwater IROD in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) 42 USC § 9601 *et seq.*, and with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300 (National Contingency Plan [NCP]). The Administrative Record identifies the documents used in the selection of the interim remedial actions. The Administrative Record is available for review at Travis AFB.

The U.S. Environmental Protection Agency (U.S. EPA), Region IX, concurs with the selected interim remedies. The State of California, through the California Environmental Protection Agency's Department of Toxic Substances Control (Cal-EPA/DTSC) and the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), concurs with the selected interim remedies.

Assessment of the Site

Releases of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), dioxins, and metals have contaminated the groundwater at 15 sites within the NEWIOU at Travis AFB as a result of historic Base activities. Actual or possible releases of hazardous substances from these sites, if not addressed by implementing the response actions selected in the Groundwater IROD, may present a threat to public health and welfare, or to the environment.

Rationale for Interim ROD

The Air Force has developed interim remedial actions to address groundwater contamination in the NEWIOU. The Air Force has decided to prepare an IROD for groundwater sites rather than a final ROD in order to allow remediation of groundwater to begin quickly to reduce contamination and risk. The IROD establishes a five-year interim period after which a final ROD will establish the final remedial actions and final cleanup levels. The Air Force will use information from the interim remedial actions to allow for the selection of final cleanup levels and technically and economically feasible long-term actions under a final groundwater ROD. The Air Force will publish a public notice, hold a public comment period, and address the public's comments before the regulatory agencies finalize and approve the groundwater ROD.

The Air Force will complete a separate Proposed Plan (PP) and ROD for soil, sediment, and surface water sites in the NEWIOU.

Description of the Selected Interim Remedies

The Air Force considered three potential interim remedial alternatives to address contaminated groundwater in the NEWIOU: 1) Alternative 1 (No Action); 2) Alternative 2 (Natural Attenuation/Monitoring); and 3) Alternative 3 (Extraction, Treatment, and Discharge).

The Air Force has selected interim remedial alternatives for 13 of the 15 sites with groundwater contamination in the NEWIOU. The Air Force selected Alternative 1 (No Action) for none of the sites. The Air Force selected Alternative 2 for one site (LF006), and Alternative 3 for seven sites. At five sites, the Air Force has selected Alternative 3 for a portion of the plume and deferred the alternative selection for the remaining portion. These five sites require additional characterization to determine if Alternative 2 or 3 is the most appropriate remedial alternative. At two sites, the Air Force will defer the selection of an alternative for the entire groundwater plume until the final ROD; the Air Force will perform additional characterization during the five-year interim period. The following table summarizes selected interim remedial alternatives:

Selected Alternative	No. of Sites	Site Names
Alternative 2	1	LF006
Alternative 3	7	FT004, FT005, SS029, SS030, SD031, SD034, SD036
Alternative 3 and portion of plume remedy deferred	5	LF007, SS016, ST032, SD033, SD037
Alternative selection deferred until final ROD	2	SS015, SS035
Total sites that will be addressed in the final ROD	**15**	

The Air Force chose the selected interim remedies, from many alternatives, as the best methods for containing, monitoring, and treating contaminated groundwater in the NEWIOU. These remedies address the potential risks to human health and the environment that could result from exposure to groundwater by human (e.g., workers and residents) and ecological (e.g., aquatic) receptors.

Based on the RI/FS, the Air Force has selected the most appropriate alternative(s) to reduce the potential risk at each site. The Air Force selected Alternative 3 (Extraction, Treatment, and Discharge) for all or part of 12 of the 15 groundwater sites in the NEWIOU (see Table 5-3).

For the remaining sites or portions of sites where Alternative 3 was not selected, the Air Force considered Alternative 2 (Natural Attenuation/Monitoring) as a possible interim action. The Air Force selected Alternative 2 for one site and deferred the selection of alternatives for the remaining sites.

The Air Force will submit a Groundwater NEWIOU Remedial Design/Remedial Action (RD/RA) Work Plan to the regulatory agencies for approval. The Groundwater NEWIOU RD/RA Work Plan will be a primary document according to the Federal Facilities Agreement (FFA). This Work Plan will provide a description of the overall rationale for treatment and discharge of extracted groundwater for all groundwater sites in the NEWIOU, and will include the RD/RA schedule and a decision matrix for selecting the treatment technologies at each site. The Air Force will provide an opportunity for public participation during the Remedial Design phase.

The Air Force will also submit a Natural Attenuation Assessment Plan (NAAP) to the regulatory agencies for approval. The NAAP will be a primary document according to the FFA and will include a schedule. A Natural Attenuation Decision Matrix will be included which will outline the method to determine which sites and/or portions of plumes are appropriate for remediation by natural attenuation (Alternative 2). In reference to the five sites where a portion of the plume is Alternative 3 and a portion has the alternative selection deferred, the NAAP will clearly explain the methodology to determine where Alternative 2 and Alternative 3 will be applied. Where the selection of an alternative is deferred for the entire site, the NAAP will describe the Air Force approach for evaluating natural attenuation. The NAAP is described in more detail in Section 5.0 (Alternative 2) and Appendix B.

In addition to the Groundwater NEWIOU RD/RA Work Plan, the Air Force will prepare a site-specific RD/RA work plan for each groundwater site within the NEWIOU. The site-specific RD/RA work plans will include details for monitoring and evaluation based on site-specific conditions. Each work plan will address placement of monitoring wells, protocols and frequency for monitoring, and evaluation procedures for determining if migration above water quality objectives is occurring. The agencies will review each of the site-specific RD/RA work

plans. If a contingency action is necessary to control migration, the Air Force will not wait until the end of the five-year interim period. The Air Force will request funding and implement the contingency action as soon as funding becomes available.

There is potential for contaminated groundwater to migrate along storm sewer lines and other preferential pathways. The Air Force will implement Alternative 3 at some sites to control migration of contaminated groundwater along preferential pathways. At other sites where the Air Force has deferred the remedy selection until the final ROD, the Air Force will employ monitoring and a contingency plan to ensure that preferential migration does not occur. At all sites with known or potential interface between the storm sewer and contaminated groundwater, the Air Force will investigate the interface during the Remedial Design (RD). At locations where the Air Force has found the contaminated groundwater to be migrating to the storm sewer or creek, the Air Force will use an interim remedial action such as pump and treat to control migration. Where pump and treat is used, the Air Force will monitor the effectiveness of this action; if the Air force finds that the pump and treat action is not adequately controlling the migration, the Air Force will initiate a contingency action such as repair or lining of the storm sewer.

The Air Force will implement interim remedial actions in accordance with the Groundwater IROD. The Air Force will monitor all sites, including those proposed for natural attenuation, and will evaluate the change in contaminant concentrations during the five-year interim period. The Air Force will utilize the monitoring results to evaluate the potential for natural attenuation under conditions present at Travis AFB. The Air Force and U.S. EPA are developing the protocol for monitoring the natural attenuation of chlorinated compounds. The Air Force and agencies will periodically review and evaluate data obtained from these actions to determine the effectiveness of the action(s) and the need for additional action(s). Five years after signing the IROD, the Air Force and agencies will hold a formal review. The Air Force and the agencies will use the information obtained to determine final remedial actions and cleanup levels that are technically and economically feasible at that time.

Declaration

These interim actions are protective of human health and the environment, are compliant with Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) directly associated with these actions, and are cost-effective. These actions utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable given the limited scope of the action. This action does not constitute the final remedy for groundwater at the Travis AFB NEWIOU sites. The Air Force and the agencies will address the statutory preference for remedies which reduce toxicity, mobility, or volume as a principal element at the time of the final groundwater ROD. The Air Force will base subsequent actions on the knowledge and experience gained during the interim action. Any future actions will fully address the principal threats posed by contaminated groundwater in the NEWIOU at Travis AFB.

Lead and Support Agency Acceptance
of the Interim Record of Decision for Groundwater
Travis Air Force Base, NEWIOU

This signature sheet documents agreement between the United States Air Force and the United States Environmental Protection Agency and the State of California, by the California Environmental Protection Agency, Department of Toxic Substances Control, and the San Francisco Bay Regional Water Quality Control Board on the Interim Record of Decision for groundwater in the NEWIOU at Travis Air Force Base. This sheet may be signed in counterparts by the respective parties.

Dan Opalski
Chief
Federal Facilities Cleanup Branch
U.S. Environmental Protection Agency, Region IX

12/3/97
Date

Anthony J. Landis, P.E.
California Environmental Protection Agency
Department of Toxic Substances Control
Chief of Operations
Office of Military Facilities

Date

Loretta K. Barsamian
San Francisco Bay Regional Water Quality Control Board
Executive Officer

Date

John B. Sams, Jr.
Lieutenant General, USAF
Air Mobility Command
Chairperson, Environmental Protection Committee

Date

Lead and Support Agency Acceptance
of the Interim Record of Decision for Groundwater
Travis Air Force Base, NEWIOU

This signature sheet documents agreement between the United States Air Force and the United States Environmental Protection Agency and the State of California, by the California Environmental Protection Agency, Department of Toxic Substances Control, and the San Francisco Bay Regional Water Quality Control Board on the Interim Record of Decision for groundwater in the NEWIOU at Travis Air Force Base. This sheet may be signed in counterparts by the respective parties.

_____ _____

Dan Opalski
Chief
Federal Facilities Cleanup Branch
U.S. Environmental Protection Agency, Region IX

Date

Anthony J. Landis 9-29-97

Anthony J. Landis, P.E.
California Environmental Protection Agency
Department of Toxic Substances Control
Chief of Operations
Office of Military Facilities

Date

_____ _____

Loretta K. Barsamian
San Francisco Bay Regional Water Quality Control Board
Executive Officer

Date

_____ _____

John B. Sams, Jr.
Lieutenant General, USAF
Air Mobility Command
Chairperson, Environmental Protection Committee

Date

Lead and Support Agency Acceptance
of the Interim Record of Decision for Groundwater
Travis Air Force Base, NEWIOU

This signature sheet documents agreement between the United States Air Force and the United States Environmental Protection Agency and the State of California, by the California Environmental Protection Agency, Department of Toxic Substances Control, and the San Francisco Bay Regional Water Quality Control Board on the Interim Record of Decision for groundwater in the NEWIOU at Travis Air Force Base. This sheet may be signed in counterparts by the respective parties.

Dan Opalski
Chief
Federal Facilities Cleanup Branch
U.S. Environmental Protection Agency, Region IX

Date

Anthony J. Landis, P.E.
California Environmental Protection Agency
Department of Toxic Substances Control
Chief of Operations
Office of Military Facilities

Date

CALIFORNIA REGIONAL WATER
OCT 0 3 1997
QUALITY CONTROL BOARD

Loretta K. Barsamian
Loretta K. Barsamian
San Francisco Bay Regional Water Quality Control Board
Executive Officer

Date

John B. Sams, Jr.
Lieutenant General, USAF
Air Mobility Command
Chairperson, Environmental Protection Committee

Date

Lead and Support Agency Acceptance
of the Interim Record of Decision for Groundwater
Travis Air Force Base, NEWIOU

This signature sheet documents agreement between the United States Air Force and the United States Environmental Protection Agency and the State of California, by the California Environmental Protection Agency, Department of Toxic Substances Control, and the San Francisco Bay Regional Water Quality Control Board on the Interim Record of Decision for groundwater in the NEWIOU at Travis Air Force Base. This sheet may be signed in counterparts by the respective parties.

Dan Opalski
Chief
Federal Facilities Cleanup Branch
U.S. Environmental Protection Agency, Region IX

Date

Anthony J. Landis, P.E.
California Environmental Protection Agency
Department of Toxic Substances Control
Chief of Operations
Office of Military Facilities

Date

Loretta K. Barsamian
San Francisco Bay Regional Water Quality Control Board
Executive Officer

Date

John B. Sams, Jr.
Lieutenant General, USAF
Air Mobility Command
Chairperson, Environmental Protection Committee

29 SEP 97
Date

Section Tab

PART 2

Section Tab

1

PART II: DECISION SUMMARY

The Decision Summary includes findings, evaluations, decision-making process, and selected actions for the North, East, West Industrial Operable Unit (NEWIOU) Groundwater Interim Record of Decision (IROD). Section 1.0 describes features of Travis Air Force Base (AFB) including topography, climate, land use, ecology, geology, and hydrology. Section 2.0 provides an overview of non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and CERCLA environmental programs at Travis AFB. Section 3.0 summarizes the nature and extent of contamination as presented in the North Operable Unit (NOU) Remedial Investigation (RI), East Industrial OU (EIOU) RI, and West Industrial OU (WIOU) RI. Section 4.0 presents a summary of the NEWIOU Feasibility Study (FS). Section 5.0 identifies the selected interim remedies and rationale. Section 6.0 presents the applicable or relevant and appropriate requirement and performance standards for the interim actions. Section 7.0 is the list of references.

This Decision Summary provides an overview of the NEWIOU, the groundwater contaminants, and the areas considered for interim remedial response. The interim remedial alternatives considered and the analysis of those alternatives compared to the criteria set forth in the National Contingency Plan (NCP) are presented. This Decision Summary explains the rationale for selecting the interim remedies and how the statutory requirements of the CERCLA have been met.

1.0 NEWIOU DESCRIPTION

Travis AFB, located between Sacramento and San Francisco (see Figure 1-1), was established in 1943. Travis AFB rapidly grew into the largest military aerial port, ferrying troops and materials from California to the Pacific during World War II and the Korean conflict. The base was used from 1948 to 1958 as a base for the Strategic Air Command (SAC). SAC relinquished control of the base to Military Air Transport Services (MATS) in 1958, which

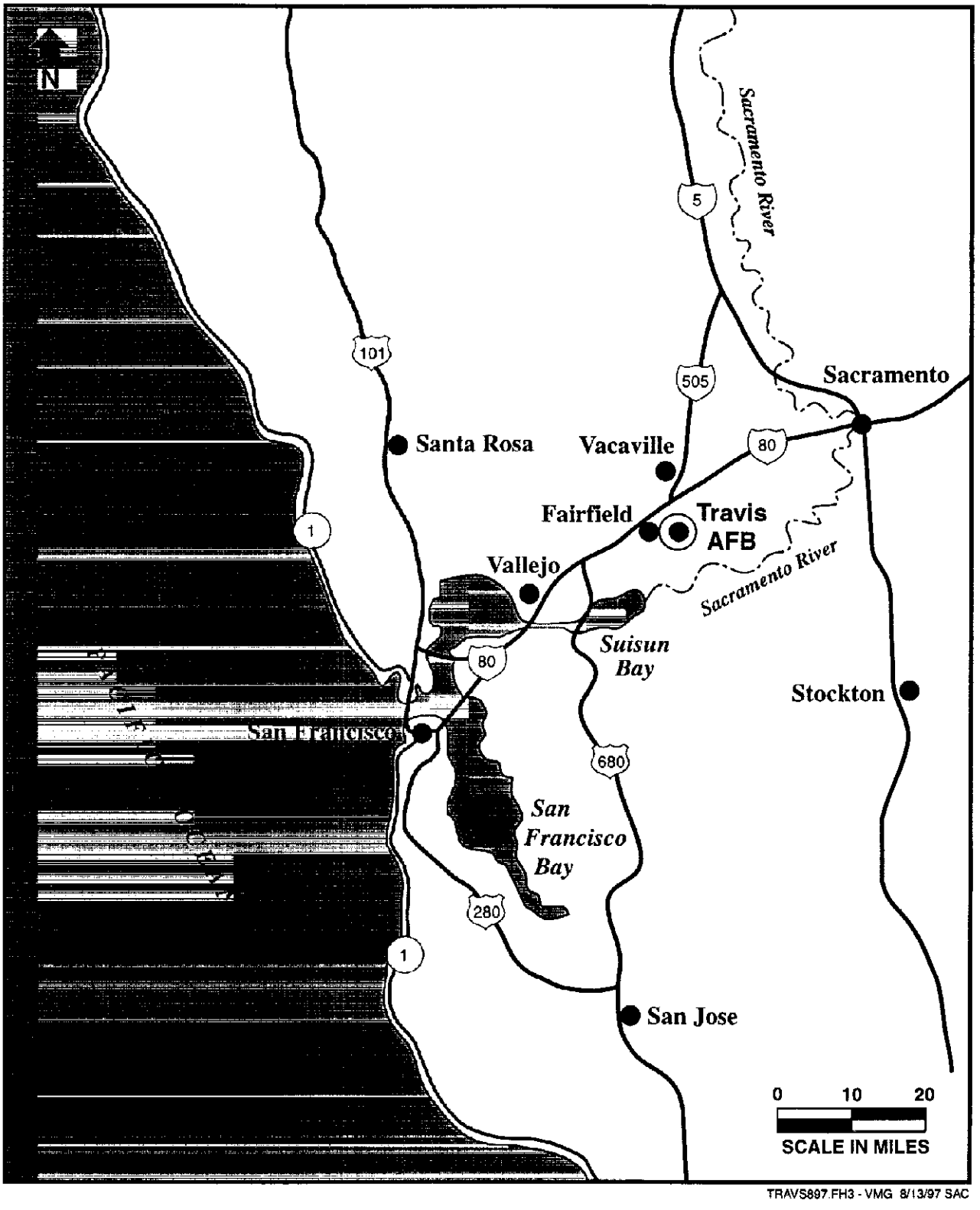


Figure 1-1. Regional Location Map, Travis AFB

established the headquarters for the Western Transport Air Force at Travis AFB. MATS evolved into the Military Airlift Command (MAC) in the early 1960s. MAC was renamed the Air Mobility Command in June 1992.

Travis AFB is part of the Air Mobility Command and is home to the 60th Air Mobility Wing. The Air Mobility Wing operates C-5 and C-141 aircraft and KC-10 aerial refueling aircraft and is the largest mobility organization in the Air Force, incorporating both MAC and SAC units. The Air Force may redeploy additional units to Travis AFB as other bases undergo realignment and closure.

Figure 1-2 shows the boundaries of the four operable units at Travis AFB. The NOU, the EIOU, and WIOU comprise the NEWIOU. This IROD addresses groundwater contamination within the NEWIOU. Soil, sediment, and surface water in the NEWIOU will be addressed in a subsequent ROD. The fourth operable unit, the West/Annexes/Basewide Operable Unit (WABOU), is not covered by this Groundwater IROD for the NEWIOU, and will be covered in a separate IROD, which will be completed at a later date. The Travis AFB National Priorities List (NPL) site includes two annexes, Annex 6 and Annex 10, that are part of the WABOU (see Figure 1-3).

1.1 Physical Description

Topography at Travis AFB is characterized by a sloping to flat surface with variations in topographic expression up to 50 feet. Elevations at Travis AFB range from over 100 feet above mean sea level (msl) near the northern boundary to less than 20 feet above msl near the south gate. The ground surface generally slopes to the south or southeast at about 30 feet per mile (slope 0.6%) (Weston, 1992). The hills north of Travis AFB have a vertical relief of approximately 110 feet. The hills south of Travis AFB reach elevations of approximately 400 feet above msl. The areas to the west, northwest, northeast, east, and south of Travis AFB are nearly flat.

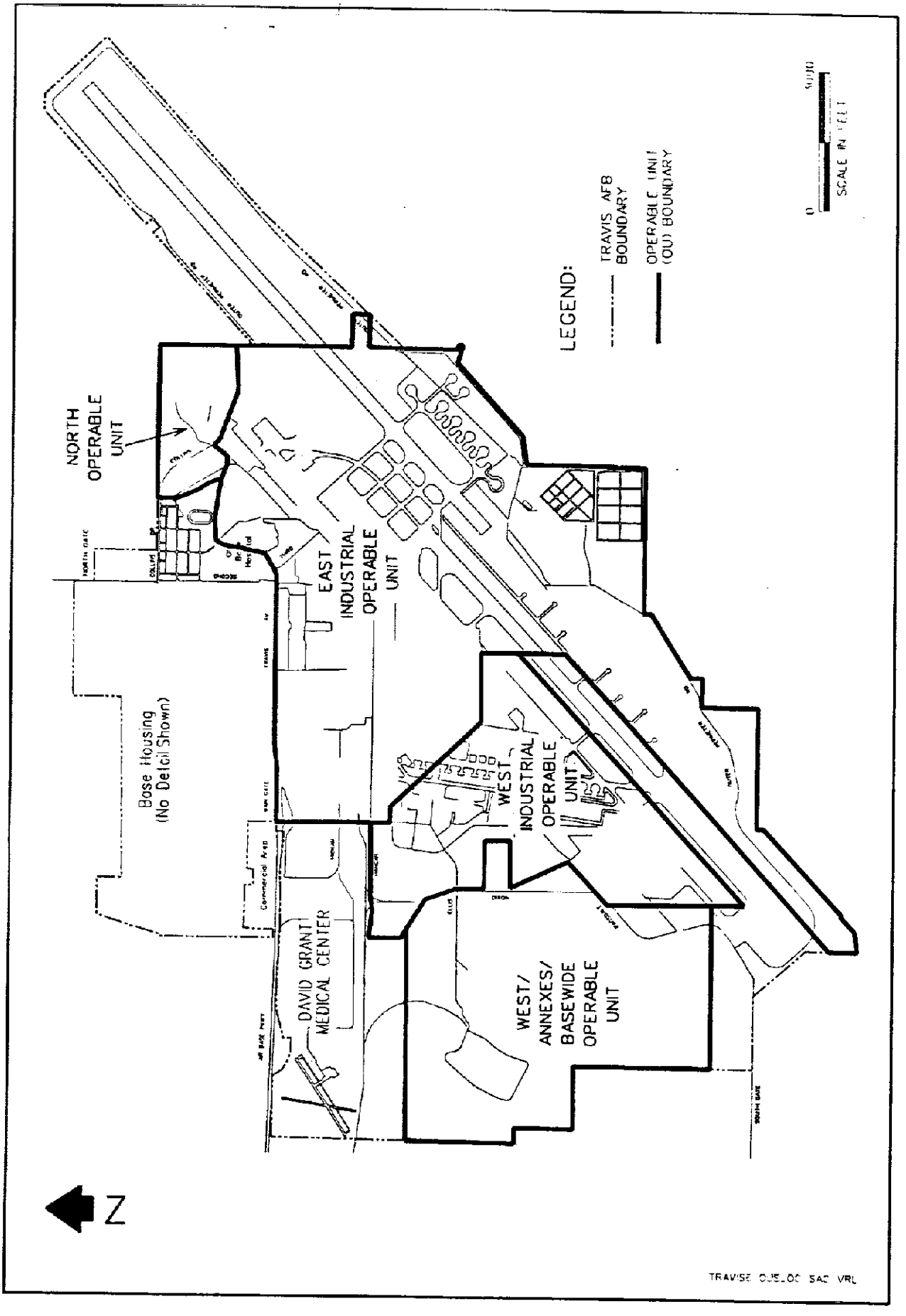


Figure 1-2. Travis AFB and Operable Units

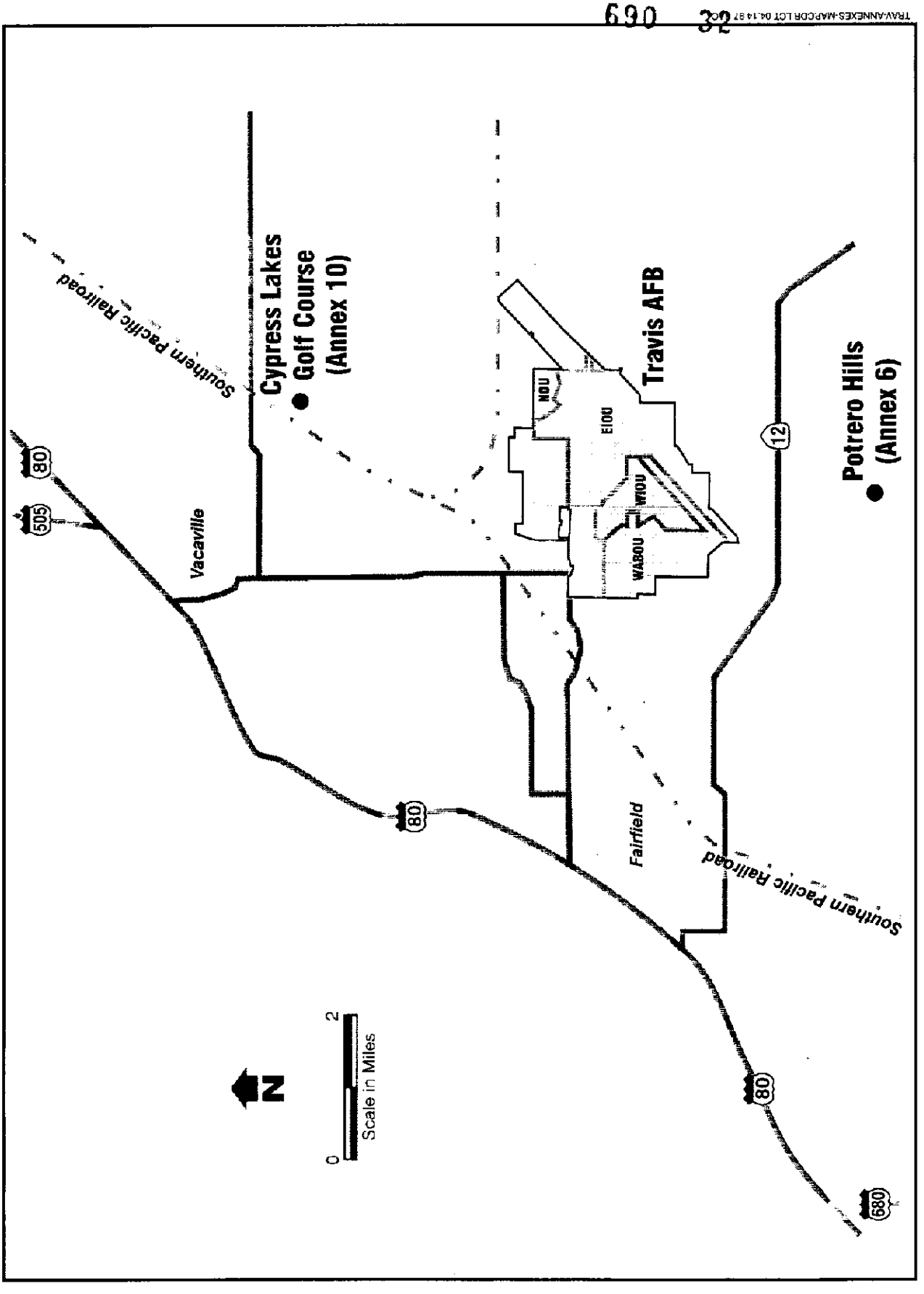


Figure 1-3. Travis AFB/Major Annexes Location Map

Central California is characterized by wet winters and dry summers. The mean annual temperature at Travis AFB is 60 degrees Fahrenheit (°F); the mean monthly temperatures range from 46°F during December and January to 72°F during July, August, and September. The mean annual precipitation is 17.5 inches with an average annual evaporation rate of 47 inches. Approximately 85% of the precipitation falls between November and March. The prevailing wind direction is from southwest to northeast, although wind directions vary throughout the year. The mean annual wind speed is 8 knots, with the greatest monthly wind speeds typically occurring from May through August. The monthly relative humidity ranges from a high of 77% during January to a low of 50% during June (Weston, 1995a).

1.2 Land Use

Travis AFB occupies approximately 5,025 acres of land near the center of Solano County, California, and is approximately 3 miles east of downtown Fairfield and 8 miles south of downtown Vacaville (see Figure 1-3). Travis AFB consists of five types of land uses:

- Industrial support areas;
- Air field or direct mission areas;
- Administrative and medical service areas;
- Housing, recreation, and service areas; and
- Open space areas.

The lands surrounding Travis AFB are primarily used for ranching and grazing, with some light industrial activity present to the northwest. The estimated populations of Fairfield, Vacaville, and nearby Suisun City are 85,560, 85,000, and 23,560, respectively. The projected population growth between 1990 and 2000 is 47.4 % for the City of Fairfield and 33.6% for Solano County (Weston, 1995a). Approximately 3,700 military personnel and 4,400 family

members live on Travis AFB. In addition, 3,172 civilians are employed at the base. Approximately 17,000 people are on Travis AFB daily (Weston, 1995a).

1.3 Ecology

The Air Force conducted a special-status species survey at Travis AFB in 1993 (BioSystems Analysis, 1992; BioSystems Analysis, 1993). This survey characterized habitats and identified special-status species on contaminated sites at the base. Four general habitats have been identified at Travis AFB:

- Disturbed herbaceous-dominated grasslands containing a mixture of native and non-native grasses and ruderal vegetation;
- Developed areas including lawns, landscaping trees and shrubs, barren areas, and paved areas;
- Permanent and temporal natural pools; and
- Riparian and wetland habitat (main branch of Union Creek and portions of the west branch of Union Creek).

Surface features of the base include creeks, drainages, buildings, paved areas, and small amounts of grassland. Most of the land at Travis AFB is covered by buildings or paved areas, but several natural and artificial wetlands exist there as well. Wetlands include Union Creek and the vernal pools (i.e., seasonal ponds) in the NOU and WIOU.

The Air Force identified several special-status species at Travis AFB (BioSystems Analysis, 1992; BioSystems Analysis, 1993; and Weston, 1995b). These species include:

- the black-shouldered kite (*Elanus caerleus*);
- the Boggs Lake dodder (*Cuswata howelliana*);

- the burrowing owl (*Speotyto cunicularia*);
- the Cooper's hawk (*Accipter cooperii*);
- the California gull (*Larus californicus*);
- the golden eagle (*Aquila chrysaetos*);
- the loggerhead shrike (*Lanius ludovicianus*);
- the northern harrier (*Circus cyaneus*);
- the red fox (*Vulpes vulpes*);
- the tricolor blackbird (*Agelaius tricolor*);
- the vernal pool fairy shrimp (*Branchinecta lynchi*);
- the Contra Costa goldfields (*Lasthenia conjugens*);
- the Northwestern pond turtle (*Clemmys hammondi hammondi*);
- the San Joaquin spearscale (*Atriplex joaquiniana*);
- the round wooly-marbles (*Psilocarpthus tenellus* var. *globiferous*);
- the alkali milkvetch (*Astragalas tener* var. *tener*);
- the San Francisco forktail damselfly (*Ischnura gemina*); and
- the vernal pool tadpole shrimp (*Lepidurus packardi*).

Other special-status species may have the potential to occur at Travis AFB, but were not identified during surveys.

1.4 Geology and Hydrogeology

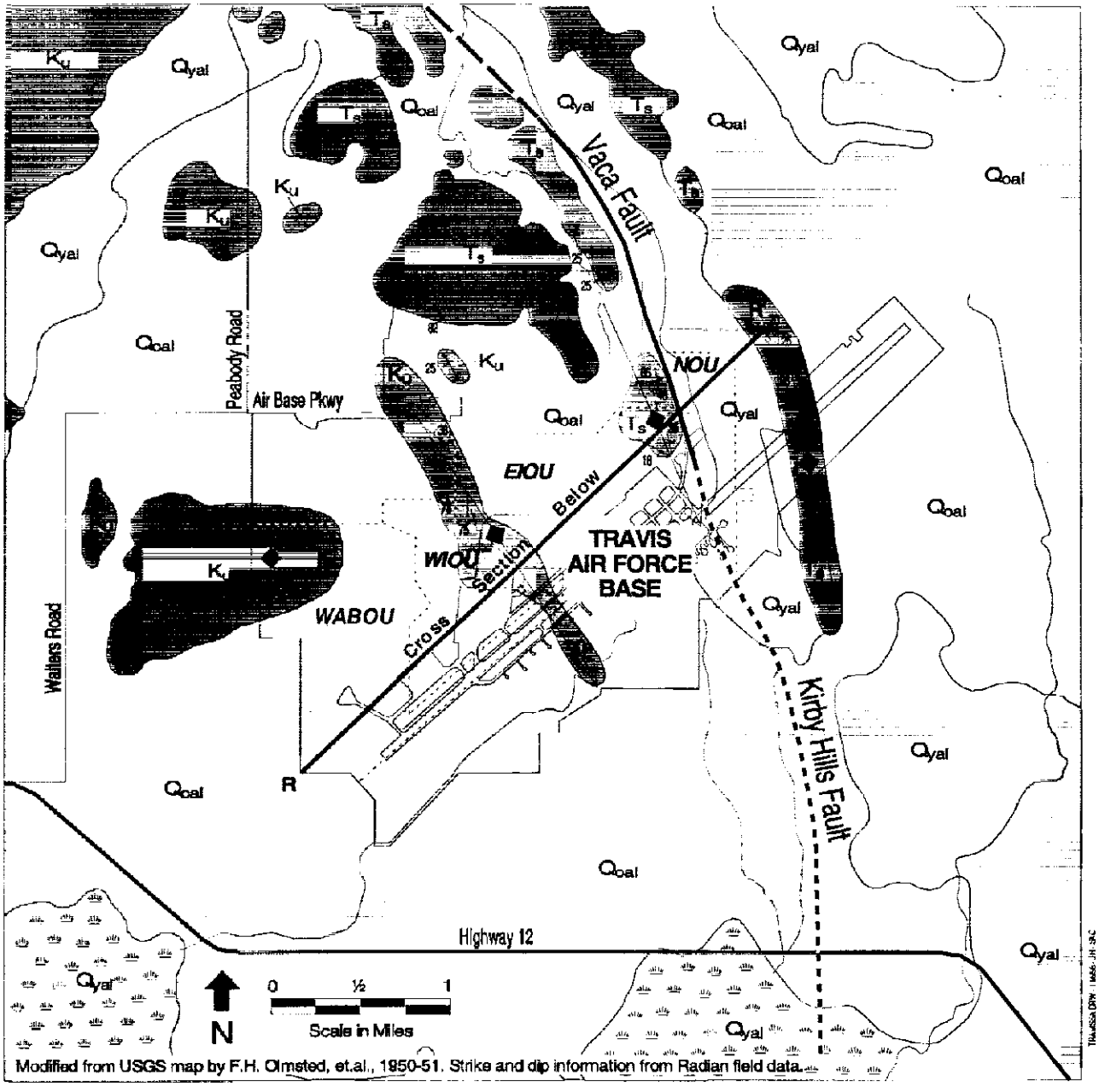
The basewide topography, and regional and local geologic and hydrogeologic conditions of Travis AFB are described to provide a basis for predicting the migration of contaminants in the subsurface. Geologic and hydrogeologic conditions control the movement of water and contaminants through the subsurface. The respective RIs for each of the three operable units present in greater detail the geology and hydrogeology of the individual facilities within the NEWIOU.

1.4.1 Geology

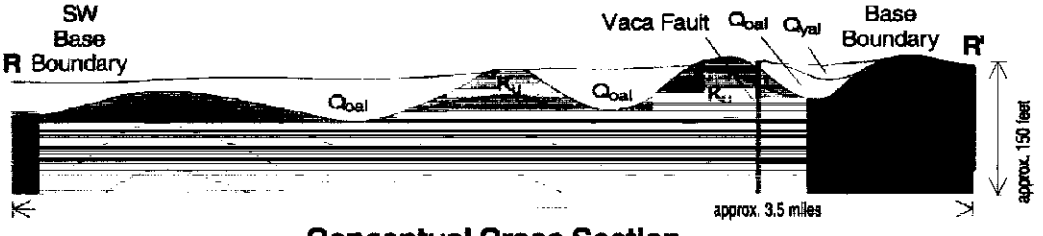
Travis AFB is located near the western boundary of the Central Valley Physiographic Province of California (Weston, 1992). The California Central Valley is a sediment-filled synclinal basin with a northwest-to-southeast oriented axis. The Coast Range Physiographic Province west of Travis AFB generally consists of folded and uplifted bedrock.

Figure 1-4 is a geologic map and generalized cross-section illustrating the shallow bedrock units and alluvium in the area surrounding Travis AFB. Table 1-1 is a geologic column that summarizes the characteristics of the shallow bedrock and alluvium. Bedrock units recognized in the vicinity of Travis AFB include (from oldest to youngest) the Domengine Sandstone, the Nortonville Shale, the Markley Sandstone, and the Neroly Sandstone. The surface trace of the Vaca Fault has been mapped from northwest to southeast across Travis AFB.

Past tectonic processes folded and uplifted the bedrock to form the hills and mountains located north, west, and south of Travis AFB. The alluvium in the vicinity of Travis AFB originated from the erosion of the elevated bedrock formations and subsequent deposition in various continental environments.



Plan View



Conceptual Cross Section

LEGEND:
See text for further description of rock types.

- Qyal — Younger Alluvium
- Qoal — Older Alluvium
- Ts — Undifferentiated Sandstones, Siltstones, and Shales, including the Markley Sandstone, Nortonville Shale, and Domengine Sandstone
- Ku — Undifferentiated Rocks, including the Tehama Formation
- 75 — Strike and Dip
- Anticline Axis
- Fault, dashed where uncertain, dotted where buried.

Figure 1-4. Geological Map of Travis AFB and Vicinity

Table 1-1

Geologic Column – Travis AFB and Vicinity, California

Million Years Before Present	Geologic Period	Geologic Epoch	Geologic Unit	Description	Environment of Deposition
1.8	Quaternary	Holocene	Alluvium (Q_{yal})	Poorly-sorted stream and basin deposit clay to boulder size.	Continental
		Pleistocene	Older Alluvium (Q_{oal})	Dissected alluvial deposits.	Continental
5	Tertiary	Pliocene	Tehama Formation (Tt)	Sand, silt rocks. Volcaniclastic.	Continental
		Miocene	Neroly Sandstone	Interbedded sandstone, siltstone, and shale.	Marine
		Eocene	Markley Sandstone (Tmk)	Massive, brownish-gray, Feldspathic, Micaceous sandstone.	Marine
			Nortonville Shale (Tn)	Dark brown, silty shale, interbedded with sandstone.	Marine
			Domengine Sandstone (Td)	Quartzose sandstone, basal glauconite grit.	Marine
55	Cretaceous	–	Guinda Formation (Kg)	Massive sandstone with calcareous concretions and interbedded shale.	Marine

Source: California Division of Mines and Geology, Regional Geologic_Sacramento Quadrangle_Map No. 1A 1981.

Also see: Marchard, D.E., and Allwardt, A. 1977, *Late Cenozoic Stratigraphic Units Northeastern San Joaquin Valley, California,* U.S. Geologic Survey open file. Report number 77-748, 136 p.

Rock grains and fragments eroded from the Coast Ranges were deposited as alluvial sediment units by Putah, Ulatis, Alamo, Laurel, Suisun, and Union Creeks. The parent rocks for the alluvium at Travis AFB include metasediments, serpentinites, ultramafic rocks, and the Sonoma Volcanics (Olmsted and Davis, 1961; Wagner, 1982). The alluvium is divided into units of older and younger alluvium. At Travis AFB, the thickness of the alluvium ranges from 0 feet to approximately 70 feet. West of Travis AFB, the thickness of the alluvium increases to over 200 feet (Weston, 1992; Thomasson et al, 1960).

Outcrops of the relatively resistant Markley and Domengine Sandstones form most of the topographic high points on the base including the hill at the old base hospital, the low ridge along the boundary between the WIOU and the EIOU near the center of Travis AFB, and the hills north of Travis AFB. Erosion of the less resistant bedrock units, such as the Nortonville Shale, formed low areas that were later filled with alluvium. Three major subsurface bedrock ridges have been identified in the EIOU: the Eastern Ridge, the Central Ridge, and the Western Ridge (Weston, 1995a). These areas have bedrock at 20 feet below ground surface (bgs) or less. The three ridges are anticlines which plunge slightly towards the south – as does the surface elevation in these areas. The Vaca Fault runs through the Central Ridge in a south-southeastern direction. The material between these anticlines is alluvium – predominantly silts and clays with intermittent sand lenses. The Western Ridge bisects the EIOU and the WIOU. The bedrock consists of poorly to moderately indurated (cemented) sandstone.

Travis AFB is located in an alluvial fan extending from the Vaca Mountains (located north of Travis AFB) to the Suisun Marsh. Sediment eroded from the Vaca Mountains has been carried in several streams (including the West Branch of Union Creek) which have migrated laterally across the Base. Deposition of alluvium usually occurs during floods. Coarse sands and gravels are deposited immediately adjacent to the stream levee; finer silts and clays are carried much further. Consequently, the intermittent sand lenses are usually elongated parallel to the stream. Sand lenses throughout Travis AFB trend south-southeast (Weston, 1995a).

1.4.2 Hydrogeology

Travis AFB is located at the eastern edge of the Fairfield-Suisun hydrogeologic basin. The Fairfield-Suisun Basin is a hydrogeologically distinct structural depression adjacent to the Sacramento Valley segment of the Central Valley Province (Weston, 1992; Thomasson et al, 1960).

The hydrogeologic basin is bordered to the north by the Vaca Mountains and to the east by the ridge which runs along the eastern portion of the NOU and EIOU. The basin slopes south into the Suisun Marsh (Thomasson et al, 1960); consequently, most groundwater and surface water at Travis AFB flows south toward Suisun Marsh. For example, both the West Branch of Union Creek and Storm Sewer Systems II and III empty surface waters and storm runoff into Union Creek which ultimately discharges into the marsh.

Within Travis AFB, the Fairfield-Suisun Basin can be further divided into three subbasins which are bordered by subsurface ridges of low permeability bedrock – sandstones and siltstones. The hydrological subbasins are alluvial-filled depressions. These depressions are composed predominantly of clay and silt with some intermittent sand lenses. The subbasins are underlain by the Nortonville Shale (Weston, 1995a).

Coarse-grained sediments (sand and gravel) within the alluvium are the primary water-bearing deposits in the region around Travis AFB. The bedrock units generally do not yield groundwater of usable quantity or quality (Thomasson et al, 1960).

1.4.3 Groundwater Gradient and Flow

Groundwater recharge occurs from the direct infiltration of rainfall on the ground surface and from the infiltration of runoff through depressions, and local creek beds. Natural groundwater discharge may occur in the ditches and branches of Union Creek that flow into

Suisun Marsh, as well as directly into the marshlands located near the Potrero Hills, south of Travis AFB (Thomasson et al, 1960). When the water table elevation is above the surface water in areas with a high water table, discharge of groundwater occurs.

Depth to groundwater changes seasonally depending on the amount of rainfall and subsequent infiltration. Thus at the end of the dry season, depths to groundwater are greater than during the rainy season.

The groundwater gradient describes the differences in hydraulic potential and indicates the direction of groundwater flow. The general direction of the groundwater gradient within the alluvium at Travis AFB is southerly, similar to the regional gradient. However, local variations (groundwater mounds and depressions) exist within the boundaries of Travis AFB. Alluvium is between 0 to 70 feet thick and the hydraulic gradient is southerly throughout much of Travis AFB. The groundwater contours are diverted from the southerly gradient in areas where alluvium is thinner (i.e., the bedrock ridges). The change in gradient is due to the decreasing thickness of the more permeable alluvium and the increasing thickness of the less permeable bedrock.

Figure 1-5 illustrates the bedrock ridges, alluvial valleys, and generalized groundwater flow directions. The bedrock ridges bordering the subbasins are indicated by potentiometric highs in the shallow groundwater elevation map. Bedrock highs, such as the old base hospital (northern EIOU) and the TF33 Test Stand Area (western WIOU), have elevated groundwater levels. These groundwater highs result from horizontal flow from the bedrock to the adjacent alluvium, limited by the low permeability of bedrock (Radian, 1996b).

The maximum horizontal hydraulic gradient in the upper portion of the aquifer at Travis AFB is approximately 0.02 (vertical foot per horizontal foot) at the groundwater mound near the old base hospital. The minimum horizontal gradient in the upper portion of the aquifer is approximately 0.002 near the southern border of Travis AFB. The average magnitude of the

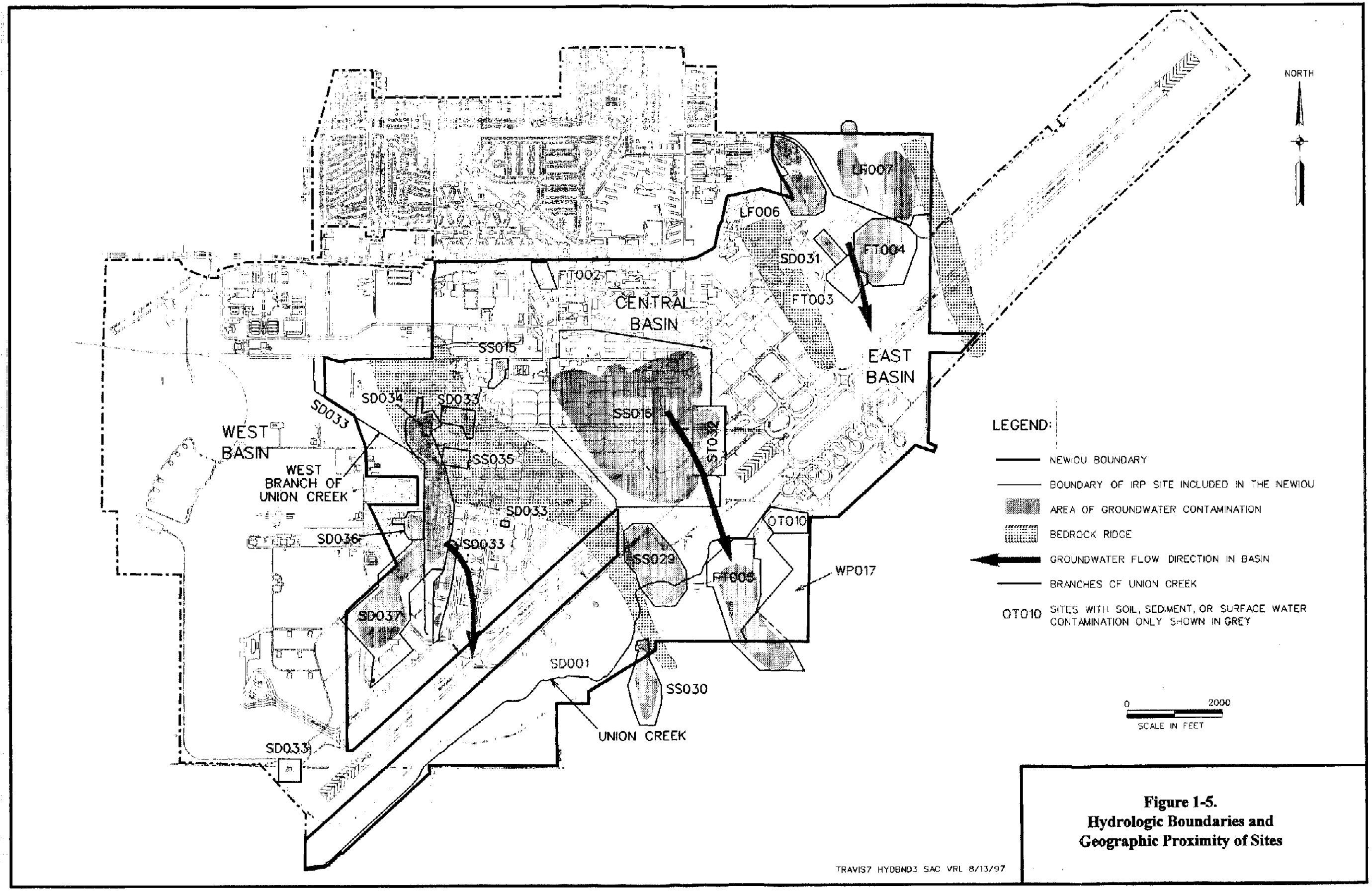


Figure 1-5.
Hydrologic Boundaries and Geographic Proximity of Sites

groundwater gradient in the upper portion of the aquifer at Travis AFB is approximately 0.005. The horizontal hydraulic gradients in the deep portion of the aquifer range from 0.01 to 0.003.

1.4.4 Aquifer Tests

The hydrogeologic parameters of hydraulic conductivity and porosity are needed to calculate groundwater flow velocities. To define the hydrogeologic parameters of the alluvial deposits and bedrock, aquifer slug tests and aquifer pumping tests were conducted at Travis AFB between 1988 and 1991. In general, fine-grained material (e.g., clay and silt) are expected to exhibit lower values of hydraulic conductivity than coarse-grained material (e.g., sand and gravel).

Table 1-2 summarizes the range of calculated hydraulic conductivities of the major geologic units based on the aquifer tests conducted at Travis AFB. Hydraulic conductivity readings in the younger and older alluvium indicate the wide range of textures (i.e., grain sizes and sorting) observed in these alluvial units. Hydraulic conductivity readings of the sandstone and shale or siltstone bedrock also varied. Fewer tests were conducted on the bedrock units. Bedrock test wells are generally screened in the upper portion of the bedrock units, which was probably subject to weathering. This may have increased its permeability prior to being covered by alluvium.

Significant overlap occurs in the range of hydraulic conductivities for each of the four geologic units listed in Table 1-2. The average hydraulic conductivity of the sandstone bedrock and the older alluvium vary by only a factor of 3. However, the range of measured hydraulic conductivities varies greatly (Table 1-2), depending on the adjacent alluvium and bedrock at any specific location.

Vertical hydraulic conductivities were calculated from aquifer pumping test data collected at two locations (monitoring well [MW]-245 and MW-214) within the EIOU. The

Table 1-2

Summary of Hydraulic Conductivity Values

Geologic Unit	Number of Tests	Hydraulic Conductivity (ft/minute)		
		Minimum	Maximum	Average
Younger Alluvium	9	0.0005	0.079	0.020
Older Alluvium (Vertical K)	30 (2)	0.0001 (0.000121)	0.074 (0.00229)	0.027 (0.0012)
Sandstone Bedrock	2	0.0025	0.021	0.0088
Shale or Siltstone Bedrock	4	0.0006	0.0415	0.020

Sources: Modified from Weston, 1990; Weston, 1992.

ft/minute = feet per minute
Vertical K = Vertical Hydraulic Conductivity

vertical hydraulic conductivity in the EIOU ranged from 1.21×10^{-4} feet per minute to 2.29×10^{-3} feet per minute. These tests were short-term tests; therefore, they reflect the hydraulic conductivity near the pumping wells.

The lower hydraulic conductivities calculated for the vertical direction relative to the horizontal direction indicate that groundwater will flow more easily horizontally than vertically. If the ratio of horizontal to vertical hydraulic conductivity is approximately 100 or more, groundwater flow will essentially be horizontal even in the presence of a vertical gradient (Freeze and Cherry, 1979). Consequently, dissolved contaminants will also migrate horizontally, through the more permeable units such as the alluvium and with minimal vertical migration into the bedrock due to dispersion.

Groundwater velocities from a basewide perspective were estimated as part of the NEWIOU FS (Radian, 1996a) based on gradients, aquifer test results, and literature values. The velocities (ranging from 5 to 50 feet per year) were used in calibrating a model to estimate times to cleanup. A velocity of 10 feet per year provided the best fit with the field data.

1.4.5 Regional Groundwater Use

Large volume pumping of groundwater generally occurs only to the west of Travis AFB and in Fairfield where the alluvium is thicker and contains a greater abundance of coarse-grained sediment. Groundwater wells in the area of Travis AFB are limited to domestic, stock-watering, and irrigation wells. Domestic wells, several of which are downgradient from Travis AFB, are typically used for households and gardens (Weston, 1995a). Groundwater contamination does not affect domestic wells. Interim actions will be protective of these off-base wells. The residences surrounding Travis AFB use groundwater for their domestic water supply because there is no existing county water supply.

No on-base wells are currently used for potable water production. However, several wells located 4 miles north of Travis AFB, at the golf course annex, produce 400 to 500 million gallons of water per year. This well water is mixed with surface water purchased from the city of Vallejo to supply potable water to Travis AFB. The Fairfield public water supply field is located approximately 3 miles west of Travis AFB (Weston, 1995a). Groundwater contamination from Travis AFB does not affect Fairfield's water supply; these interim actions will be protective of Fairfield's wells.

1.4.6 Surface Water

Local drainage patterns have been substantially altered at the base by the rerouting of Union Creek, the runway and apron construction, the installation of storm sewers and ditches, and general development (e.g., industrial shops, maintenance yards, roads, and housing). Vernal pools are present on base; the quality and specific locations are described in the Basewide Ecological Habitat Survey (Weston, 1995b). Surface water at Travis AFB drains into several storm sewer systems (or storm drains), a network of underground pipes, culverts, and open drainage ditches, which directs surface water runoff and rainfall to Union Creek (Figure 1-6). In general, drainage from the WIOU flows into the West Branch of Union Creek which flows into Union Creek at Outfall II. Drainage from the EIOU flows into storm sewer systems which flow into Union Creek at Outfall III. At the north end of the base, Union Creek flows into the duck pond, through an underground piping system, resurfacing and flowing into Union Creek at Outfall IV. Union Creek flows southwest and discharges into Hill Slough. Hill Slough is a tidal wetland, approximately 1.6 miles south of the base boundary. Although some tributaries to Hill Slough may be intermittent, the slough itself is a permanent, not seasonal, wetland. Surface water from Hill Slough flows into Suisun Marsh, the largest contiguous estuarine marsh in the continental United States, and a major wintering ground for migratory waterfowl (Weston, 1992). Surface water contamination will be addressed in the NEWIOU Soil, Sediment, and Surface ROD which will be completed after the NEWIOU IROD is finalized.

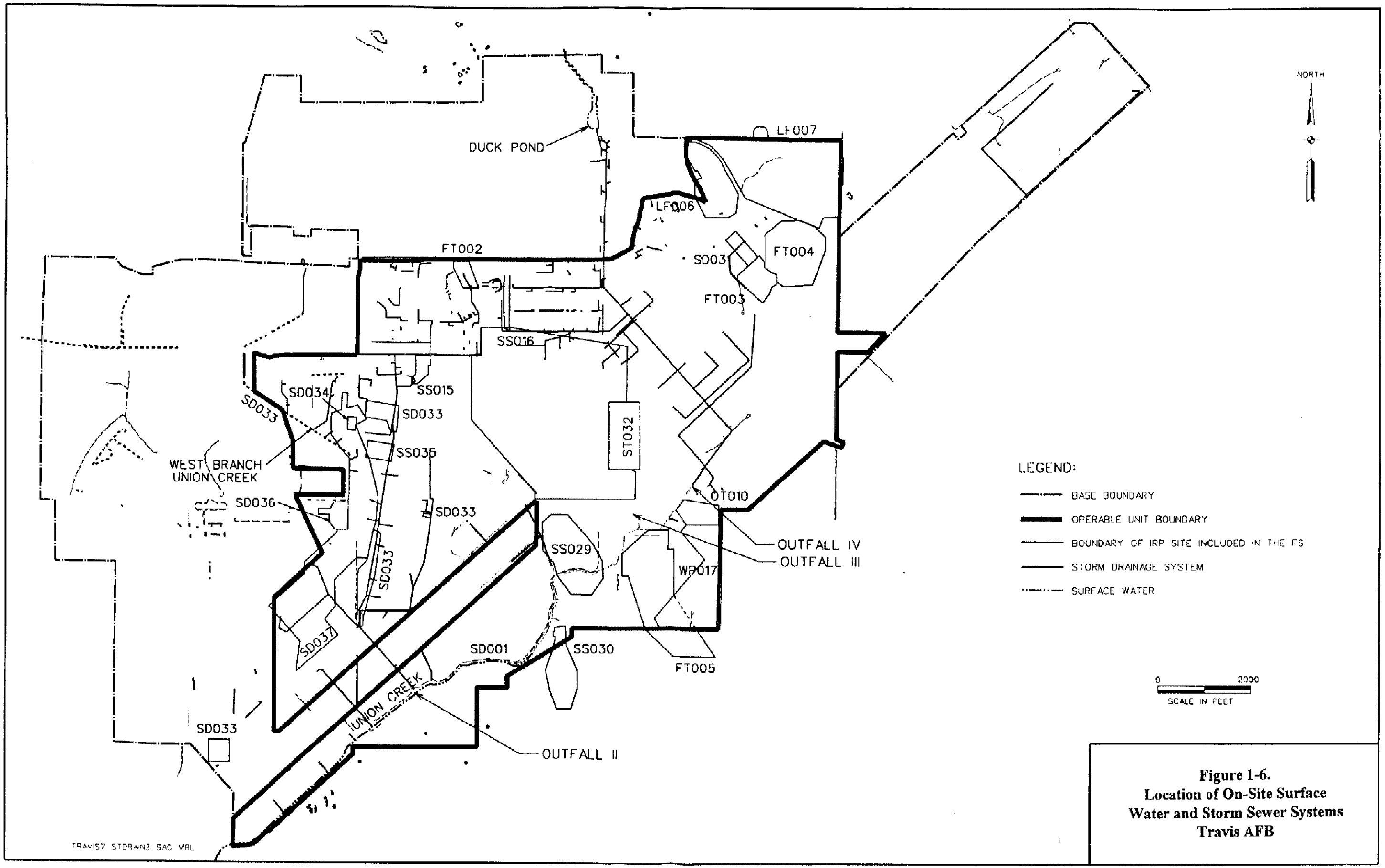


Figure 1-6.
Location of On-Site Surface Water and Storm Sewer Systems Travis AFB

Section Tab

2

2.0 OVERVIEW OF TRAVIS AFB ENVIRONMENTAL PROGRAMS

2.1 Non-CERCLA Environmental Programs

In addition to Travis AFB's efforts to investigate and remediate sites under the CERCLA program, Travis AFB maintains an active environmental compliance program to comply with a wide variety of non-CERCLA environmental regulations. This section briefly discusses some of the more important non-CERCLA compliance programs.

2.1.1 Air Force Regulations and Management Action Plan

The Air Force has developed a parallel set of environmental regulations to the federal environmental regulations. These Air Force regulations are designed to ensure that federal requirements are implemented in an appropriate manner at Air Force installations. Air Force regulation AFI 32-7005 sets up Environmental Protection Committees to oversee management of all environmental programs. The following are examples of environmental compliance subject areas where the Air Force has specific environmental regulations designed to parallel federal environmental regulations:

- Environmental Restoration Program;
- Air Quality Compliance;
- Water Quality Compliance;
- Solid and Hazardous Waste Compliance;
- Storage Tank Compliance;
- Environmental Impact Analysis Process;
- Integrated Natural Resource Management;

- Cultural Resource Management; and
- Pollution Prevention Program.

The Management Action Plan (MAP) for Travis AFB (Parsons Engineering Science, 1996) summarizes the current status of the Travis AFB environmental restoration and associated compliance programs, and presents a comprehensive strategy for implementing response action necessary to protect human health and the environment. The Air Force produced the most recent version of the MAP in January 1997. The MAP is used by Travis AFB environmental staff and Air Force headquarters to direct and monitor environmental response action and to schedule activities needed to resolve technical, administrative, and operational issues.

The Travis AFB Base General Plan, known as the Base Comprehensive Plan, a companion document to the MAP, provides an organized, systematic, and comprehensive approach to current and future planning and development. The Base General Plan is a tool that addresses a multitude of installation requirements and assists in the long-range growth of the base, including natural resources, environmental protection, land use, airfield operation, utilities, transportation, and architectural compatibility. Of particular importance is its role in environmental protection. The Plan requires addressing proper hazardous waste management and recognizing CERCLA related activities, through proper land use at Travis AFB.

2.1.2 Resource Conservation Recovery Act and Hazardous Waste Management Program

Travis AFB operates as a generator and facility for hazardous waste management under the Resource Conservation Recovery Act (RCRA) and State of California hazardous waste management programs. Travis AFB received a Part B hazardous waste facility storage permit from the California Department of Toxic Substances Control Division (DTSC) and the United States Environmental Protection Agency (U.S. EPA) on 5 March 1993.

2.1.3 Petroleum-Only Contaminated Sites Program (POCOS)

Travis AFB has a POCOS program designed to manage sites on base whose contamination is limited to petroleum-related constituents. Travis AFB and the agencies agreed to remove the POCOS from the Travis AFB CERCLA program because the law excludes petroleum as a CERCLA contaminant. The Air Force will address petroleum contamination under CERCLA if it is commingled with CERCLA contaminants.

POCOS are typically associated with surface and sub-surface releases from fuel spills, piping leaks, oil-water separators, or underground storage tanks (USTs). The POCOS program includes removal of leaking USTs and remediation of petroleum-only contaminated soil and groundwater. The agencies and the Air Force delisted the North/South Gas Station site from the CERCLA program; the site is now a POCOS. The North/South Gas Station is also a demonstration site for the Lawrence Livermore National Laboratory for a natural attenuation study. The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) is the lead oversight agency for this program.

2.1.4 Stormwater Discharge Permit

Travis AFB monitors stormwater outfalls in compliance with its state of California National Pollution Discharge Elimination System (NPDES) permit. The ongoing monitoring program was developed in 1992. The Air Force conducts sampling and reporting according to the permit requirements. The SFBRWQCB is the lead oversight agency for stormwater discharges.

2.1.5 Pollution Prevention Program

Travis AFB has an active Pollution Prevention Program which strives to reduce the generation of wastes through a hierarchy of actions. The actions range from the most preferred choice of source reduction, to recycling, treatment, and finally disposal as a last resort. The

Pollution Prevention MAP (P2 MAP) defines the framework to accomplish these actions. The plan analyzes all processes generating hazardous waste streams and performs opportunity assessments of potential pollution prevention options to reduce the volume and/or toxicity of generated wastes. This program includes minimizing wastes generated by sampling activities in the IRP.

2.2 CERCLA Environmental Programs

This section summarizes the basic steps of the CERCLA process in Section 2.2.1. The following section, Section 2.2.2, then discusses how the Air Force has implemented the CERCLA process basewide at Travis AFB. Finally, Section 2.2.3 discusses what CERCLA activities have been, and will be, performed within the NEWIOU.

2.2.1 CERCLA Process

CERCLA, passed in 1980, and amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, was designed to establish a program to remediate sites contaminated with hazardous constituents to protect public health and the environment.

2.2.1.1 General CERCLA Process, Remedial Investigation/Feasibility Study/Record of Decision/Proposed Plan/Remedial Design/Remedial Action

CERCLA established a series of steps designed to investigate contamination at sites and develop and implement appropriate remedial actions at these sites. The first key step is the RI. The RI serves as the mechanism for collecting data to characterize site conditions, to determine the nature of the waste, and to assess risk to human health and the environment. The Air Force generally collects data in several stages, with initial data collection efforts usually limited to developing a general understanding of the site. As the Air Force achieves a basic understanding of site characteristics, subsequent data collection efforts focus on filling identified gaps in the

understanding of site characteristics and gathering information necessary to evaluate remedial alternatives.

The FS serves as the mechanism for the development, screening, and detailed evaluation of alternative remedial action. The FS consists of developing and screening of potential technologies for treatment, containment, or disposal of contaminated media. The Air Force then consolidates technologies into remedial alternatives. The Air Force then evaluates each of the alternatives against nine CERCLA criteria within the categories of effectiveness, cost, and implementability.

Following completion of the RI/FS process, the Air Force writes the Proposed Plan (PP), which outlines the preferred alternative for each site(s). This document allows the public an opportunity to comment on the preferred alternative and to gain an understanding of what alternative is proposed for implementation and why the proposed alternative best fits the problems at the site. After the public comment period, the Record of Decision (ROD) authorizes the selected alternative. The ROD summarizes all CERCLA activities at the site and selects the final remedial alternative. The ROD, which is signed by Travis AFB and the regulatory agencies, formally documents concurrence of the selected alternative. A final ROD specifies the final remedial alternative and establishes cleanup levels. An Interim ROD (IROD) does not specify final cleanup levels or/and the final selected alternative. IRODs are designed to quickly implement remedial actions to reduce contamination, reduce risk, and/or gather information that can be used to adjust the approach down the road as needed to ensure protectiveness.

The remedial design/remedial action (RD/RA) process documents all activities after the approval of the ROD or IROD, related to implementation of the selected alternative. The RD specifies the engineering design of the alternative in much more detail than was presented in the ROD or PP. The RA is the construction and operation of the selected alternatives specified in the ROD and RD. The Air Force will submit a schedule for the RD/RA to the regulatory agencies

twenty-one days after the ROD or IROD is signed. The RD/RA schedule is described in Section 5.4.

2.2.2 CERCLA Activities at Travis AFB

The Air Force, under the Installation Restoration Program (IRP), began an effort to identify contaminated sites at Travis AFB in 1983. (The IRP is the Air Force program to address CERCLA sites at bases.) After completing the Records Search and a Phase II study to confirm problem areas, Travis AFB developed an integrated IRP Work Plan in 1986. The U.S. EPA placed Travis AFB on the National Priority List in 1989. In 1993, the Air Force divided the site into four specific OUs: the NOU, the EIOU, the WIOU, and the WABOU (Figure 1-2). The Air Force made this division into separate OUs because each OU has different types of contaminant sources (e.g., landfills in the NOU), contaminant types, and contaminated media (e.g., storm drains in the WIOU and EIOU). Also, the very large geographic size of Travis AFB necessitated that the contaminated areas be separated into OUs for efficiency and to focus the separate RIs. The Air Force combined the NOU, EIOU, and WIOU into one FS to be more cost effective. The FS for the NEWIOU is presented in the *North, East, and West Industrial Operable Unit Feasibility Study*, (Radian, 1996a).

The Air Force has decided to prepare an IROD for NEWIOU sites with contaminated groundwater (see Table 2-1) rather than a final ROD in order to speed up the site cleanup. This IROD establishes a five-year interim period after which a final ROD will establish the final remedial actions and final cleanup goals. The Air Force will publish a public notice and hold a public comment period before the ROD is finalized and approved by the regulatory agencies. The Air Force will prepare a separate final ROD for soil, sediment, and surface water in the NEWIOU later.

Table 2-1

Description of NEWIOU IRP Sites with Groundwater Contamination

Operable Unit	IRP Site	Activities Leading to Current Contamination
NOU	LF006	Landfill 1 was a general refuse landfill that used burn and fill disposal methods from 1943 through 1950.
	LF007	Landfill 2 (Areas B, C, and D) was a general refuse landfill that used trench and fill methods from 1950 to 1973.
EIOU	FT004	Fire Training Area 3. The Air Force used this area for fire fighting training exercises which burned waste fuels, oils, and solvents on the open ground. The Air Force used the area from 1953 until 1962, reportedly.
	FT005	Fire Training Area 4. The Air Force used this area for fire fighting training exercises from 1962 through 1987. Throughout the 1960s, waste fuels, oils, and solvents were burned. From the early 1970s, the Air Force used only waste fuels for training.
	SS015	Solvent Spill Area and Facilities 550 and 552. Solvent stripping of aircraft parts, aircraft maintenance and repair, oil/water separator activities, and hazardous waste accumulation occurred in these areas. The primary chemicals used in these facilities include thinners, methyl ethyl ketone, resins, and emulsifiers. The Air Force chemically stripped radomes of paint from 1964 to 1980 near Facility 552.
	SS016	Oil Spill Area (OSA), Facilities 11, 13/14, 18, 20, 42/1941, 139/144, and selected sections of Storm Sewer Right of Way. Oil spills, degreasing operations, leaking oil/water separators, equipment maintenance and repair, aircraft washing, hazardous waste storage, vehicle maintenance, storm water run-off, and a wash rack are the principal contamination sources in these areas. Chemicals handled include lubricating oils, hydraulic fluid, solvents, and water containing solutions of these chemicals. The Air Force used the OSA from the 1940s through the 1980s. The Air Force used most of the facilities from the 1940s up to the present day.
	SS029	Monitoring Well (MW) 329 Area. Unknown past activities contaminated the groundwater with trichloroethene (TCE).
	SS030	MW-269 Area. Past practices near Facility 1125 (a radar facility) may have released TCE to the subsurface at an unknown time in the past. Possible sources include a leach field and/or surface disposal of TCE.
	SD031	Facility 1205. Maintenance and repair of diesel powered generators, wash rack activities, and oil/water separator leaks contributed to contamination at this site. Aerial photographs suggest that the Air Force may have used the area for aircraft maintenance. The facility has handled oils, antifreeze, and solvents and has been in use from 1957 to the present.
	ST032	Areas MW-107 and MW-246. Past fuel line leaks have contaminated the subsurface with fuel.

Table 2-1

Description of NEWIOU IRP Sites with Groundwater Contamination (Continued)

Operable Unit	IRP Site	Activities Leading to Current Contamination
WIOU	SD033	Storm Sewer II, Facilities 810 and 1917, South Gate Area, and West Branch of Union Creek. The Air Force used these areas to handle storm water runoff, fuel transport, aircraft maintenance, and aircraft washdown including wash racks and oil/water separators. Chemicals used in these areas include fuels, lubricating oil, hydraulic fluids, chlorinated solvents, and soap solutions. The Air Force constructed Facility 1917 in 1956, and the facility is no longer in use. Facility 810 was constructed in 1955 and is currently used for aircraft maintenance.
	SD034	Facility 811. An aircraft wash rack with oil/water separator and overflow pond have contributed to groundwater contamination at this site. Chemicals used at this facility include acids, solvents, antifreeze and the Stoddard solvent PD-680. The Air Force constructed this facility in 1979, and it is still in use.
	SS035	Facility 818/819. Aircraft washing, painting and repair and oil/water separator activity have contributed to groundwater contamination at this site. Chemicals used at these facilities include lubricating oil, hydraulic fluids, PD-680 and water solutions of these chemicals. The Air Force constructed these facilities in 1970, and they are still in use.
	SD036	Facilities 872/873/876. These facilities were constructed as multiple use shops which have included a wash rack and an oil/water separator. Current uses of the facilities include paint shops, electrical shops, landscape maintenance, paint mixing, and paint accumulation. Chemicals used include cleaning solutions, grease, degreasers, hydraulic oils and fluids, PD-680, pesticides, paints, and solvents. The Air Force constructed the shops in 1953, and they are still in use.
	SD037	Sanitary Sewer System, Facilities 837, 838, 919, 977, 981, Area G Ramp, and Ragsdale/V Area. These facilities include handling of domestic and industrial waste water, aircraft maintenance, heavy equipment maintenance, air cargo, vehicle washing, fuel transport, and waste accumulation. Chemicals used and handled in these areas include wastewater, oils, hydraulic fluids, fuels, transformer fluids, and chlorinated solvents. The Air Force began operating these facilities in the 1940s and continue to the present day.

An IROD for groundwater will allow interim remedial actions to begin quickly without increased time necessary to negotiate final cleanup levels that would be required in a final ROD. Actions taken under an IROD will use interim remedial goals, which are not enforceable standards, but simply goals to use as tools for decision making. Travis AFB and the agencies will determine the IROD/ROD strategy for the WABOU at a later time. Actions taken under different RODs and IRODs need to be coordinated into an integrated approach. For example, treatment of contaminated groundwater at Site SD033 may result in improvements to surface water and sediment water quality in West Branch of Union Creek and therefore may affect remedial actions in the ROD for soil, sediment, and surface water for SD033.

2.2.2.1 Removal Actions

Travis AFB has initiated expedited cleanups or removal actions in the NEWIOU to address contaminated groundwater in portions of sites. Information obtained from these removal actions has been used to help develop the interim remedial actions.

The Tower Area Removal Action (TARA) and Oil Spill Area (OSA), SS016 – The TARA system, located within SS016, includes extraction wells, a carbon treatment system, and discharge to irrigation lines or the storm sewer. As described in the "Engineering Evaluation/Cost Analysis" (Radian, 1994), the Air Force designed and operated TARA to remove high concentrations of volatile organic compounds (VOCs) in the groundwater and also to protect workers during construction of a hydrant system near the tower. The system has removed over 190 pounds of contaminants since the system began operation in 1995.

TARA is the only groundwater extraction system now operating at Travis AFB. The Air Force expanded this extraction system under an Explanation of Significant Differences to the "TARA EE/CA and Action Memo" (Radian, 1996d) to include the OSA and treats approximately 90 gallons per minute. The treated water is used for landscape irrigation during the dry season and will continue to be operated.

Jet Fuel Spill Area (JFSA), SS014 – The Air Force prepared an EE/CA and environmental assessment (Earth Technology, 1994), which included a public comment period. The action installed a treatment system in the southern part of the WIOU to remove fuel floating on top of the groundwater. The system recovered more than 4,800 gallons of fuel which was then recycled. This action is completed.

Outfall III Treatment System – The Air Force built a surface water treatment system for VOCs at Outfall III (part of SD001) in 1995. The system was built as a part of a Time Critical Removal Action (U.S. EPA, 1992) which used a liquid phase carbon system to remove TCE from surface water collected via the storm sewer system from the upstream industrial area. The system operated from June to September 1995 at a capacity of approximately 1,500 gallons per minute. The system discharged treated water to Union Creek. The system was shut down because TCE concentrations decreased after the TARA removal action was initiated. Operation of the TARA system (SS016) may have reduced infiltration of contaminated groundwater into the storm sewer system. Travis AFB does not anticipate the need to operate the system in the future due to continued operation and expansion of the extraction system at OSA (SS016).

2.2.2.2 Treatability and Pilot Studies

Monitoring Well (MW)-269 Area, SS030 – Actions at this site, located within SS030, included a 10-month small scale treatment feasibility study conducted by Weston in 1993/94 and a week-long 2-phase extraction test conducted by Radian in 1995. The objective of this extraction test was to develop data to design a system to remediate VOC-contaminated soil and groundwater. A Treatability Study is currently underway to investigate removal of off-base contamination and control migration.

North/South Gas Station, ST018 – The Air Force, in cooperation with Lawrence Livermore National Laboratories (LLNL), is undertaking a natural attenuation study to

investigate the rate and types of natural attenuation processes for contaminants at this site. This site is now managed under the POCOS program.

SD036 – A natural attenuation study is being conducted by the Air Force Center for Environmental Excellence (AFCEE) at SD036 (Facilities 872, 873, and 876). The study will evaluate the feasibility of natural attenuation of chlorinated solvents using the technical protocol jointly developed by AFCEE and U.S. EPA. The study is being conducted according to the "Workplan For A Risk Based Remedial Action Assessment at Facilities 872, 873, and 876 (SD036)" (January 1997). The Air Force will use this natural attenuation study as a prototype for other natural attenuation evaluations at Travis AFB.

2.2.3 CERCLA Activities for Groundwater at NEWIOU

2.2.3.1 Human Health Risk Assessments

The Air Force conducted human health risk assessments as an element of the RI process for each of the three OUs. These assessments evaluated the risks to human health from the constituents of concern. Each of the individual RIs include the assessments. Section 3.3 discusses the results of these assessments.

2.2.3.2 Ecological Risk Assessments

The Air Force also completed ecological risk assessments (ERAs) for the OUs. Each of the OU ERAs evaluates specific sites for completed exposure pathways, defines contaminants of potential ecological concern (COPECs), defines assessment and measurement endpoints, defines critical toxicity values (CTVs), and compares analytical sample data to the site specific CTVs. Following the completion of the OU-specific ERAs, a document entitled "Final Comprehensive Basewide Ecological Risk Assessment - Tier 2: Screening Assessment" (CH2M HILL, 1996), designed to quantify the potential ecological risks to plants and animals on the Base using a

basewide perspective, was completed. This document provides further information on ecological risk to help guide potential interim remedial actions. Section 3.3 of the Groundwater IROD presents more information on these ecological risk assessments.

2.2.3.3 RI/FS Activities

The Air Force completed remedial investigations at the three OUs (NOU, EIOU, and WIOU). The final reports for the RIs are: *Remedial Investigation, North Operable Unit, Travis Air Force Base, California* (Radian, 1995b); *East Industrial Operable Unit Remedial Investigation, Travis AFB* (Weston, 1995a); and *Remedial Investigation, West Industrial Operable Unit, Travis Air Force Base, California* (Radian, 1996b). Details regarding the RIs can be found in these reports and are summarized in Section 3.0.

The findings of the three RIs indicate similar types of soil, groundwater, surface water, and sediment contamination in the three OUs. The Air Force combined the NOU, EIOU, and WIOU into one FS to be more cost effective. The FS for the NEWIOU is presented in the *North, East, and West Industrial Operable Unit Feasibility Study*, (Radian, 1996a). The FS is summarized in Section 4.0.

2.2.3.4 Community Participation

Travis AFB conducts a comprehensive effort to inform the public and involve the community in the environmental decision-making process. Following are the highlights of the community relations activities taken by Travis AFB to date:

- **Federal Facilities Agreement (FFA).** The Air Force, U.S. EPA, California Department of Health Services (now Department of Toxic Substances Control), and SFBRWQCB have negotiated an interagency agreement, which includes requirements for community relations activities based on provisions in federal (and where applicable, state) statutes, regulations, and guidelines.

- **Restoration Advisory Board (RAB).** In 1994, Travis AFB established a RAB comprised of representatives of the community and the regulatory agencies. Through its quarterly meetings and its focus groups, the RAB has provided valuable input about community concerns regarding the Restoration Program. The Technical Document Review focus group has reviewed the draft of every major report and provided comments. The Relative Risk focus group has provided input on the project prioritization, and the Community Relations focus group is working to reach out for new community members. The RAB replaced the Technical Review Committee, which met periodically to review program progress.

- **Administrative Record/Information Repository.** The Air Force established an Administrative Record of Information, used to support Air Force decision making related to the IRP at Travis AFB. In addition, the Air Force established a public information repository for the relevant portion of the Administrative Record at the Vacaville Public Library.

- **Community Relations Plan (CRP).** The Air Force implemented the first Travis AFB CRP in 1991. The Air Force revised the CRP in 1995. The Travis AFB Remedial Project Manager (RPM) is currently implementing the CRP.

- **Mailing List.** A mailing list of all interested parties in the community is maintained by Travis AFB and updated regularly. The mailing list currently totals more than 1,300 names.

- **Fact Sheets and Newsletters.** The Air Force has been publishing fact sheets describing activities and milestones in the restoration program occasionally since 1993. Since 1995 the Air Force has published and mailed quarterly newsletters to everyone on the mailing list. The newsletters contain information about public participation, issues of potential concern to the public, and program updates. The RAB co-chairs also write columns in each newsletter.

Travis AFB has had a community relations program since 1990. Public review copies of the OU RIs were made available:

- July 1995 (NOU);
- October 1995 (EIOU); and
- February 1996 (WIOU).

The Air Force released the NEWIOU FS in September 1996. These documents are available to the public at the Information Repository in Vacaville. The Air Force mailed the PP to all parties on the Travis AFB mailing list, government officials, representatives of interested community groups, and members of the media.

The Air Force held a 30-day public comment period for the NEWIOU Groundwater Proposed Plan from 25 September 1996 through 24 October 1996. The Air Force held a public meeting on the evening of 17 October 1996 from 7:00 p.m. to 9:00 p.m. At this meeting, representatives from the Air Force, Cal-EPA/DTSC, the SFBRWQCB, and U.S. EPA answered questions about the groundwater contamination off-base. Questions and comments from the public and responses are included in Part III, the Responsiveness Summary.

2.2.3.5 Remedial Design/Remedial Action

The RD/RA will include the design and implementation of all actions specified in the Groundwater IROD. The regulatory agencies will be involved in the approval and oversight of the design and construction of the interim remedial actions. Experience gained through implementation of the interim remedial actions will allow for technically and economically feasible long-term remedial options in the final ROD for groundwater at Travis AFB.

The Air Force will submit the RD/RA schedule for implementing the IROD twenty-one days after signing of the IROD in accordance with the FFA. The regulatory agencies will review and approve the RD/RA schedule, as well as all reports and actions specified in the RD/RA schedule. Section 5.4 presents the elements that will be included in the RD/RA schedule.

Section Tab

3

3.0 SUMMARY OF NEWIOU GROUNDWATER REMEDIAL INVESTIGATION

Section 3.1 summarizes the nature and extent of groundwater contamination in the NEWIOU determined during the three separate remedial investigations for the North, West Industrial, and East Industrial OUs. Section 3.2 presents a generalized conceptual model of contamination at Travis AFB. Section 3.3 summarizes the risk evaluations performed as part of the individual OU RIs. Section 3.4 discusses contaminants of concern, and the areas requiring response actions. A summary statement is included in Section 3.5.

3.1 Nature and Extent of Contamination

Table 2-1 describes IRP sites with groundwater contamination within the NEWIOU. The primary activities that generated waste at the base have been aircraft and vehicle fueling, maintenance and repair. Waste streams generated at the base include used oils, contaminated fuels, used hydraulic fluids, spent chlorinated and non-chlorinated solvents, and paint thinners. Fuel handling, fire protection training, and grounds maintenance also have generated additional waste streams. The Air Force has stopped the materials handling and disposal practices that resulted in the contamination. Travis AFB now follows environmentally safe practices and guidelines for the management and disposal of all hazardous materials and wastes.

In the past, Travis AFB disposed of some hazardous waste streams in landfills, to the land surface, and by burning during fire training exercises. Starting in the 1960s, Travis AFB collected these wastes for off-base recycling or disposal. Many of the facilities include wash racks that are used for cleaning parts or aircraft. Travis AFB treated the aqueous waste streams generated by these wash racks using oil/water separators, and discharged the streams to the storm and sanitary sewers. Leakage from these separators or sewers may have contributed to the groundwater contamination at the base. Travis AFB now enforces a no-discharge policy for any industrial wastes to the storm drain system, has rerouted all such discharges to the sanitary sewer, and complies with applicable district influent limitations.

Figure 3-1 shows the locations of the NEWIOU groundwater sites and the extent of groundwater contamination.

The discussion of nature and extent focuses on groundwater contamination unless the soil contamination at the site is relevant to the site description or to groundwater remediation. Appendix A provides a summary of the pertinent environmental information for each groundwater site in the NEWIOU including a history of the site, information on the nature and extent of contamination results of the FS evaluation, the site conditions that influence selection of a remedy, and the selected interim action, including rationale.

3.1.1 North Operable Unit

The remedial investigation conducted at the NOU includes two landfills that were recommended for further evaluation. Groundwater contamination was identified in three areas of LF007 (Landfill 2) and in two areas of LF006 (Landfill 1). The sites and areas are shown in Figure 3-2 and are:

- LF006 – Landfill 1, Area A and Area F;
- LF007B – Landfill 2, Area B;
- LF007C – Landfill 2, Area C; and
- LF007D – Landfill 2, Area D.

In general, LF006A, LF007B, and LF007C are similar in that each is part of two former landfills with low concentrations (less than 50 micrograms per liter [µg/L] trichloroethene [TCE] at LF006A and LF007C and less than 60 µg/L benzene at LF007B) of dissolved contaminants. At LF007D, VOC concentrations are less than 50 ppb except a result of 282 µg/L for chlorobenzene was detected. The groundwater contamination at LF006 is in two general areas. Sampling results identified total petroleum hydrocarbons (TPH) contamination in the northern

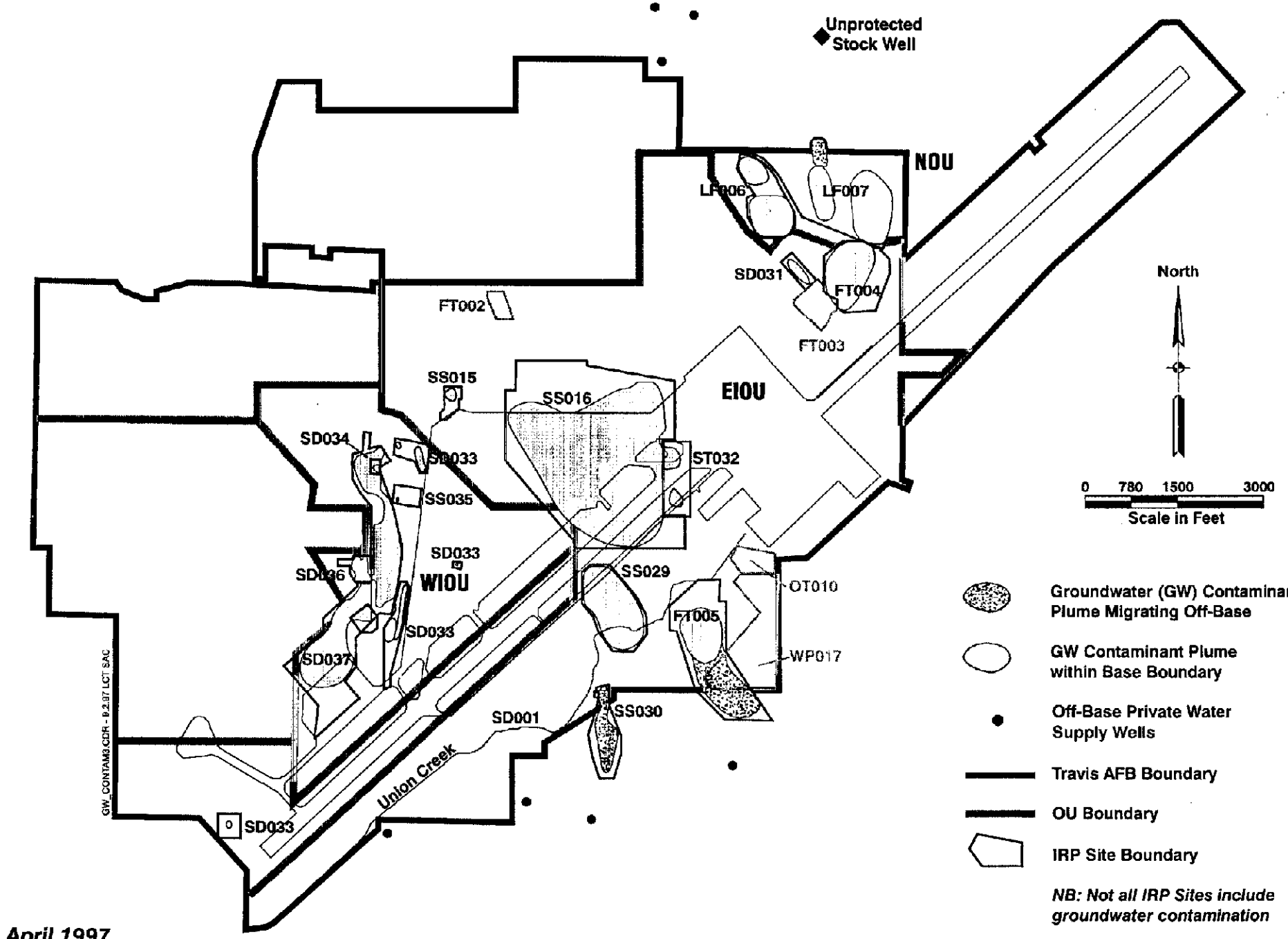


Figure 3-1. NEWIOU Groundwater Sites and

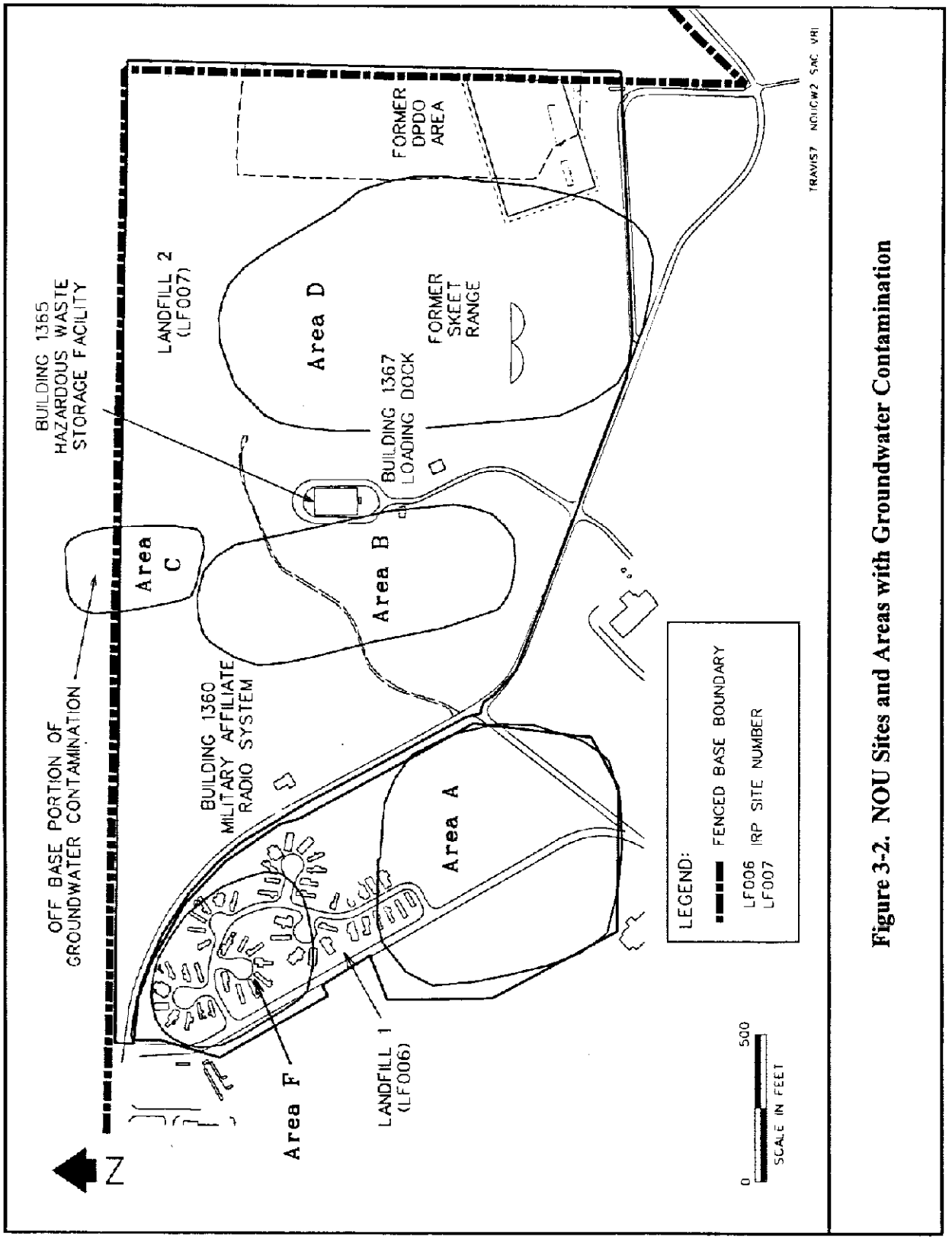


Figure 3-2. NOU Sites and Areas with Groundwater Contamination

part of LF006 (Area F) at concentrations up to 140 µg/L. In the southern part of LF006 (LF006A), groundwater contaminants include VOCs such as TCE and TPH.

At LF007B and LF007D, other contaminants of concern (COCs) in the groundwater include semivolatile organic compounds (SVOCs), pesticides, and PCBs. Sampling results detected dioxins in groundwater samples at concentrations above the U.S. EPA Preliminary Remediation Goal (PRG) at one location in each area. The presence of PCBs and dioxins is consistent with the disposal histories of these landfills; Landfill 2 received unspecified industrial wastes. Sampling of downgradient wells in March 1996 indicate that the dioxins and PCBs have not migrated (Radian, 1995b).

At LF007C, groundwater contaminated with dissolved chlorinated solvents extends off-base no more than 200 feet based on cone penetrometer testing (CPT) data. Although the local groundwater flow directions in this area of the base are towards the south and southwest, local changes in the groundwater flow direction are caused by the irregular topography, near surface bedrock and poor surface drainage. Such a local flow variation is responsible for transporting the dissolved plume off-base to the north at LF007C.

Sampling results detected bis(2-ethylhexyl)phthalate in some groundwater samples collected at LF007B and LF007D. This compound is associated with plastics.

3.1.2 East Industrial Operable Unit

The remedial investigation conducted at the EIOU includes IRP sites that were recommended for further evaluation (Figure 3-3). These sites are:

- FT004 – Fire Training Area 3;
- FT005 – Fire Training Area 4;

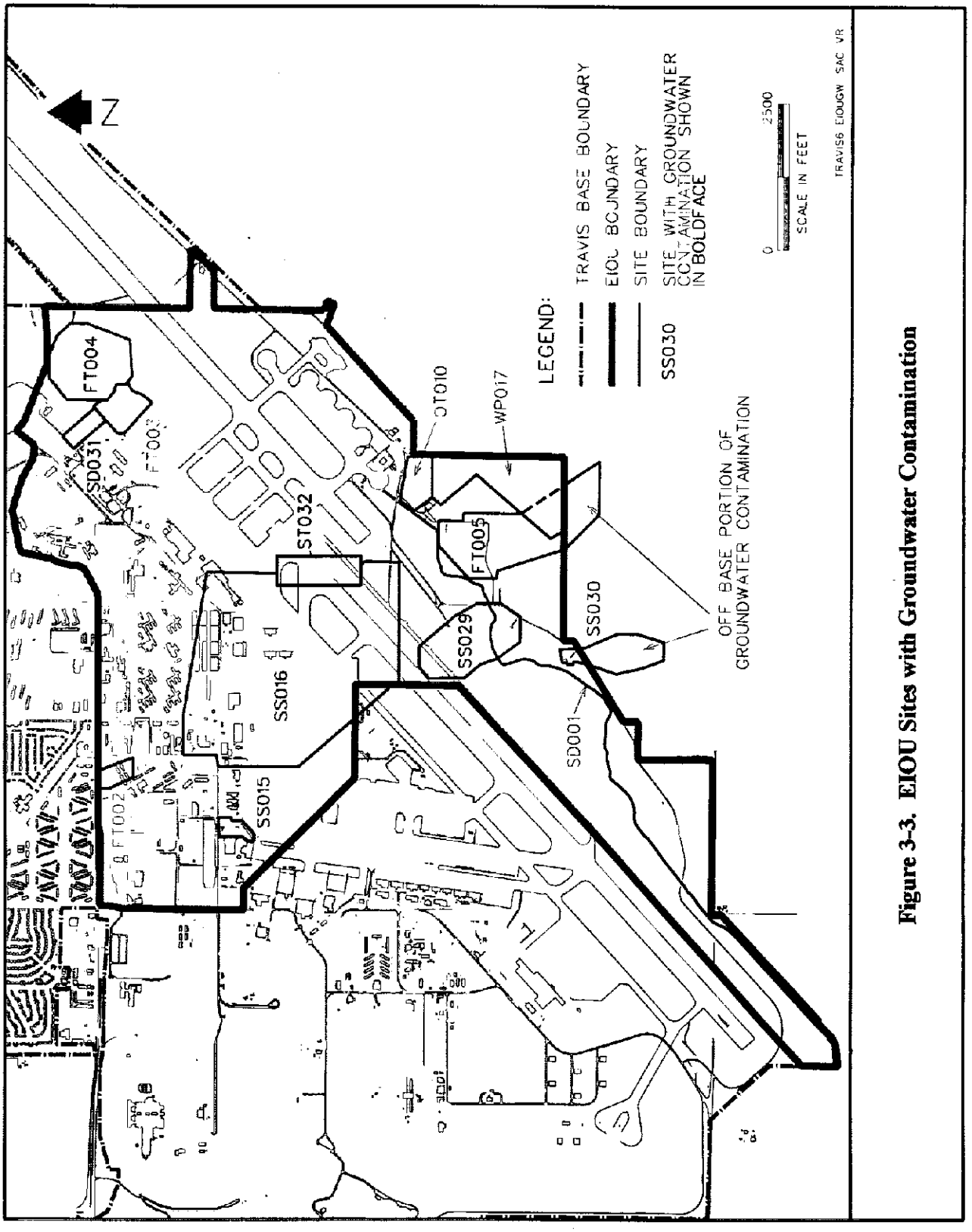


Figure 3-3. EIOU Sites with Groundwater Contamination

- SS015 – Solvent Spill Area and Facilities 550 and 552;
- SS016 – Oil Spill Area, Facilities 11, 13/14, 18, 20, 42/1941, 139/144, and selected sections of Storm Sewer Right of Way;
- SS029 – MW-329 Area;
- SS030 – MW-269 Area;
- SD031 – Facility 1205; and
- ST032 –Areas MW-107 and MW-246.

FT005, SS015, and SS029 all have dissolved chlorinated VOC groundwater plumes with COC concentrations less than 1,400 µg/L. COCs at SS029 are all VOCs, and COCs at FT005 and SS015 include VOCs, SVOCs, and metals (nickel). While the activities conducted in these areas were dissimilar in function, they all contributed to dissolved TCE (and related breakdown products) contamination. At SS029 there is no clearly identified source area. Solvent spills may be sources of contamination at SS015. The source of the contamination at FT005 is probably the fire-training activities. Contaminated groundwater at FT005 extends approximately 500 feet south of the base boundary.

FT004, SS030, and SD031 have similar maximum concentrations of dissolved chlorinated VOCs (TCE concentrations ranging from 2,400 µg/L to 8,100 µg/L. Other classes of COCs at these sites include metals (nickel), plus one SVOC bis(2-ethylhexyl)phthalate at FT004. The dissolved VOC plume from SS030 (the MW-269 area) has migrated beyond the base boundaries approximately 1,400 feet. A Pilot Study is planned for SS030, with an estimated start in the summer of 1997.

At SS016, groundwater samples from one well (MW-214) indicate the highest observed concentration of dissolved TCE detected from a monitoring well sample at the NEWIOU (32,000 µg/L). HydroPunch® groundwater samples in the area detected TCE at a concentration

of 180,000 µg/L. This area is the focus of two early actions, the current OSA Removal Action and the TARA that the Air Force has initiated in SS016 to address these areas of high TCE concentrations in groundwater. Classes of COCs identified at SS016 include VOCs, one SVOC, and one metal. SS016 includes the Storm Sewer Right-of-Way which is an area of potential surface water/groundwater interaction that impacts Union Creek.

ST032 has high concentrations of dissolved fuel-related VOCs. Sampling from monitoring wells at this site detected free-phase petroleum hydrocarbons. The highest benzene groundwater concentration is 5,040 µg/L. TCE is also a COC at this site. Classes of COCs identified at ST032 include VOCs and one SVOC. There is potential interaction between surface water and groundwater at ST032 via the storm sewers that may lead to TCE and petroleum migration to Union Creek.

In groundwater samples from FT004, FT005, SS015, SS016, and ST032, the Air Force has occasionally detected bis(2-ethylhexyl)phthalate (a SVOC). Bis(2-ethylhexyl)phthalate is a common laboratory contaminant and is associated with plasticizers. There is no history of plastic disposal at this site; therefore, the detection of this chemical may not indicate groundwater contamination, although it is considered a COC at these sites based on risks.

The Air Force has identified nickel as a COC in groundwater at Sites FT004, FT005, SS015, SS016, SS030, and SD031. Treatment for metals may be needed to meet NPDES limits (see Table 6-6). Sites with metals will have treatment processes for metals. The Air Force will monitor actual levels of nickel and other metals during extraction/treatment system startup to determine the need for metals treatment. The actual source of the nickel is unknown and currently being investigated.

3.1.3 West Industrial Operable Unit

The remedial investigation conducted at the WIOU includes five sites that were recommended for further evaluation (Figure 3-4). These sites are:

- SD033 – Storm Sewer System II/Facilities 810 and 1917, South Gate Area, and West Branch of Union Creek;
- SD034 – Facility 811;
- SS035 – Facility 818/819;
- SD036 – Facility 872/873/876; and
- SD037 – Sanitary Sewer System, Facilities 837, 838, 919, 977, and 981, Area G Ramp, and Ragsdale/V Area.

SD033 and SD037 include the storm sewer system and the sanitary sewer system within the WIOU and several facilities. Leaks from oil/water separators (OWSs) and other industrial lines contributed to contamination in the groundwater. The Air Force has since replaced or repaired the oil/water separators. In both of these areas, dissolved contamination in the groundwater migrated along the permeable backfill around the pipes or into the storm sewer directly through breaks or damaged areas. Wastewater from the oil/water separators and other industrial lines has leaked out of damaged sewer sections into the groundwater.

Classes of COCs identified at SD033 and SD037 include VOCs and SVOCs. The dissolved contaminants in these groundwater plumes include chlorinated solvents (and related breakdown products), gasoline related compounds (TPH-G [VOCs]), and TPH-E SVOCs. The storm sewer discharges into Union Creek, and the sanitary sewer discharges to the Fairfield-Suisun Publicly Owned Treatment Works (POTW).

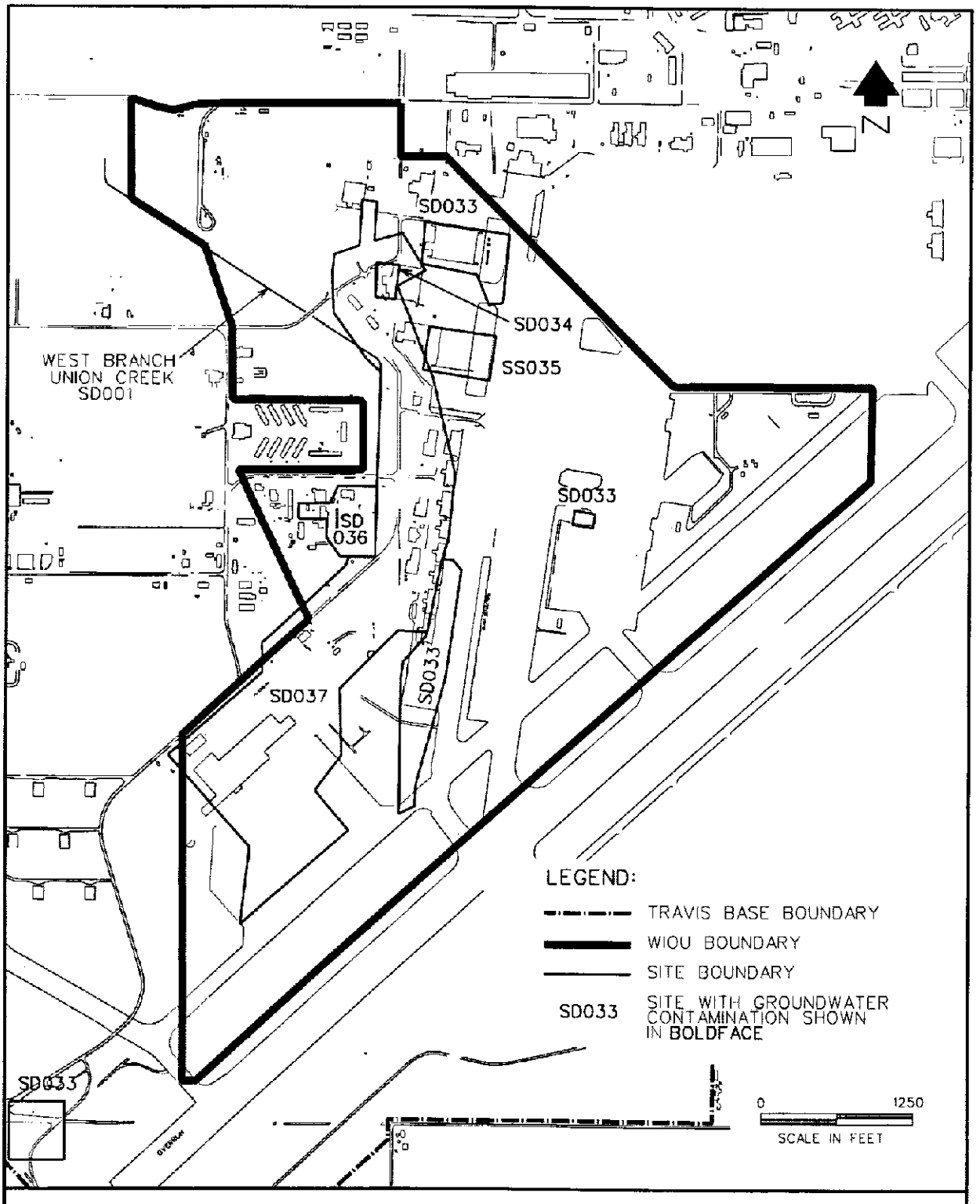


Figure 3-4. WIOU Sites with Groundwater Contamination

TRAVIS6 WIOUGW SAC VR

Groundwater at SD034 is contaminated due to the presence of hydrocarbons in the subsurface (primarily the solvent PD-680--a "Stoddard solvent" composed of 15% trimethyl benzene and 85% n-nonane) and dissolved VOCs. Classes of COCs identified at SD034 include VOCs and SVOCs. Floating product (PD-680) was found in a monitoring well located near the OWS located at Facility 811. This OWS, which has been removed, was also connected to an overflow pond located nearby. The OWS and the pond are the likely sources for the observed contamination. The VOC contaminated groundwater plume may also be mixed with contaminated groundwater at SD037.

Groundwater contamination at SS035 is characterized by low concentrations of dissolved TCE (21 µg/L) and SVOCs such as TPH-extractable (TPH-E) (160 µg/L). Dissolved contamination may have infiltrated into the aquifer due to a leaking OWS. TCE and TPH-E are the only identified COCs at SS035.

Elevated concentrations of chlorinated solvents (cis-1,2-dichloroethene [DCE] up to 3,870 µg/L) have been detected in groundwater samples from SD036. Dissolved benzene, which is thought to be associated with the wash rack or the OWS formerly located near Facility 872 has also been detected at SD036. In addition to VOCs and petroleum compounds, one SVOC was identified as a COC at SD036 (bis[2-ethylhexyl]phthalate). AFCEE is currently evaluating this site for natural attenuation of chlorinated compounds such as TCE.

3.2 Conceptual Model of Contamination

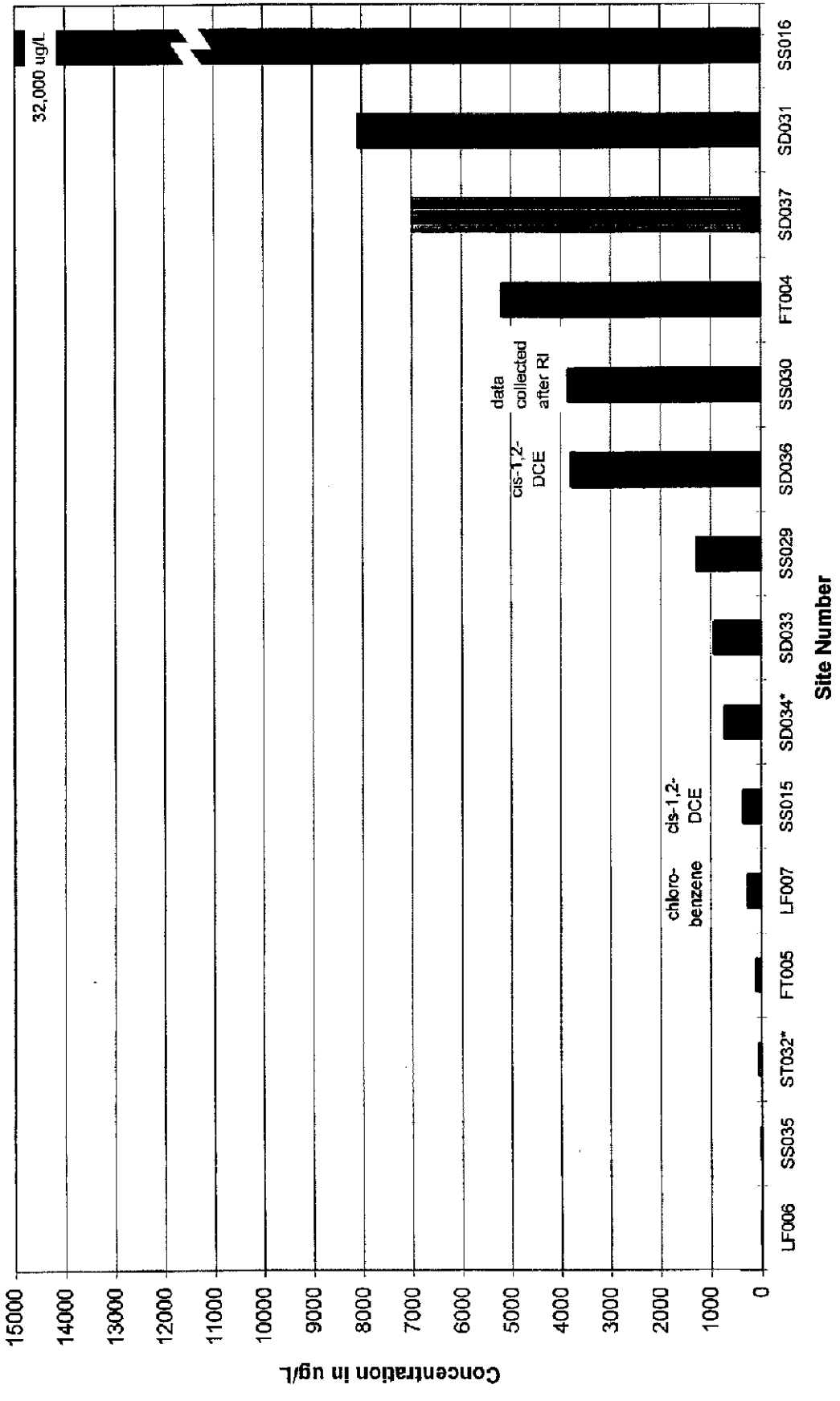
The details of the conceptual models for each of the groundwater sites have been discussed in the individual RIs. The site-specific summary sheets in Appendix A also contain conceptual diagrams for each site.

Contaminants of concern can reach or leave the groundwater via many pathways. The various mechanisms affecting contaminant concentrations throughout the NEWIOU include:

- Adsorption/desorption of organic chemicals to organic matter, or mineral surfaces from free-phase, vapor phase, or dissolved phase contamination;
- Dissolution of organic compounds into infiltrating precipitation, vadose zone pore water, and groundwater from adsorbed, free-phase, or vapor phase contamination;
- Volatilization of VOCs from adsorbed, dissolved, or free-phase contamination into the unsaturated zone;
- Vertical migration of dissolved VOCs and SVOCs into groundwater;
- Migration of free-phase VOCs and SVOCs through the vadose zone to the groundwater;
- Diffusion of free-phase dense nonaqueous phase liquids (DNAPLs) into fine grained silts and clays to form a secondary source;
- Migration or advection of dissolved phase contamination;
- Natural attenuation; and
- Migration of contaminated groundwater to surface water or storm sewers where groundwater flows into surface waters.

Groundwater VOC concentrations greater than 3,000 µg/L may indicate a potential for residual or DNAPL (dense nonaqueous phase liquid; TCE is heavier than water; thus is termed a DNAPL) contamination which can act as secondary sources of contamination. Free-phase DNAPL can remain as a residual liquid within the pore spaces, or it can diffuse into low permeability soils. This diffused DNAPL can also act like a residual source, even though the resultant aqueous concentrations are lower than typically expected near the source zone (Cherry, 1996). These aqueous concentrations may be from 1,000 µg/L or greater. Because Travis AFB aquifers are dominated by fine-grained silts and clays, DNAPL may have diffused into the finer sediments. Maximum contaminant concentrations in samples from monitoring wells are presented in Figure 3-5.

Figure 3-5.
Maximum Contaminant Concentration from Monitoring Wells
NEW/OU Groundwater Sites
All contaminants are TCE unless indicated. Sites with floating hydrocarbon are denoted by *.



VOCs or SVOCs can be lost from the subsurface through volatilization and advection of vapor phase contamination. In certain areas of the NEWIOU, dissolved groundwater contaminants can enter the storm sewer systems through broken conduits and be discharged to Union Creek. Dissolved VOCs migrating with the groundwater could reach Union Creek if the groundwater table is above the elevation of the stream bed.

In Figure 3-6, areas of potential inflow of groundwater to storm sewers are shown if there are any broken pipes or fractures in the storm sewer lines. The figure shows sections that have the potential to receive inflow during the entire year or only when the water table is higher during the winter months.

Natural attenuation of organic contamination leads to decreases in concentrations and ultimately plume size. Biodegradation is the primary degradation pathway for dissolved organic contamination at Travis AFB. Fuel hydrocarbons and non-chlorinated aliphatics are more susceptible than chlorinated solvents to both aerobic and anaerobic biodegradation by microorganisms. Aerobic biodegradation of fuel hydrocarbons uses dissolved oxygen as an electron acceptor, and produces carbon dioxide and water. This can reduce dissolved oxygen concentrations to less than 1 mg/L. Below 1 mg/L in concentration the oxygen levels are low enough to permit anaerobic biodegradation to begin. Anaerobic degradation uses other compounds as electron acceptors, and produces different byproducts such as methane and sulfides (Wiedemeier et al, 1996). Natural attenuation is discussed as a remedial alternative in Section 5.0.

Chlorinated solvents can biodegrade aerobically and anaerobically. Chlorinated solvents are man-made, and these compounds undergo somewhat limited degradation due to their microbial toxicity. These degradation mechanisms depend on complex chemical interactions between the aquifer material, the dissolved VOCs, native bacteria, and the surrounding soil vapor. Most often, these mechanisms degrade TCE or perchloroethene to 1,2-DCE or 1,1-DCE.

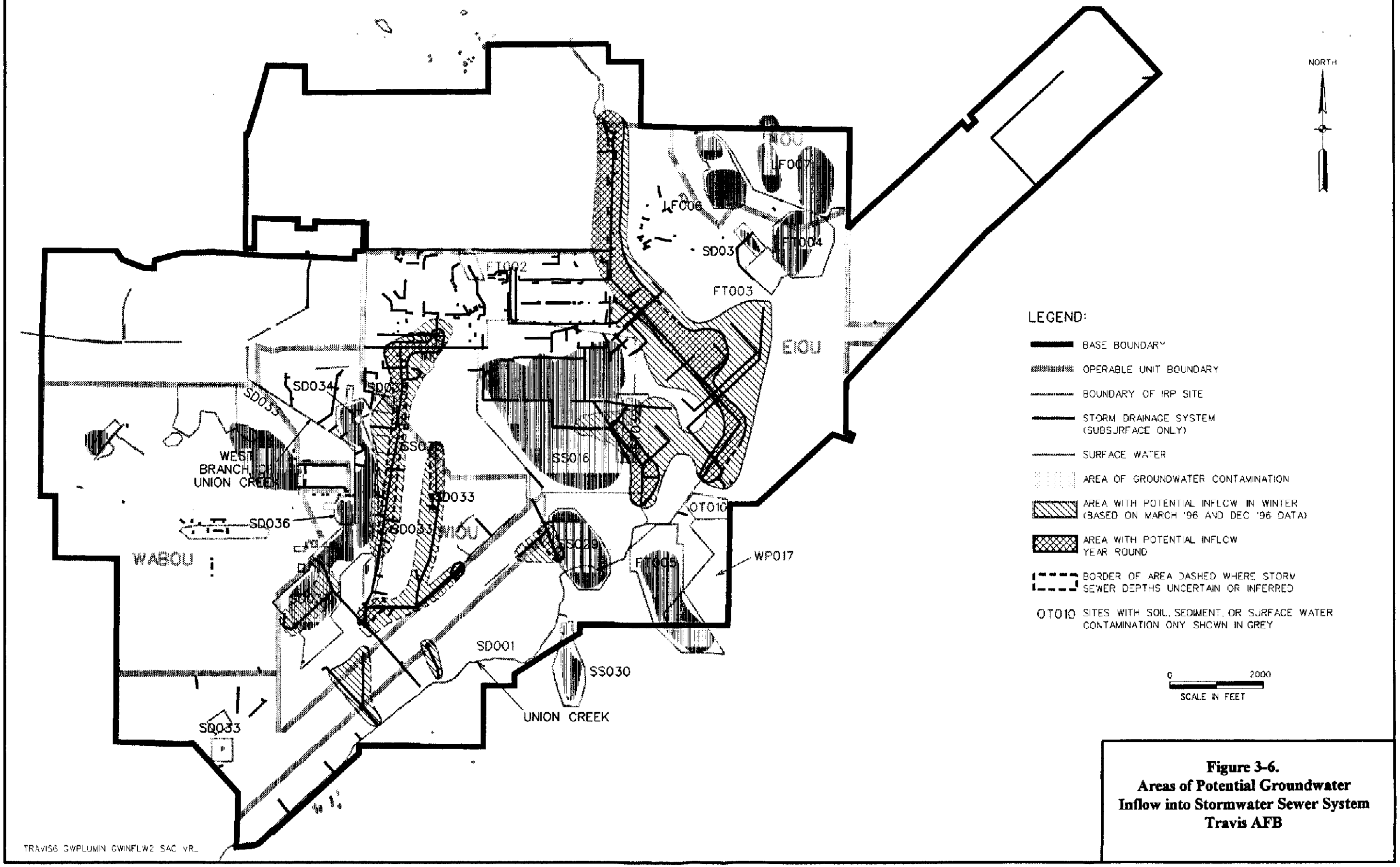


Figure 3-6.
Areas of Potential Groundwater Inflow into Stormwater Sewer System Travis AFB

These byproducts can then degrade to vinyl chloride, which can then be further reduced or oxidized to benign compounds such as carbon dioxide and water (Wiedemeier et al, 1996). Throughout the NEWIOU, it is common to find chlorinated solvent degradation products dissolved in groundwater and soil vapor. This suggests that at least partial biodegradation is occurring in the NEWIOU, and supports the feasibility of using natural attenuation to remediate certain areas (Wiedemeier et al, 1996).

3.3 Risk Evaluation

Detailed information about the calculation of the human and ecological risks is in the OU RIs. Table 3-1 summarizes the human and ecological risks posed by the dissolved chemicals found in the groundwater at the NEWIOU IRP sites.

The objectives for the RIs and the health risk assessments conducted for the three OUs that make up the NEWIOU were to define:

- OU-specific hydrogeology and a complete conceptual model;
- Approximate nature and extent of contamination;
- Risks to human health and the environment; and
- Sites, contaminants, and affected media to be considered in the FS.

Using contaminant concentrations from the field investigation, human health risk values were calculated for a future residential scenario (adult reasonable maximum exposure [RME]) for cancer risks, and child RME for noncancer risks and for industrial workers. The future residential scenarios were the most conservative approach; although future use of groundwater by residences was evaluated for the health risk assessment (HRA), future water is likely to continue to be supplied basewide from sources outside Travis AFB. In addition, the planned future use of most sites is industrial, not residential.

Table 3-1

Summary of IRP Sites, Groundwater Contaminants, and Risks

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[e]
NOU	LF006	Landfill 1	Groundwater	Human (Total Risk = 8×10^{-6})	VOCs	6.3×10^{-6}	TCE	20 µg/L	5 µg/L
						1.7×10^{-6}	1,1-DCE	0.64 µg/L	6 µg/L
						NA	TPH	330 µg/L	TBD[e]
	LF007	Landfill 2 Area B	Groundwater	Human (Total Risk = 7.8×10^{-4})	VOCs	3.9×10^{-5}	Benzene	59.3 µg/L	1 µg/L
						1.9×10^{-5}	1,4-DCB	30.8 µg/L	5 µg/L
						HI = 1.3	Chlorobenzene	161 µg/L	70 µg/L
					SVOCs	4.1×10^{-6}	Bis(2-ethylhexyl)phthalate	14.3 µg/L	4 µg/L
					Pesticides[b]/PCBs	7.0×10^{-4}	PCBs[c]	13.5 µg/L (PCB-1248)	0.50 µg/L
					Dioxins	1.3×10^{-6}	2,3,7,8-TCDDeq	0.55 pg/L	0.03 pg/L
	LF007	Landfill 2 Area C	Groundwater	Human (Total Risk = 3.6×10^{-5})	VOCs	1.6×10^{-5}	TCE	49.1 µg/L	5 µg/L
						5.6×10^{-6}	Vinyl Chloride	0.198 µg/L	0.5 µg/L
						3.5×10^{-6}	1,1-DCE	0.297 µg/L	6 µg/L
						1.3×10^{-6}	1,2-DCA	0.314 µg/L	0.5 µg/L
						1.0×10^{-5}	1,2-Dichloropropane	3.38 µg/L	5 µg/L

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[a]
NOU	LF007	Landfill 2 Area D	Groundwater	Human (Total Risk = 5.4×10^{-4})	VOCs	1.4×10^{-5}	Benzene	25.8 µg/L	1 µg/L
						2.9×10^{-6}	Vinyl Chloride	1.78 µg/L	0.5 µg/L
						2.5×10^{-5}	1,4-DCB	43.8 µg/L	5 µg/L
						1.1×10^{-6}	1,1-DCE	0.96 µg/L	6 µg/L
						HI = 15.5	Chlorobenzene	282 µg/L	70 µg/L
					Dioxins	2.4×10^{-4}	2,3,7,8-TCDDeq	16.99 pg/L	0.03 pg/L
					Pesticides*/PCBs	2.2×10^{-4}	PCBs[c]	14.1 µg/L (PCB-1242)	0.50 µg/L
					SVOCs	8.2×10^{-6}	Bis(2-ethylhexyl)phthalate	124 µg/L	4 µg/L
EIOU	FT004	FTA-3	Groundwater	Human	VOCs	1.69×10^{-3}	TCE	5,200 µg/L	5 µg/L
							cis-1,2-DCE	14.7 µg/L	6 µg/L
							1,2-DCA	5.12 µg/L	0.5 µg/L
							Chloroform*	1.81 µg/L	100 µg/L
							Dichlorobromomethane*	3.1 µg/L	100 µg/L
							1,1-DCE*	1.28 µg/L	6 µg/L
							Vinyl Chloride*	6.1 µg/L	0.5 µg/L
							1,4-DCB*	3.8 µg/L	5 µg/L
					SVOCs		Bis(2-ethylhexyl)phthalate	5.49 µg/L	4 µg/L
					Metal		Nickel	2,540 mg/L	0.1 mg/L

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
EIOU	FT005	FTA-4	Groundwater	Human	VOCs	1.12×10^{-4}	TCE	120 µg/L	5 µg/L
							1,2-DCA	14.2 µg/L	0.5 µg/L
							cis-1,2-DCE	19 µg/L	6 µg/L
							Chloroform*	10 µg/L	100 µg/L
							Dichlorobromomethane*	1.8 µg/L	100 µg/L
					SVOCs		Bis(2-ethylhexyl)phthalate	35.9 µg/L	4 µg/L
					Metal		Nickel	370 mg/L	0.1 mg/L
	SS015	SSA (Fac. 552)	Groundwater	Human	VOCs	7.22×10^{-4}	TCE	25 µg/L	5 µg/L
							cis-1,2-DCE	370 µg/L	6 µg/L
							Vinyl Chloride	48 µg/L	0.5 µg/L
							1,4-DCB*	3.8 µg/L	5 µg/L
							1,2-DCA*	0.39 µg/L	0.5 µg/L
							PCE	12 µg/L	5 µg/L
					SVOCs		Bis(2-ethylhexyl)phthalate	6.68 µg/L	4 µg/L
					Metal		Nickel	1,500 mg/L	0.1 mg/L

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
EIOU	SS016	OSA, Fac. 11, Fac. 13/14, Fac. 20, Fac. 42/1941, Fac. 139/144	Groundwater	Human	VOCs	1.11×10^{-2}	TCE	32,000 µg/L[d]	5 µg/L
							cis-1,2-DCE	4,600 µg/L	6 µg/L
							Vinyl Chloride	56 µg/L	0.5 µg/L
							Benzene	6.4 µg/L	1 µg/L
							Chloroform*	4.7 µg/L	100 µg/L
							1,4-DCB*	8.6 µg/L	5 µg/L
							Dichlorobromomethane*	0.9 µg/L	100 µg/L
							1,2-DCA	3.97 µg/L	0.5 µg/L
							1,1-DCE	5.4 µg/L	6 µg/L
							PCE	220 µg/L	5 µg/L
					SVOCs		Bis(2-ethylhexyl)phthalate	67.3 µg/L	4 µg/L
					Metal		Nickel	460 mg/L	0.1 mg/L

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
EIOU	SS029	MW-329 Area	Groundwater	Human	VOCs	4.22×10^{-4}	TCE	1,300 µg/L	5 µg/L
							1,2-DCA	1.13 µg/L	0.5 µg/L
							cis-1,2-DCE	80 µg/L	6 µg/L
							Benzene*	0.55 µg/L	1 µg/L
							Chloroform*	0.61 µg/L	100 µg/L
							1,1-DCE*	0.57 µg/L	6 µg/L
							Vinyl Chloride*	0.22 µg/L	0.5 µg/L
	SS030	MW-269 Area	Groundwater	Human	VOCs	7.6×10^{-4}	TCE	2,400 µg/L	5 µg/L
							Chloroform*	1.2 µg/L	100 µg/L
							Dichlorobromomethane*	0.53 µg/L	100 µg/L
							1,2-DCA*	0.34 µg/L	0.5 µg/L
					Metal		Nickel	903 mg/L	0.1 mg/L
	SD031	Fac. 1205	Groundwater	Human	VOCs	5.24×10^{-2}	TCE	8,100 µg/L	5 µg/L
							Benzene	6.75 µg/L	1 µg/L
							1,1-DCE	7,300 µg/L	6 µg/L
							cis-1,2-DCE	3,600 µg/L	6 µg/L
							Carbon Tetrachloride	11 µg/L	0.5 µg/L
							Chloroform	4.34 µg/L	100 µg/L
							1,2-DCA	0.41 µg/L	0.5 µg/L
							Vinyl Chloride	0.22 µg/L	0.5 µg/L
					Metal		Nickel	2,050 mg/L	0.1 mg/L

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
EIOU	ST032	MW-107 Area and MW-246 Area	Groundwater	Human	VOCs	1.5×10^{-2}	Benzene	5,040 µg/L	1 µg/L
							TCE	64 µg/L	5 µg/L
							1,1-DCE*	0.36 µg/L	6 µg/L
							Xylenes*	6,702 µg/L	1,750 µg/L
					SVOCs		Bis(2-ethylhexyl)phthalate*	153 µg/L	4 µg/L
WIOU	SD033	Storm Sewer System II (former Storm Sewer System B) (includes Facilities 810, 1917, and South Gate Area, and the West Branch of Union Creek	Groundwater	Human (Total Risk = 5.6×10^{-5})	VOCs	3.6×10^{-5}	TCE	941 µg/L	5 µg/L
						1.7×10^{-6}	1,1-DCE	0.420 µg/L	6 µg/L
						Exceeds MCL	1,2-DCA	1.36 µg/L	0.5 µg/L
						Exceeds MCL	cis-1,2-DCE	199 µg/L	6 µg/L
						NA	TPH-gasoline	1,000 µg/L	TBD[c]
					SVOCs	NA	TPH-E	1,420 µg/L	TBD[c]

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
WIOU	SD034	Facility 811	Groundwater	Human (Total Risk = 6.2×10^{-4})	VOCs	NA	LNAPL (PD-680)	~ 1 foot thick	NA
						3.0×10^{-5}	TCE	740 µg/L	5 µg/L
						3.1×10^{-5}	Vinyl Chloride	2.38 µg/L	0.5 µg/L
						1.2×10^{-6}	1,1-DCE	0.317 µg/L	6 µg/L
						Exceeds MCL	Benzene	6.8 µg/L	1 µg/L
						Exceeds MCL	cis-1,2-DCE	496 µg/L	6 µg/L
						1.2×10^{-5}	PCE	88 µg/L	5 µg/L
						NA	TPH-gasoline	10,600,000 µg/L	TBD[c]
					SVOCs	NA	TPH-E	13,000,000 µg/L	TBD[c]
						3.3×10^{-4}	Bis(2-ethylhexyl)phthalate	6,390 µg/L	4 µg/L
	SS035	Facilities 818 and 819	Groundwater	NA	VOCs	Exceeds MCL	TCE	21 µg/L	5 µg/L
					SVOCs	NA	TPH-E	160 µg/L	TBD[c]

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
WIOU	SD036	Facilities 872, 873, and 876	Groundwater	Human (Total Risk = 1.3×10^{-3})	VOCs	2.1×10^{-3}	Vinyl Chloride	198 µg/L	0.5 µg/L
						2.4×10^{-5}	TCE	308 µg/L	5 µg/L
						2.2×10^{-5}	1,1-DCE	3.71 µg/L	6 µg/L
						HI = 6.2	cis-1,2-DCE	3,870 µg/L	6 µg/L
						Exceeds MCL	1,2-DCA	1.36 µg/L	0.5 µg/L
						1.2×10^{-6}	Benzene	3.87 µg/L	1 µg/L
						1.0×10^{-6}	Bromodichloromethane	2.26 µg/L	0.18 µg/L
						1.6×10^{-4}	PCE	382 µg/L	5 µg/L
						NA	TPH-gasoline	4,380 µg/L	TBD[c]
						NA	TPH-E	480 µg/L	TBD[c]

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[c]
WIOU	SD037	Sanitary Sewer (includes Facilities 837, 838, 981, 919, the Area G Ramp, and Ragsdale/V Area)	Groundwater	Human (Total Risk = 1.6×10^{-4})	VOCs	1.1×10^{-6}	1,1-DCE	0.598 µg/L	6 µg/L
						Exceeds MCL	1,2-DCA	0.597 µg/L	0.5 µg/L
						1.9×10^{-7}	Benzene	1.93 µg/L	1 µg/L
						Exceeds MCL	Bromodichloromethane	0.69 µg/L	0.18 µg/L
						Exceeds MCL	Carbon Tetrachloride	60.7 µg/L	0.5 µg/L
						1.3×10^{-8}	Chloromethane	1.03 µg/L	1.50 µg/L
						4.6×10^{-5}	PCE	407 µg/L	5 µg/L
						5.4×10^{-5}	TCE	6,990 µg/L	5 µg/L
						6.0×10^{-5}	Vinyl Chloride	60.2 µg/L	0.5 µg/L
						Exceeds MCL	cis-1,2-DCE	340 µg/L	6 µg/L
						NA	TPH-gasoline	4,160 µg/L	TBD[e]
					SVOCs	1.4×10^{-6}	Bis(2-ethylhexyl)phthalate	139 µg/L	4 µg/L
						Exceeds MCL	Naphthalene	115 µg/L	23 µg/L
						NA	TPH-E	34,000 µg/L	TBD[e]
		Facility 977 (Sanitary Sewer) (SD037)	Groundwater	NA	VOCs	NA	TPH-gasoline	61 µg/L	TBD[e]
						Exceeds MCL	TCE	12.2 µg/L	5 µg/L
					SVOCs	NA	TPH-E	2,660,000 µg/L	TBD[e]

Table 3-1

(Continued)

Operable Unit	IRP Designation	Name/Description	Medium	Risk Criteria Exceeded	Class of Contaminants	Risk[a]	Contaminants of Concern	Maximum Reported Concentration	Maximum Contaminant Levels[e]
WIOU	SD037	Facility 981 (Sanitary Sewer) (SD037)	Groundwater	NA	VOCs	Exceeds MCL	Benzene	14 µg/L	1 µg/L
						Exceeds MCL	TCE	2.65 µg/L	6 µg/L
						NA	TPH-gasoline	790 µg/L	TBD[e]
					SVOCs	NA	TPH-E	530 µg/L	TBD[e]
		Area G Ramp (Sanitary Sewer) (SD037)	Groundwater	NA	VOCs	Exceeds MCL	Benzene	2.3 µg/L	1 µg/L
						Exceeds MCL	PCE	17 µg/L	5 µg/L
						Exceeds MCL	TCE	6.7 µg/L	5 µg/L
						NA	cis-1,2-DCE	1.32 µg/L	6 µg/L
					SVOCs	NA	TPH-E	4,100 µg/L	TBD[e]

[a] = Risk is for each COC contributing to total risk. Noncarcinogenic human health risks are reported as hazard indexes (HI); an HI greater than 1 suggests there may be a potential for adverse effects. Ecological risks are reported as maximum hazard quotients (HQ); an HQ greater than 1 suggests there may be a potential for adverse effects.

[b] = Pesticides were deleted from consideration in the FS for the NOU. See FS Report for discussion.

[c] = PCBs include Arochlors 1242 and 1248.

[d] = Recent testing has documented higher concentrations of TCE, up to a maximum of approximately 180,000 ppb. However, these results were derived from Cone Penetrometer Testing (CPT) data and should not be directly compared to monitoring well data.

[e] = Maximum contaminant levels (MCLs) presented are California Department of Health Services Primary MCLs, except where noted. U.S. EPA PRGs are used for chloromethane and total petroleum hydrocarbons have no limits in groundwater, and thus are TBD.

* This table contains revisions from the numbers in Table ES-2 from the EIOU RI (Weston, 1995). Revisions are based on recalculated risks (April, 1996). Contaminants of concern that have been added to this table are noted by an asterisk (*). In addition, PCB (Aroclor-1260) was removed as a human health risk (11 April 1996) based on an industrial exposure scenario rather than a residential scenario.

Note: All metals concentrations are dissolved (filtered samples).

DCA = Dichloroethane
DCB = Dichlorobenzene
DCE = Dichloroethene
HI = Hazard Index
HQ = Hazard Quotient
µg/L = Micrograms per Liter
NA = No maximum contaminant level available for this chemical or risks not calculated
OSA = Oil Spill Area
PCB = Polychlorinated Biphenyls
PCE = Tetrachloroethene
pg/g = Picograms per Gram
SVOCs = Semivolatile Organic Compounds
TBD = To be determined
TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCE = Trichloroethene
TPH-E = Total Petroleum Hydrocarbons - Extractable
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds

The Air Force also completed ecological risk assessments (ERAs) for the OUs. Each of the OU ERAs evaluates specific sites for completed exposure pathways, defines COPECs, defines assessment and measurement endpoints, defines CTVs and compares analytical sample data to the site specific CTVs. Depending on the risk analysis, routes of exposure and selected indicator species, CTVs may be expressed as doses or as environmental concentrations. The comparison of modeled doses or analytical concentrations to CTVs results in a hazard quotient (HQ). HQs exceeding 1 indicate a potential for adverse ecological effects. Specific OU ERAs also included additional analyses to assess ecological impact of contaminants. These included: gross pathology of organisms; site specific bioassays; biomass analysis; and biological sampling and analysis. These ERA analyses, other than the HQ analysis, may not be chemical end-point specific, but they assume all chemical concentrations identified at a site are responsible for the observed toxic endpoint (e.g., skin lesions on fish at the site).

Following the completion of the OU-specific ERAs, a document entitled "Final Comprehensive Basewide Ecological Risk Assessment - Tier 2: Screening Assessment" (CH2M HILL, 1996), designed to quantify the potential ecological risks to plants and animals on the Base using a basewide perspective, was completed. This document provides further information on ecological risk to help guide potential interim remedial actions.

The Tier 2 report presents general surface water and sediment goals based on federal standards. A supplemental approach was required to establish ecological interim remediation goals (IRGs) in the FS, specifically for soil at the NEWIOU sites. The Air Force estimated these IRGs by back-calculating media-specific concentrations to yield an HQ = 1, using the algorithms developed in the previous ERAs. The methodology involved selecting a "most sensitive receptor" for each site or habitat type, again based on the ERAs, to represent all ecological receptors. The Air Force and regulatory agencies selected these receptors to represent species that are likely to utilize the site, have a high level of contact with the contaminated media, and have available toxicity data. Exposure pathways, bioaccumulation/bioconcentration parameters, uncertainty factors, and toxicity data were all reviewed and factored into the analysis. The Air

Force then back-calculated the individual IRGs for each COC at each site, so that the IRG concentration would result in a theoretical HQ = 1.

Specific details of the HRAs for the three OUs that compose the NEWIOU are provided in the OU RIs and the NEWIOU FS.

The site-specific figures in Appendix A summarize primary groundwater contaminants that were evaluated in the FS. The summary figures for all sites include estimated areas of contamination; a complete description of the nature and extent of contamination is contained in the specific RIs. Compounds that do not drive risk or do not exceed regulatory standards are not shown on these figures.

3.4 Contaminants of Concern

Following the RI field activities, the Air Force compiled the data for each site and evaluated the data in each OU RI for the presence of contaminants and their potential effects on human health and the environment. The Air Force and regulatory agencies identified COCs based on potential human health risks, ecological risks, and regulatory limits. While each OU RI considered site-specific factors, the general criteria for the identification of groundwater COCs was as follows:

1. The contaminant drove a human health risk exceeding 1×10^{-6};
2. The contaminant had an HI exceeding 1.0; or
3. The maximum concentration of the contaminant exceeded the maximum contaminant level (MCL) (or PRGs for dioxin).

A detailed description of COC development is included in each of the OU RIs. COCs are listed in Table 3-1.

3.5 Summary

Releases of VOCs, as well as SVOCs, dioxins, and metals as a result of historic Base activities have contaminated the groundwater at the NEWIOU at Travis AFB. Most of the releases affecting groundwater at the NEWIOU involve TCE. Actual or threatened releases of hazardous substances from these sites, if not addressed by implementing the response actions selected in the Groundwater IROD, may present a current or potential threat to public health, and welfare, or to the environment.

As a result of the NOU, WIOU, and EIOU RIs, twenty sites were evaluated in the NEWIOU FS, fifteen of which have groundwater contamination. Five of the twenty sites (SD001, FT002, FT003, OT010, and WP017) do not have groundwater contamination. The fifteen groundwater sites are shown in Table 3-2. The Air Force and regulatory agencies delisted four sites and moved them to the Petroleum-Only Contaminated Sites (POCOS) program. These include SS014, ST018, SS027, and SS028. One site (OT011) was designated as no further action.

690 93

Table 3-2

Summary of NEWIOU Groundwater Sites Carried Forward to the NEWIOU FS

OU	IRP Designation	Name
EIOU	FT004	Fire Training Area (FTA)-3
	FT005	FTA-4
	SS015	Solvent Spill Area (SSA) and Facilities 550 and 552
	SS016	Oil Spill Area (OSA) Facilities 11, 13/14, 20, 42/1941, 139/144, and Storm Sewer Right of Way
	SS029	Monitoring Well (MW)-329 Area
	SS030	MW-269 Area
	SD031	Facility 1205
	ST032	MW-246/MW-107 Areas
NOU	LF006	Landfill 1
	LF007	Landfill 2
WIOU	SD033	Facilities 810 and 1917, Storm Sewer II, South Gate Area, and West Branch of Union Creek
	SD034	Facility 811
	SS035	Facility 818/819
	SD036	Facility 872/873/876
	SD037	Sanitary Sewer System, Facilities 837/838, 919, 977, 981, Ragsdale/V Area, and Area G Ramp

Note: Soil, sediment, and surface water contamination at these and other NEWIOU soil sites will be addressed in a separate ROD. For potential migration of groundwater to surface water, see Figure 3-6.

Section Tab

4

4.0 SUMMARY OF NEWIOU GROUNDWATER FEASIBILITY STUDY

The Air Force performed a Feasibility Study (FS) for the NEWIOU and the results are summarized in the FS Report dated September 1996. The FS consisted of the following activities:

- Develop Remedial Action Objectives;
- Combine cleanup technologies into remedial alternatives;
- Perform an Initial Screening of Alternatives;
- Evaluate each alternative against specific criteria;
- Perform a Detailed Analysis of Alternatives; and
- Rank each alternative for total score and cost/benefit.

This section describes each of the nine alternatives evaluated in the FS and how the Air Force combined Alternatives 3 through 9 into one alternative (Alternative 3) for this IROD. The Air Force and regulatory agencies developed Remedial Action Objectives (RAOs) in the FS to address contamination cleanup. As described in Section 3.3, the Air Force and regulatory agencies developed Interim Remediation Goals (IRGs) in the RI. The IRGs are risk based cleanup goals which are similar to cleanup levels but they are not enforceable. The Air Force used both IRGs and RAOs in the FS to evaluate the alternatives against specific criteria as described in Section 4.3.

4.1 Alternative Description

The Air Force and regulatory agencies first developed alternatives in the FS by performing an Initial Screening of Alternatives (ISA) process. This screening considered the environmental conditions at each site, the RAOs, and the IRGs to screen all potential remedial

technologies for applicability for remediation of contaminated groundwater. The screening process evaluated the effectiveness, implementability, and cost of each technology. The Air Force combined the technologies that passed the screening into a set of alternatives that could address each of the groundwater sites. The Air Force and regulatory agencies then subjected these alternatives to the second part of the FS process, the Detailed Analysis of Alternatives (DAA), which is summarized in Section 4.3.

The alternatives evaluated in the FS for groundwater were:

- Alternative #1: No Action
- Alternative #2: Institutional Actions: Access Restrictions, Monitoring, Natural Attenuation
- Alternative #3: Horizontal Well Extraction, Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #4: Horizontal Well Extraction, Air Stripper/Catalytic Oxidation, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #5: Horizontal Well Extraction, Ultraviolet Radiation and Oxidation (UV-OX), Ion Exchange, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #6: Horizontal Well Extraction, UV-OX, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #7: Horizontal Well Extraction, Ion Exchange, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #8: Horizontal Well Extraction, Activated Carbon, Discharge to Irrigation and/or Storm Drain
- Alternative #9: Vertical Well Extraction, Bioslurping, Recovered Product Recycling, Off Gas Catalytic Oxidation

These alternatives are summarized in the following sections. For the PP and IROD, the Air Force consolidated Alternatives #3 through #9 into a new Alternative 3, since the FS found that these active treatment alternatives had similar costs and effectiveness ratings.

4.1.1 No Action

This alternative (Alternative 1 in the FS) leaves the site as it is. No action is used as a baseline option for all sites. Under this alternative, the base would undertake no activity toward cleanup or risk mitigation. CERCLA guidance requires that the No Action alternative always be considered as a baseline alternative in an FS.

4.1.2 Natural Attenuation/Monitoring (Institutional Actions)

This alternative (Alternative 2 in the FS, where it was called "Institutional Actions") uses institutional controls to restrict access to groundwater and allows contaminant concentrations to naturally attenuate. This option includes monitoring to evaluate the effect of natural attenuation on contaminants in groundwater. The Air Force would perform monitoring to confirm the stability of impacted groundwater and to provide an early warning if contaminants threatened receptors, such as agricultural wells or ecological receptors. Monitoring would also track the decline in concentrations resulting from natural attenuation processes.

4.1.3 Extraction, Treatment, and Discharge

Alternatives 3 through 9 in the FS all used extraction with different types of treatment; therefore, the Air Force subsequently consolidated them into Alternative 3 for the PP and the Groundwater IROD. Alternative 3 addresses contaminated plumes by extracting contaminated groundwater and then treating to comply with regulations for discharge of water.

The Air Force evaluated five groundwater treatment options in the FS. The five treatment options were: air stripping; catalytic oxidation (catox); UV-OX; ion exchange; and activated carbon. The Air Force combined these five treatment options into 7 different treatment trains as described in the NEWIOU FS. Extraction, treatment, and discharge processes are summarized below. A more detailed description of these processes is provided in Section 5.2.2 of the Groundwater IROD.

4.1.3.1 Extraction

Extraction processes include both horizontal and vertical extraction wells. Bioslurping, two-phase, dual phase or soil vapor extraction systems to remove soil gas, floating petroleum product and/or groundwater are methods to enhance extraction and were also included.

4.1.3.2 Treatment

The five general or representative treatment processes covered in the NEWIOU FS are summarized below.

Air Stripping – Air stripping utilizes the volatility of many common organic contaminants to remove them from the contaminated water and transfer them to the gaseous phase. Contaminated water is introduced to the top of the tower while air is blown upwards through the tower. The agitation provided by the air and plates or synthetic media within the column break up the water into small droplets, providing a large water surface-to-air interface for organics to volatilize into the air phase. Treated water exits the bottom of the tower while air carrying the organic contaminants exits the top of the tower.

Catalytic Oxidation – Catalytic oxidation processes use a catalyst, which is a material that accelerates a chemical reaction but is not itself consumed in the reaction, to oxidize

contaminants. This technology would be used to treat contaminants in process offgas streams, e.g., from air stripping processes.

Activated Carbon – Activated carbon can be used to treat groundwater for removal of VOCs; the carbon is replaced or regenerated once the adsorbent is saturated. Activated carbon can also be used to treat VOCs in the vapor phase effluent from a treatment process.

Ion Exchange – Ion exchange systems are used for metals removal. Ion exchange systems use polymeric resins (or inorganic media) to sorb specific suites of metals from the water. Metal hydroxide precipitation is used following a pH adjustment step.

Ultraviolet Radiation and Oxidation (UV-OX) – UV-OX is a liquid phase process and requires chemical reagents, such as hydrogen peroxide, promoted with UV light to destroy VOCs. This process option differs from an air stripper because there is no generation (and required subsequent treatment) of an offgas stream.

4.1.3.3 Discharge

The FS assumed treated groundwater would be discharged to Travis AFB's non-potable water irrigation system or directly discharged on-base to surface water meeting NPDES limits, such as Union Creek and the storm drain system. These options are performed for the ongoing groundwater removal actions.

4.2 Summary of Comparative Analysis of Alternatives

This section summarizes how the Air Force and regulatory agencies evaluated the three alternatives (Alternative 1 - No Action, Alternative 2 - Natural Attenuation/Monitoring, and Alternative 3 - Extraction, Treatment, and Discharge) against EPA's nine criteria in the FS. The Air Force and regulatory agencies divided these criteria into three classes: threshold criteria,

balancing criteria, and modifying criteria. The following sections discuss each of these types of criteria, and how the alternatives were compared. Figure 4-1 defines the evaluation criteria, while Table 4-1 compares the alternatives to the threshold and balancing criteria.

4.2.1 Threshold Criteria

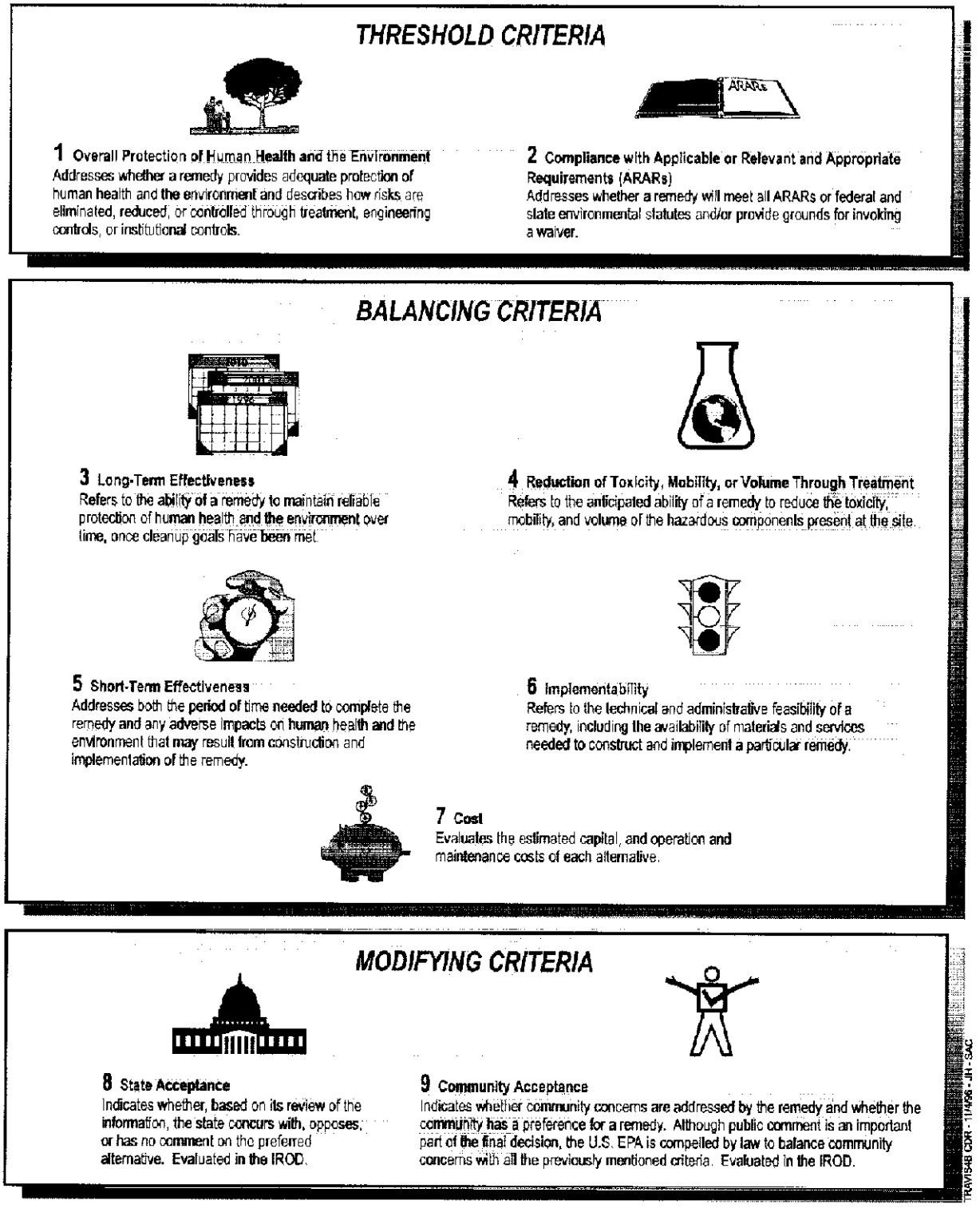
4.2.1.1 Overall Protection of Human Health and the Environment

Alternative 3 (Extraction, Treatment, and Discharge) would provide the greatest protection of human health and the environment since the contaminants would be removed by extraction. Alternative 2 (Natural Attenuation/Monitoring) would be protective of human health and the environment if natural attenuation is taking place and there is no pathway to receptors such as using groundwater for drinking water. Alternative 1 (No Action) would not be protective because people and the environment could be exposed, or potentially exposed, to groundwater. Without monitoring, the Air Force and regulatory agencies could not assess natural attenuation of the groundwater and the subsequent rate of risk reduction.

4.2.1.2 Compliance with ARARs

The Air Force would achieve compliance with ARARs for Alternative 3. Although the Air Force and regulatory agencies have not established final cleanup levels for groundwater at Travis AFB, the interim actions using Alternative 3 will reduce contamination and potential risk. In addition, the Air Force and regulatory agencies will use the data obtained to allow for selection of final cleanup levels and technically and economically feasible long-term remedial actions.

If natural attenuation is taking place and the plume is stable or decreasing in size at the sites where the Air Force implements this alternative, then Alternative 2 may meet ARARs.



Alternative 1: No Action
Alternative 2: Natural Attenuation and Monitoring
Alternative 3: Extraction, Treatment, and Disposal for Off-Base Remediation, Source Control, and Migration Control

Figure 4-2. The Nine CERCLA Criteria

Table 4-1

Comparison of Alternatives Versus the CERCLA Threshold and Balancing Evaluation Criteria

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 6	Criterion 7
Alternative	**Overall Protection of Human Health and the Environment**	**Compliance with Laws and Regulations (ARARs)**	**Long-term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, and Volume through Treatment**	**Short-term Effectiveness**	**Implementability**
No Action (Alternative 1)	Does not protect human health or the environment	Does not comply with ARARs	No long-term effectiveness	No reduction from action	No short-term effectiveness	Easily implemented; no equipment needed
Natural Attenuation/ Monitoring (Alternative 2)	Provides some protection of human health and the environment	May meet ARARs in long term	Will have long-term effectiveness from natural attenuation	No reduction from active treatment	No short-term effectiveness	Is implementable; minor equipment needed
Extraction, Treatment, and Discharge (Alternative 3) (Treatment Alternatives 3-9 in the FS)	Protects human health and environment in the long term	Will meet ARARs in the long term (sooner than Alternative 2)	Most effective at removing contamination	Will reduce contaminant volume and mobility	Short-term effectiveness depends on removal rate	Technology is implementable but does require effort to maintain system and will have some effect on base operations

Note: Criterion 5 (costs) are shown in Table 4-2.

Alternative 1 (No Action) will not comply with ARARs for groundwater, and without monitoring there would be no way to determine when or if groundwater cleanup levels had been achieved. Affected groundwater would have the potential to discharge to Union Creek.

4.2.2 Primary Balancing Criteria

4.2.2.1 Long-Term Effectiveness and Permanence

Alternative 3 would be the most effective at removing contamination from the groundwater. Alternative 2 may be effective if natural attenuation is taking place at the selected sites. Alternative 1 would be the least effective in the long-term since no steps are taken to reduce risks, or monitor the reduction in risks.

4.2.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

Only Alternative 3 would incorporate active treatment, and therefore it would reduce the contaminant volume, and to some degree, contaminant mobility through hydraulic containment. Alternative 1 would not reduce contaminant toxicity, mobility, and volume since it does not include active treatment. Alternative 2 may reduce contaminant toxicity, mobility, and volume although at a slower rate than Alternative 3.

4.2.2.3 Short-Term Effectiveness

Alternative 3 would remove contaminated groundwater, control the further spread of groundwater contamination and would be the most effective alternative in the short-term.

Alternative 2 is not as effective in the short-term. This alternative is expected to take longer than Alternative 3 to reach cleanup levels since it does not actively extract or treat

groundwater. Alternative 1 would be the least effective in the short-term since no steps are taken to reduce risks, or monitor the reduction in risks.

4.2.2.4 Implementability

Alternative 1 would be easily implemented since no actions would be involved. Alternative 2 would be implementable, and only minor additional equipment or monitoring wells would be required. Alternative 3 would use available technology such as treatment equipment and wells, but it would take time to design and install all of the required equipment. Because Travis AFB is an active military Air Force installation, the installation and operation of this equipment must be coordinated with base operations.

4.2.2.5 Cost

The Air Force estimated order-of-magnitude costs in the FS for each alternative applicable for each site. The Air Force considered both capital costs and operation and maintenance (O&M) costs. The Air Force estimated costs to be accurate to -30% to +50%, per U.S. EPA CERCLA Guidance. The Air Force assumed a 5% discount rate, including the effects of inflation, for present worth analysis, again based on the CERCLA Guidance. The Air Force estimated costs only for the purposes of comparing alternatives according to the CERCLA Guidance. Actual remediation costs could vary significantly from those in the FS and will be determined in the remedial design phase. The Air Force calculated capital costs for each alternative as separate components and then assembled as appropriate for each remedial alternative. Component construction costs were calculated using the RACER/ENVEST™ cost estimating model (version 3.1) (U.S. Air Force, 1993). The RACER/ENVEST™ model was developed by the U.S. Air Force specifically for estimating costs of remediation approaches for CERCLA documents, including FSs.

Table 4-2 shows the relative costs in thousands of dollars estimated in the FS of each alternative as applied to the 15 different IRP sites within the NEWIOU (costs were calculated separately for LF007B, LF007C, and LF007D). The treatment alternative with the lowest cost is presented in Table 4-2. The cost presented for all alternatives is the capital cost plus the first year of operating and/or monitoring. The cost of the different treatment technology trains depends on the type, volume, and concentrations of the contaminated groundwater. The Air Force will determine the actual costs for the selected alternative(s) during the remedial design stage following signing of the IROD. Because all treatment processes are effective at removing contaminants, the initial treatment processes used will depend on costs, which will, in turn, depend on the volume and contaminant concentration of the extracted groundwater. The Air Force would select the treatment plant locations during the remedial design stage. As concentrations and volumes change with time, the Air Force could implement different treatment processes if they are more cost-effective.

Alternative 1 has no cost. Alternative 2 has a low cost since it relies on labor and analytical costs, and requires little additional equipment. The Air Force and regulatory agencies assumed natural attenuation and monitoring costs to be constant at each site: three new monitoring wells and analytical costs were assumed for four quarters. The Air Force will develop the number and layout of monitoring wells and associated monitoring costs as part of the site-specific RD. The costs shown for Alternative 3 are the lowest costs for the various treatment alternatives evaluated in the FS. Alternative 3 costs more than Alternative 2 due to the capital equipment required, and the comparatively high operation and maintenance costs.

4.2.3 Modifying Criteria

4.2.3.1 State Acceptance

State acceptance was not evaluated in the FS. Refer to Section 5.3.6 of the Groundwater IROD for state acceptance discussion.

Table 4-2

Summary of Comparative Costs (thousands of dollars)

Site	Alternative 1 No Action	Alternative 2 Natural Attenuation/ Monitoring[1]	Alternative 3 Extraction, Treatment, and Discharge[2]		
			Capital Cost	First Year O&M	Total
FT004	0	90	915	280	1,200
FT005	0	90	1,800	260	2,100
LF006	0	90	640	61	700
LF007B	0	90	550	72	620
LF007C	0	90	450	58	510
LF007D	0	90	1,800	224	2,000
SS015	0	90	750	120	870
SS016	0	90	2,880[3]	274[3]	3,200[3]
SS029	0	90	1,600	170	1,800
SS030	0	90	490	78	570
SD031	0	90	620	128	750
ST032	0	90	2,000	280	2,300
SD033	0	90	2,300	140	2,400
SD034	0	90	380	79	460
SS035	0	90	190	100	290
SD036	0	90	795	110	910
SD037	0	90	2,600	210	2,800

[1] Natural attenuation/monitoring costs assumed to be the same for each site. The $90,000 estimates include $18,000 in capital costs to install monitoring wells and $72,000 in operational costs for the first year, mainly for sample analysis.

[2] Costs for the Extraction alternative include the capital cost to build the system and one year of operating the system. All costs in thousands of dollars. Costs were developed for NEWIOU FS and assume individual treatment plants for each site. The lowest cost estimate for all the treatment alternatives evaluated in the FS is shown.

[3] These costs are for Oil Spill Area portion of SS016, and do not include the "Remainder of Plume" costs which were calculated separately in the FS.

4.2.3.2 Community Acceptance

Community acceptance was not evaluated in the FS. Refer to Section 5.3.6 of the Groundwater IROD for community acceptance discussion.

4.2.4 Comparative Analysis

The FS presented quantitative, comparative analyses for the groundwater sites. The Air Force and regulatory agencies factored the results of a sensitivity analysis into these conclusions. The benefit/cost ratio and total effectiveness score were indicated for each representative alternative for each group of groundwater sites.

The Air Force and regulatory agencies used a relative numerical rating system to measure the degree to which an alternative fulfills each evaluation criterion. Subjective factors and numerical values in a rating system evaluate how completely an alternative meets the evaluation criteria (Table 4-3). The Air Force rated all criteria, with the exception of cost, with a three number system of 5, 3, or 0. The cost criterion includes a four number system including 5, 3, 1, and -1. The addition of a fourth score for the cost criterion is included to provide for a wider range of cost scores. These values are not absolute and served as a subjective ranking method for the purpose of performing the comparative analysis. This rating system assumed that each of the CERCLA criteria were equally important, since each are numerically weighted the same. This may not always be representative in that certain criteria can have more importance, depending on site-specific circumstances. For example, threshold factors must be achieved and therefore might be seen as more important than a balancing factor, such as implementability. Despite these factors, this unbiased scoring system was selected in the FS as the best method to consistently evaluate all alternatives.

Table 4-3

Remedial Alternative Evaluation Criteria Rating System

Evaluation Criterion	Condition	Value
Protective of human health and the environment	Is protective	5
	Potentially or contingent protection	3
	Is not protective	0
Compliance with appropriate ARARs	Complies with appropriate ARARs	5
	Complies with most appropriate ARARs or waivers needed	3
	Does not comply	0
Long-term effectiveness and permanence	Once cleanup is completed, there is no recurrence potential	5
	Contaminants transferred, future re-release possible	3
	Contaminants not removed or destroyed	0
Reduction in toxicity, mobility, and volume through treatment	Eliminates toxicity, mobility, and volume	5
	Reduces toxicity, mobility, and volume	3
	No reduction or no treatment	0
Short-term effectiveness	Short-term environmental improvement protects human health and the environment. No risks (or only insignificant risks) created by implementation	5
	Limited short-term improvement in environment. Minor risks created by implementation of alternative	3
	No short-term improvement in environment. Significant risks created by implementation	0
Implementability	Alternative proven, all materials and personnel available, permitting available or in place, little effect on operations	5
	Alternative requires significant space, raises some action-specific ARAR compliance issues, has some effect on operations	3
	Uncertain permitting, major impact on operations	0
Cost	<$1.5 million	5
	$1.5 to 5 million	3
	$5 to 10 million	1
	>$10 million	-1
State acceptance*	To be determined (in the IROD)	NA
Community acceptance*	To be determined (in the IROD)	NA

* These final two criteria are typically evaluated following comment on the RI/FS report and the Proposed Plan; and, therefore, were not scored in the FS.

ARARs = Applicable or Relevant and Appropriate Requirements
IROD = Interim Record of Decision
NA = Not Applicable

For the comparative analysis, two methods of quantitatively totaling the scores are presented. The "Total Score" sums the seven criterion scores (i.e., all criteria except for the two modifying considerations). A higher score indicates that more of the criteria were met. The "Benefit/Cost Ratio" sums the scores of the five effectiveness criteria and divides by the estimated cost, in millions of dollars. While the total score measures overall compliance with the CERCLA criteria, the benefit/cost ratio better quantifies the degree to which CERCLA criteria are satisfied per unit cost.

4.2.4.1 Total Score

The active treatment alternatives consistently had the highest total scores for all the groundwater sites, with the differences in total scores between the different technologies not being significant. The natural attenuation/monitoring alternative scored lower that the treatment alternatives, but greater than the no action alternative.

4.2.4.2 Benefit/Cost Ratio

The benefit/cost ratios were more variable among alternatives. The natural attenuation/monitoring alternative in some cases scored higher than the treatment alternatives, and lower in other cases. The benefit/cost ratios were more favorable for Alternative 2 than the treatment alternatives because the lower cost of natural attenuation/monitoring was a greater factor in computing the benefit/cost ratio than in computing total cost.

4.2.4.3 Conclusion

The FS concluded that the active treatment alternatives, Alternatives #3 through #9, have similar total scores and benefit/cost ratios, which is why these alternatives were later consolidated into Alternative 3 in the PP and IROD. The natural attenuation/monitoring alternative had lower total scores than the active treatment alternatives but often had higher

benefit/cost ratios because benefit is provided at a much lower cost. However, the benefit (i.e., remediation) is often slower than with extraction and treatment.

The FS did not recommend implementation of specific alternatives for each site. The FS provides information on the pros and cons of each alternative and site-specific factors to consider when selecting site alternatives. The FS evaluated and compared the complete implementation of each single alternative at each site, to provide maximum information to be later used in selecting alternatives, or combinations of alternatives, at each site. The PP/IROD process then performed a site-by-site analysis to develop selected alternatives.

FS Alternatives 3 through 9 were all found to be equally protective and effective for remediating contaminated groundwater depending on the type and concentration of contaminant (i.e., petroleum products, VOCs, metals). Therefore, the Air Force has decided to determine the most appropriate method of extraction treatment and discharge during the RD. This is discussed further in Section 5.0 (Alternative 3).

Section Tab

5

5.0 INTERIM REMEDIAL ACTIONS

Travis Air Force Base (AFB) has selected interim remedial actions for the North/East/West Industrial Operable Unit (NEWIOU) sites with groundwater contamination. Section 5.1 presents the selected interim remedial actions and the rationale for the actions; Section 5.2 describes the selected alternatives; and Section 5.3 presents the statutory determinations.

5.1 Selected Interim Remedial Actions

The Air Force has developed interim remedial objectives for this Interim Record of Decision (IROD) as shown on Table 5-1. A later, final ROD will include the final cleanup goals; therefore, the Air Force has developed interim remediation goals (IRGs) to evaluate the performance of implemented remedial alternatives during the five-year interim period. These IRGs are similar to final cleanup levels but are not enforceable goals. The IRGs are shown on Table 5-2.

Figure 5-1 shows the selected interim remedial actions for the NEWIOU groundwater IROD. Table 5-3 shows these same interim remedial actions in table format. Table 5-3 lists the 15 NEWIOU Installation Restoration Program (IRP) sites with groundwater contamination. The table includes site summary figure numbers and site names for reference. A checkmark indicates the selected interim action for each site. If Alternative 3 (Extraction, Treatment, and Discharge) is the selected interim action, the objective of the extraction is source control, migration control, off-base remediation, or a combination of these.

Each of the selected remedies will protect human health and the environment, and comply with ARARs. They will be effective at reducing contamination, and are implementable, cost-effective, and acceptable to the public and the State of California.

Table 5-1

Interim Remedial Action Objectives for NEWIOU Groundwater IROD

Interim Remedial Action Objectives
1. Utilize an IROD, as opposed to a final ROD, to begin to quickly remediate groundwater contamination to reduce contamination and risk, while collecting information necessary to allow for selection of final cleanup levels and technically and economically feasible long-term actions.
2. Comply with NEWIOU ARARs.
3. Coordinate remedial actions with ongoing interim removal actions, e.g., the Tower Area Removal Action (TARA) in SS016.
4. Consolidate sites whenever possible to cost-effectively treat groundwater, e.g., at FT005, SS029, and SS030.
5. Use treated groundwater on base whenever possible (i.e., for industrial or irrigation use) or discharge to the sanitary sewer, if feasible.
6. Ensure any discharge of treated water to Union Creek meets substantive National Pollutant Discharge Elimination System (NPDES) requirements.
7. Consider use of existing groundwater treatment plants, e.g., SS016, Outfall III treatment system.
8. Meet all Federal Facilities Agreement (FFA) dates.
9. Do not impact Travis AFB's mission.

Table 5-2

Interim Remediation Goals for NEWIOU Groundwater IROD

Chemical	IRG Concentration (mg/L)	Applicable Sites
Benzene	1.0×10^{-3} (1)	LF007, SS016, SS029, SD031, ST032*, SD034*, SD036, SD037
Bis(2-ethylhexyl)phthalate	4.0×10^{-3} (1)	FT004, FT005, LF007, SS015, SS016, ST032, SD034, SD037
Carbon Tetrachloride	5.0×10^{-4} (1)	SD031, SD037
Chlorobenzene	7.0×10^{-2} (1)	LF007
Chloroform	1.0×10^{-1} (1), (2)	FT004, FT005, SS016, SS029, SS030, SD031
Chloromethane	1.50×10^{-3} (5)	SD037
1,4-Dichlorobenzene	5.0×10^{-3} (1)	LF007, SS015, SS016
Dichlorobromomethane	1.0×10^{-1} (1), (2)	FT004, FT005, SS016, SS030, SD036, SD037
1,2-Dichloroethane	5.0×10^{-4} (1)	FT004, FT005, LF007, SS015, SS016, SS029, SS030, SD031, SD033, SD036, SD037
1,1-Dichloroethene	6.0×10^{-3} (1)	FT004, LF006, LF007, SS016, SS029, SD031, ST032, SD033, SD034, SD036, SD037
cis-1,2-Dichloroethene	6.0×10^{-3} (1)	FT004, FT005, SS015, SS016, SS029, SD031, SD033, SD034, SD036, SD037
1,2-Dichloropropane	5.0×10^{-3} (1), (2)	LF007
Napthalene	2.0×10^{-2} (4)	SD037
Nickel	1.0×10^{-1} (1)	FT004, FT005, SS015, SS016, SS030, SD031
PCBs	5.0×10^{-4} (1), (2)	LF007
2,3,7,8-Tetrachlorodibenzo-p-dioxin	3.0×10^{-8} (1), (2)	LF007
Tetrachloroethene	5.0×10^{-3} (1), (2)	SS015, SS016, SD034, SD036, SD037
TPH as Diesel	1.0×10^{-1} (3)	LF006, SD033, SD034*, SS035, SD036, SD037
TPH as Gasoline	5.0×10^{-3} (3)	SD033, SD034, SD036, SD037
Trichloroethene	5.0×10^{-3} (1), (2)	FT004, FT005, LF006, LF007, SS015, SS016, SS029, SS030, SD031, ST032, SD033, SD034, SS035, SD036, SD037
Vinyl Chloride	5.0×10^{-4} (1)	FT004, LF007, SS015, SS016, SS029, SD031, SD034, SD036, SD037
Xylenes	2.0×10^{-2} (3)	ST032

IRG = Interim Remediation Goal
mg/L = milligrams per liter
NE = Not Established
PCBs = Polychlorinated Biphenyls
TPH = total petroleum hydrocarbon

* Light Non-Aqueous Phase Liquid (LNAPL) or floating petroleum product has been detected at Sites ST032 and SD034.

IRGs are derived from the following:
(1) Drinking Water Standards - Maximum Contaminant Levels (MCL), California Department of Health Services, Primary MCL.
(2) Drinking Water Standards - MCLs, U.S. Environmental Protection Agency (U.S. EPA), Primary MCL.
(3) Other Taste and Odor Thresholds.
(4) Health Advisories or Suggested No-Adverse-Response Levels for toxicity other than cancer risk, U.S. EPA.
(5) Preliminary Remedial Goals, U.S. EPA.

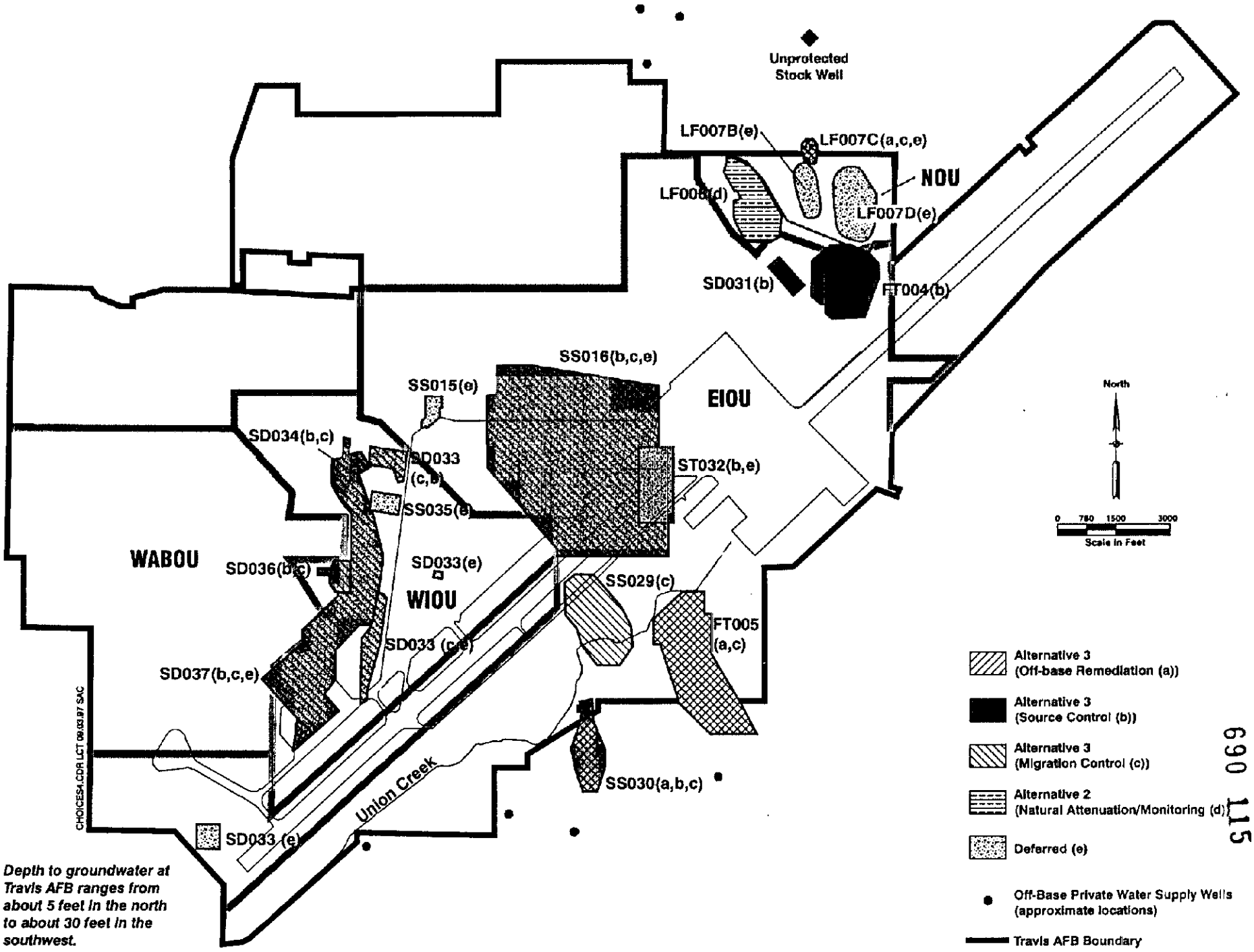


Figure 5-1. Selected Alternatives for NEWIOU IRP Sites with Groundwater Contamination

Table 5-3

Selected Interim Remedial Actions for NEWIOU IRP Sites with Groundwater Contamination

Associated Figure	IRP Site	Site Name	Selected Interim Actions			
			Alternative 2 Natural Attenuation/ Monitoring	Alternative 3 Extraction, Treatment, and Discharge		
				Source Control	Migration Control	Off-base Remediation
North Operable Unit						
Figure A-3	LF006	Landfill 1	X			
Figure A-4	LF007B†	Landfill 2, Area B	*			
Figure A-5	LF007C†	Landfill 2, Area C	* (on-base portion of plume)		X (at base boundary)	X (off-base portion of plume)
Figure A-6	LF007D†	Landfill 2, Area D	*			
East Industrial Operable Unit						
Figure A-1	FT004	Fire Training Area 3		X		
Figure A-2	FT005	Fire Training Area 4			X	X
Figure A-7	SS015	Solvent Spill Area and Facilities 550 and 552	*			
Figure A-8	SS016	Oil Spill Area (OSA) and Facilities 11, 13/14, 18, 20, 42/1941, 139/144, and selected sections of storm sewer right of way	*	X (OSA Area)	X (southern plume)	
Figure A-9	SS029	Monitoring Well 329 Area			X	
Figure A-10	SS030	Monitoring Well 269 Area		X	X	X
Figure A-11	SD031	Facility 1205		X		
Figure A-12	ST032	Monitoring Wells 107 and 246 Areas	* (Plume A)	X (bioslurp/free product removal for Plume B)		

† As part of the RI and subsequently the FS, risks and remediation costs associated with contaminated groundwater were calculated for three areas in LF007; LF007B, LF007C, and LF007D.

* Selection of alternative for all or part of site is deferred until completion of the basewide natural attenuation assessment plan. Selected alternative will be documented in the basewide groundwater ROD.

Table 5-3

(Continued)

Associated Figure	IRP Site	Site Name	Selected Interim Actions			
			Alternative 2 Natural Attenuation/ Monitoring	Alternative 3 Extraction, Treatment, and Discharge		
				Source Control	Migration Control	Off-base Remediation
West Industrial Operable Unit						
Figure A-13	SD033	Storm Sewer II, Facilities 810 and 1917, South Gate Area, and West Branch of Union Creek	* (South Gate Area, Facility 1917, and Facility 810 plumes)		X (Storm Sewer)	
Figure A-14	SD034	Facility 811		X (bioslurp/free product removal)	X (coordinated with SD037)	
Figure A-15	SS035	Facility 818/819	*			
Figure A-16	SD036	Facility 872/873/876	(complete AFCEE Natural Attenuation Study)	X (depending on results of AFCEE Natural Attenuation Study)	X (depending on results of AFCEE Natural Attenuation Study)	
Figure A-17	SD037	Sanitary Sewer System, Facilities 837, 838, 919, 977, 981, Area G Ramp, and Ragsdale/V Area	* (portions of plume near Facilities 919, 977, 981, and Area G Ramp)	X (portions of plume near Facilities 837, 838, and Ragsdale/V Area)	X (remainder of plume)	

* Selection of alternative for all or part of site is deferred until completion of the basewide natural attenuation assessment plan. Selected alternative will be documented in the basewide groundwater ROD.

5.1.1 Justification for Selected Interim Remedial Actions

The Air Force based the selection of interim remedial actions on the results of the RI/FS process, as well as on previous removal actions, treatability studies, and pilot studies conducted at Travis AFB. As discussed in Section 4.3.4.3, the FS provides the information to select an alternative for each site but does not specify each selected alternative. The PP/IROD process used the FS evaluation of each alternative at each site to select the interim remedial action, or combination of actions, appropriate to each site. This selection process also considered the interim nature of remedial actions under an IROD, as opposed to final actions under a ROD. Appendix A presents additional detail on the rationale for selection of remedial actions at each site. The Air Force eliminated the no action alternative because it does not adequately meet the nine CERCLA criteria.

Alternative 3, Extraction, Treatment, and Discharge, will be used at specified sites to reduce concentrations of groundwater contaminants and to remove floating petroleum product. The goal is to attempt to achieve IRGs, but the Air Force will, at a minimum, continue the action as necessary to prevent migration of the plume and will evaluate the level of cleanup that is economically and technically achievable using Alternative 3. Alternative 3, is the selected interim remedial action for sites where at least one of the following cases exists:

1. **Off-base Remediation** – Where dissolved VOC contamination extends off-base.

2. **Source Control** – Where floating petroleum product or secondary sources of VOC contamination (dense nonaqueous phase liquids [DNAPLs]) exist.

3. **Migration Control** – Where migration of contaminated groundwater is confirmed.

For sites where none of the above criteria apply, the Air Force considered **Alternative 2**, Natural Attenuation/Monitoring, as a possible interim action. Some portions of

groundwater plumes have low concentrations of contaminants; therefore, the contaminant plume may be stable due to natural processes, but additional characterization is needed to make a determination. In addition, some plumes have mixtures of VOCs and petroleum contamination, which can facilitate the natural degradation of chlorinated solvents. Also, some plumes contain breakdown products of TCE which may indicate that biodegradation is occurring. Although conditions at the sites indicate the potential for natural attenuation, confirmation that the process is taking place requires additional data and evaluation. Therefore, the interim remedial decision for these sites is:

1. Select **Alternative 2**, Natural Attenuation, as the interim remedial alternative for one representative site (LF006) to initiate a site-specific natural attenuation evaluation because of evidence indicating that natural attenuation is occurring.

2. Defer the selection of an alternative for the remaining sites, or portions of sites, until the Air Force obtains and evaluates additional data.

3. Initiate a basewide natural attenuation assessment plan to obtain the data for a natural attenuation evaluation for the remaining sites, or portions of sites. The evaluation at LF006 will develop Travis AFB's approach for this basewide assessment plan.

The Remedial Action/Remedial Design (RD/RA) Work Plan for LF006 will address placement of monitoring wells, protocols for monitoring, and evaluation procedures for determining if the contaminated plume is stable (no significant migration above water quality objectives). If natural attenuation is found to be inadequate to stabilize the plume, the Air Force will implement a contingency action such as Alternative 3. The work plan will indicate a "trigger point" based on methods such as modeling and statistical analysis that will indicate the need for contingency action. The agencies will review and approve the work plan. If a contingency action is necessary, the Air Force will not wait until the end of the five-year interim period. The Air Force will request funding and implement the contingency action as soon as funding becomes available.

Information obtained during the five-year interim period will be used to determine whether natural attenuation and/or containment is the most technologically and economically feasible final remedy. The Air Force will not allow horizontal or vertical migration of contaminants along preferential pathways or within the aquifer at the natural attenuation sites during the five-year period.

Travis AFB will proceed with interim remedial actions to begin quickly to remediate groundwater contamination to reduce contamination and risk, while collecting information necessary to allow for the selection of final cleanup levels and technically and economically feasible long-term remedial actions in the final ROD.

5.1.2 Institutional Actions

The Air Force will use institutional actions for groundwater together with Alternatives 2 and 3 at all groundwater sites within the NEWIOU. The Air Force will place administrative controls on the use of on-base groundwater from contaminated areas. Groundwater is not currently used for drinking water at Travis AFB. The Air Force will place administrative controls also on areas with groundwater contamination, restricting excavation and subsurface work where the excavation worker will encounter groundwater or vapors emitted from the groundwater. Excavation and work will only commence after the Air Force implements environmental and worker safety control measures. Travis AFB already has a program to restrict contractors and base personnel from digging in contaminated areas. This program requires that a digging permit be obtained prior to any excavation activities. The Base Master Plan will cover any land use restrictions, after the IROD proceeds to a final ROD.

The Air Force will implement alternative water supplies if monitoring identifies a threat to off-base water supply wells. A contingency plan for alternative water supplies will be incorporated into the RD/RA for sites with off-base plumes as a separate document. Groundwater

from beneath Travis AFB is not used for on-base water supply; therefore, the Air Force needs no contingency plan for on-base water supply.

5.1.3 Groundwater Monitoring

Groundwater monitoring of all NEWIOU groundwater sites will continue during all interim remedial actions to document the effect of the interim actions. Data will be evaluated on a regular basis, with agency review, to determine the effectiveness of extraction remedies and to evaluate natural attenuation. At all groundwater sites, if data indicates the plume is not stable, the Air Force will initiate actions such as Alternative 3 to stabilize the plume. Appendix B contains recommendations to the Travis AFB groundwater monitoring program for developing data for all NEWIOU groundwater sites. The Air Force will consider these recommendations during the interim remedial design task, and will revise the existing groundwater monitoring plan accordingly. The GSAP annual report will be a primary document in accordance with the FFA. The RD/RA work plan for each site will include details for monitoring and evaluation based on site-specific conditions. Each work plan will address placement of monitoring wells, protocols and frequency for monitoring, and evaluation procedures to determine if significant migration is occurring. The agencies will review each of the site-specific RD/RA work plans, which are primary documents in accordance with the FFA.

5.2 Alternative Description

This subsection summarizes the selected interim remedial actions. Site-specific information on each alternative is provided in Appendix A.

5.2.1 Alternative 2 – Natural Attenuation/Monitoring

The Air Force has selected Alternative 2 (natural attenuation) for one site (LF006) because the results from the RI/FS indicate a high probability that natural attenuation is an

appropriate remedial alternative at this site. Additional characterization and field data will be collected to confirm that plume migration is stable and that natural attenuation is effective at LF006. The Air Force will implement Alternative 3 as a contingency action if natural attenuation is not effective and the plume is not stable at LF006. The Natural Attenuation Assessment Plan (NAAP) and the RD/RA Work Plan for LF006 will describe the specific details for implementation of Alternative 2 and LF006. As described in Section 5.1, the Air Force has deferred selection of the remedial alternative at other sites for entire plumes or portions of plumes.

The Air Force will develop a NAAP Work Plan which is a primary document in accordance with the FFA and will be submitted for approval to the regulatory agencies and will include a separate schedule for implementation. Appendix B further discusses Alternative 2 and elements of the NAAP.

The NAAP will be based on the AFCEE document "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater" (Wiedemeier, et al, 1996). The NAAP will describe the Air Force's approach for assessing natural attenuation at LF006, the deferred sites, deferred portions of plumes, and will incorporate information from the AFCEE pilot Study at SD036. The NAAP will describe how the Air Force will collect additional information during the five-year interim period to evaluate the potential for selecting Alternative 2 (natural attenuation) at the deferred sites and/or deferred portions of plumes.

The NAAP will include a schedule and a decision matrix that outlines the method to determine which sites and/or portions of plumes are appropriate for remediation by Alternative 2 (natural attenuation). In reference to the sites where a portion of the plume is Alternative 3 and a portion has the alternative selection deferred, the NAAP will clearly explain the methodology to determine where the Air Force will apply Alternative 2 and Alternative 3.

The Air Force will modify the existing Basewide Groundwater Monitoring Plan as soon as possible to include additional parameters, which will be useful in assessing the effectiveness of natural attenuation.

The NAAP will provide a method to determine the migration rates for groundwater contaminants at each site. The NAAP will establish a method to determine points of compliance, locations for compliance wells, and a "trigger action" that initiates implementation of an appropriate contingency action if natural attenuation is not effective at a site.

5.2.1.1 Definition of Natural Attenuation

"Natural Attenuation" refers to naturally-occurring processes in groundwater that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in those media. These in-situ processes include biodegradation, adsorption, volatilization, and chemical or biological stabilization or destruction of contaminants. This option includes monitoring to evaluate the affect of natural attenuation on contaminants in groundwater, and to evaluate changes or migration of contaminated groundwater.

Monitored natural attenuation can be a viable method of remediation at some sites for soil and groundwater. However, the Air Force will select natural attenuation only where it meets all relevant remedy selection criteria, where it fully protects human health and the environment, and where it meets remedial action objectives within a feasible time frame.

Monitored natural attenuation is not a "no action" or "walk away" option because the Air Force must conduct adequate site characterization, monitoring and analysis to determine its viability as a remedy. Once in place, the Air Force will perform continued monitoring to verify that contaminant levels are decreasing as anticipated, and the remedy is protecting human health and the environment.

Monitored natural attenuation does not have to be the only remedy component at a site and it is typically combined with other types of remedies (such as source control or soil vapor extraction), or used to complete remediation after other remedy components have cleaned up most of the contamination and are no longer efficiently reducing contaminant levels. At Travis AFB, the Air Force will assess each site to determine which plumes, or portions of plumes, the Air Force can address by natural attenuation.

Travis AFB will perform a site-specific natural attenuation evaluation at the selected natural attenuation site (LF006). The Air Force deferred the selected interim remedial alternative of remaining "non-Alternative-3" sites, because the Air Force needs additional data to make a proper selection of a remedial action. Therefore, Travis AFB will then perform a natural attenuation evaluation at each of these sites similar to the evaluation at LF006. The goals and contingencies of these evaluations will be the same as for the Alternative 2 (LF006) evaluation, and will apply the results of the LF006 evaluation.

Travis AFB is considering the purchase of off-base land adjacent to Site LF007C. Should the Air Force complete this purchase, then the selected interim remedial action for the off-base portion of the plume will change from Alternative 3 to deferred (and will be included in the basewide NAAP).

The Air Force will provide the monitoring data from all sites to the regulatory agencies and the Restoration Advisory Board (RAB) for their review and comment. At sites where the Air Force has assessed natural attenuation, the Air Force will also provide each site's data summary and assessment report for review and approval. A formal review at the end of the five-year interim period will address the acceptability of natural attenuation as a final cleanup action. After this five-year review, a Basewide Groundwater Proposed Plan will present the preferred final cleanup action (natural attenuation, pump and treat, or other) for each site. This Proposed Plan will have a minimum 30-day public comment period. Following the Proposed Plan, a Basewide Groundwater Record of Decision (ROD) will finalize the cleanup decision. The Air Force will

submit the Draft Basewide Groundwater ROD to the agencies and the RAB for review and comment. The regulatory agencies will review and approve the Draft Final Basewide Groundwater ROD.

5.2.2 Alternative 3 – Extraction, Treatment, and Discharge

This alternative (also referred to as "pump and treat") cleans or controls the contaminated plume by extracting contaminated groundwater. The Air Force will treat extracted groundwater to comply with discharge standards shown on Tables 6-7 and 6-8. The final ROD will include final cleanup goals in the final ROD; therefore, the Air Force has developed IRGs to evaluate the performance of implemented remedial alternatives during the five-year interim period. IRGs are shown in Table 5-2.

As part of Alternative 3, the Air Force will treat and discharge extracted groundwater. Extraction, treatment, and discharge processes that will be used for the interim remedial actions are described in the following sections.

5.2.2.1 Extraction Strategy and Technology

Extraction processes could include both horizontal and vertical extraction wells; Travis AFB presently uses both types of wells at the base. Vertical wells with skimmer pumps could also be used for floating product recovery. Bioslurping, two-phase, dual phase or soil vapor extraction systems to remove soil gas, free product and/or groundwater may also be used. The Air Force will assess specific site conditions, such as land use, plume size and concentration, hydrogeology, soil permeability, and distribution of the contamination to determine the most appropriate extraction technique. For example, most of Travis AFB has low permeability soils, which result in limited production rates for vertical wells. Past experience at Travis AFB has shown that high vacuum enhanced extraction can increase the production rate of such wells. For higher permeability soils, experience at Travis AFB has shown that horizontal wells can

effectively remove groundwater from a large area. The Air Force will select the method of extraction during the RD process.

5.2.2.2 Treatment Strategy and Technologies

One or more of the following treatment technologies will be implemented for treatment:

Air Stripping – Air stripping utilizes the volatility of many common organic contaminants to remove them from the contaminated water and transfer them to the gaseous phase. Air strippers may consist of towers with heights up to fifty feet, and with diameters from several inches to several feet. Contaminated water enters the top of the tower while air blows upwards through the tower. The agitation provided by the air and plates or synthetic media within the column break up the water into small droplets, providing a large water surface-to-air interface for organics to volatilize into the air phase. Treated water exits the bottom of the tower while air carrying the organic contaminants exits the top of the tower. Depending on concentration and local requirements, the contaminants in the air will usually require subsequent treatment, consisting of thermal or catalytic destruction or adsorption onto activated carbon, before discharge to the atmosphere.

Thermal and Catalytic Oxidation – Thermal and catalytic oxidation are two similar processes that are used to destroy contaminants in process offgas streams, such as the air stream from an air stripping tower or the effluent from a soil gas extraction blower. In a thermal oxidation process, the contaminant gas is heated in the presence of air to a high temperature sufficient to completely burn the contaminants and produce the combustion products of carbon dioxide, water, and hydrochloric acid. Hydrochloric acid is formed only if chlorine is present in the original contaminant. If a significant amount of hydrochloric acid is formed in this process, a scrubbing unit is added. Thermal oxidation systems are economically favored if the contaminated gas to be burned has a high fuel value, and the heat associated with burning the fuel can be recovered.

Catalytic oxidation processes occur at lower temperatures than thermal oxidation processes and can be economically favored if the gas to be treated has a low fuel value. A catalyst is a material that accelerates a chemical reaction but is not itself consumed in the reaction. A specially formulated catalyst may be required to operate in the presence of hydrochloric acid, which would form from the oxidation of compounds such as TCE.

The target contaminant groups for catalytic oxidation are volatile and semivolatile organic compounds (VOCs and SVOCs, respectively). For groundwater treatment, catalytic oxidation would be the secondary technology in the treatment train. A primary treatment technology (e.g., air stripping) would be required to transfer contaminants from the liquid phase to the vapor phase prior to secondary treatment.

Activated Carbon – Activated carbon can be used to treat contaminated groundwater for VOCs; the carbon is replaced or regenerated once the adsorbent is saturated. Activated carbon is currently in use at Travis AFB and is effective in meeting discharge requirements for streams with initial moderate VOC concentration (1,000 ppb). The target contaminant groups for liquid-phase carbon adsorption are halogenated and non-halogenated semivolatile organic compounds. The technology can be used, but may be less effective, in treating halogenated VOCs, fuel hydrocarbons, pesticides, and inorganics.

The following factors may limit the applicability and effectiveness of liquid-phase carbon adsorption:

- The solubility and concentration of the contaminants can impact process performance;
- Metals can foul the system;

- Costs are high if used as the primary treatment on waste streams with high contaminant concentration levels; and
- Type and pore size of the carbon, as well as the operating temperature, will impact the process performance.

Vapor phase carbon could also be used to adsorb VOCs from the air stream, and the carbon filter would eventually need replacement or regeneration. The adsorptive capacity of activated carbon significantly increases when it is used with vapor phase rather than with aqueous phase contaminants. Vapor phase carbon has been used to remove VOCs from soil vapor extraction (SVE) system effluent at Travis AFB.

Ion Exchange – The Air Force will use ion exchange systems or comparable technology for metals removal if warranted. Ion exchange systems would be installed upstream of the activated carbon and downstream of the air stripper. Specific polymeric resins (or inorganic media) can be used to sorb specific suites of metals. In addition, ion exchange affords some operating flexibility because regeneration of the resin can occur either on- or off-site.

Ultraviolet Radiation and Oxidation – Ultraviolet Radiation and Oxidation (UV-OX) is a liquid phase process and requires chemical reagents, such as hydrogen peroxide, promoted with UV light, to destroy VOCs. Relative to an integrated system with an air stripper and catalytic oxidizer, this method is equally effective and implementable, and the estimated costs are comparable. However, this process option differs from an air stripper because there is no generation (and required subsequent treatment) of an offgas stream. As with the air stripper/catalytic oxidation system, an ion exchange unit followed by activated carbon will be placed downstream of the UV-OX to provide for metals removal and final VOC treatment, respectively. The target contaminant groups for UV oxidation are halogenated VOCs and SVOCs, and pesticides. The technology can also be used, but may be less effective, in treating

non-halogenated VOCs and fuels. The following factors may limit the applicability and effectiveness of UV oxidation:

- The technology cannot be applied on all contaminants; and
- The presence of inorganics and naturally occurring soil organics (e.g., humic substances) can adversely affect system performance.

Treatment Technology Selection

The above treatment processes present a "toolbox" of treatment options to use at sites where the Air Force implements Alternative 3. The FS concluded that the treatment technologies were all effective for treating contaminated groundwater. Therefore, the Air Force will select the most appropriate method of extraction and/or treatment for each site selected during the RD.

The Groundwater NEWIOU RD/RA Work Plan will provide a description of the overall rationale for treatment of contaminated groundwater. The Groundwater NEWIOU RD/RA Work Plan will incorporate experience from ongoing removal actions and will include a decision matrix that describes the procedure and rationale for selecting the appropriate technologies at each site. There will be an opportunity for further public participation during the Remedial Design phase.

5.2.2.3 Discharge

All treated groundwater discharges will comply with the discharge requirements of this IROD as described in Section 6.0 and Tables 6-6, 6-7, and 6-8. Additional NPDES substantive requirements will be established for each new discharge based on information provided during the development of site-specific RD/RA work plans. This information will include, but is not limited to, descriptions of treatment units with schematic drawings and design criteria, operation and maintenance procedures, results of chemical analyses of untreated groundwater (influent) at each site, projected maximum concentrations, projected flow rates, and topographic maps

showing exact locations of proposed discharges. Based on a review of this information, NPDES substantive requirements for sampling, monitoring, and reporting will be established and specified in the final site-specific RD/RA work plan which is a primary document in accordance with the FFA.

The Groundwater NEWIOU RD/RA Work Plan will use the Treated Groundwater Use Plan to estimate irrigation needs. The Groundwater NEWIOU RD/RA Work Plan will include a decision matrix that outlines the rationale and method for treated groundwater discharge at Travis AFB.

The RD/RA process, which includes agency review, will evaluate the volumes of treated groundwater discharged to Union Creek to ensure there are no adverse effects on the creek. For treated groundwater that is beneficially used on-base, the Air Force will meet the effluent treatment limits of Table 6-8. Since discharge of treated groundwater to Union Creek will always be a contingency to irrigation discharge, treatment methods will always be available to ensure that treated groundwater from all sites can meet the discharge standards in Tables 6-7 and 6-8.

The additional treated groundwater that is produced after 1997 may be used for both landscape irrigation and for industrial uses (aircraft wash water and car wash water). As interim remedial actions are designed and implemented, the Air Force will use the Treated Groundwater Use Plan to plan for the specific use of the additional treated groundwater.

Groundwater extraction and treatment will take place in phases, which will gradually increase the amount of treated water available for use. By 1999, the Air Force may extract and treat approximately 413 gpm (0.59 mgd) from contaminated groundwater sites. (The Treated Groundwater Use Plan presents the assumptions used to derive this rate.)

The Air Force will treat the extracted groundwater until contaminants have been reduced to the discharge standards, as found in Tables 6-6, 6-7, and 6-8. Travis AFB may use the treated groundwater for three possible general use options:

- Landscape irrigation at Travis AFB;
- Industrial uses such as car or aircraft washing; and
- Dust control during construction activities.

Travis AFB will discharge treated groundwater it cannot use in these options to the sanitary sewer operated by the Fairfield-Suisun Sewer District, if feasible, or to surface water (Union Creek). The figures in Appendix A indicate potential locations of discharge of treated groundwater to Union Creek.

The options for using treated groundwater on base include irrigating the following locations: Squadron operations; KC-10 maintenance facility; Grass areas, greenbelts, and ballfields; and 200 Building Area. Potential industrial uses of the treated groundwater include aircraft wash racks, car wash, motor pool, and above ground equipment.

Travis AFB will use most of the reused treated groundwater for irrigating landscape. During the wet season, varying amounts of treated groundwater will be needed for irrigation, depending on the rainfall and on when the wet season begins and ends. Consequently, Travis AFB will discharge treated groundwater to the sanitary sewer, if feasible, or to Union Creek during months of heavy precipitation.

5.3 Statutory Determinations

This section discusses the applicability and compliance of the following statutory determinations:

- Protectiveness;
- Applicable or Relevant and Appropriate Requirements;
- Cost Effectiveness;
- Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies;
- Preference for Treatment as a Principle Element;
- State and Community Acceptance.

5.3.1 Protectiveness

These selected remedies are protective of human health and the environment in the short term, and the actions are intended to increase protection until the final Groundwater ROD is signed. Protection is achieved by:

- Remediating all off-site dissolved phase contamination to below the IRGs through groundwater extraction, treatment, and discharge;
- Removing areas of contamination with floating petroleum products or VOC concentrations greater than 3,000 µg/L using groundwater extraction, treatment, and discharge;
- Preventing migration of contaminated groundwater using groundwater extraction, treatment, and discharge; and
- Monitoring by the Air Force to confirm the stability of the plumes due to the beneficial effects of natural attenuation.

5.3.2 Applicable or Relevant and Appropriate Requirements

The selected remedies comply with state and federal ARARs for this interim action. Specific ARARs are included in Section 6.0.

5.3.3 Cost Effectiveness

The technologies selected in implementing Alternative 3 for extraction, treatment, and discharge of contaminated groundwater will be the most cost-effective technologies from the "toolbox" that can meet the RAOs and IRGs. The Air Force will determine these technologies during the RD process.

The lower cost Alternative 2, Natural Attenuation/Monitoring, will be the most cost-effective remedy at sites not requiring Alternative 3, if effective at stabilizing and/or reducing the contaminated groundwater.

5.3.4 Use of Permanent Solutions, Alternative Treatment, or Resource Recovery Technologies

The selected remedies utilize permanent solutions to the potential threats posed by groundwater contamination at each of the sites to the maximum extent practicable. Use of groundwater extraction, treatment, and discharge will control and remove contamination from the subsurface permanently. Source control will remove and control contamination from the highest concentration areas, while remediation of the dissolved off-base contamination will remove contamination from areas outside the long-term control of the base. Natural attenuation of dissolved chlorinated solvents is an innovative and alternative treatment technique that may help remediate contaminated groundwater at the lower risk sites, while allowing the Air Force to focus resources to achieve the maximum benefit at the lowest cost.

5.3.5 Preference for Treatment as a Principle Element

All of these remedies will effectively use passive or active treatment to address the principal potential threats posed by contaminated groundwater. The Air Force will utilize the

operation of the groundwater extraction, treatment, and discharge options to maximize removal of contamination from the groundwater to the extent practicable.

5.3.6 State and Community Acceptance

State Acceptance

The State of California (DTSC and SFBRWQCB) concurs with the Air Force and the U.S. EPA in the selection of Alternatives 2 and 3 as the interim actions for the IRP groundwater sites within the NEWIOU.

Community Acceptance

Based on the comments received during the public comment period, the public has no preference of alternatives. The public comments received and the Air Force response is provided in Part III (Responsiveness Summary).

5.4 RD/RA Implementation and Schedule

The Air Force will implement the RD/RA in accordance with this IROD. In accordance with the Travis AFB FFA, within twenty-one days of signing the IROD, the Air Force shall propose deadlines for completing the site-specific RD/RA work plans and RDs.

The RD/RA schedule will be included in the Groundwater NEWIOU RD/RA Work Plan and is based on the Travis AFB IRP Priority Model. This model is a planning tool used by Travis AFB to prioritize and schedule funding for IRP sites. Factors considered in this model include human health risk, off-base migration, ecological risk, public interest, natural attenuation, mass of contaminants, groundwater concentration, capital cost, project execution, and projected funding levels.

The Groundwater NEWIOU RD/RA Work Plan will address the following elements:

- RD/RA initiation and purpose;
- Travis AFB site prioritization and annual site work schedule;
- An extracted groundwater treatment technology decision matrix;
- A groundwater treatment and discharge decision matrix; and
- Five-year review to evaluate the effectiveness of the remedy (five-year review will be the basis for establishment of final cleanup levels, final ROD issuance, and eventual completion of site cleanup).

Travis AFB will also develop a NAAP as described in Section 5.2.1 to assess the effectiveness of natural attenuation and revise the groundwater monitoring plan to include additional parameters needed to assess the effectiveness of natural attenuation. The NAAP will establish long term groundwater monitoring requirements to assess the effectiveness of Alternative 2. The existing Basewide Groundwater Monitoring Plan will be modified as soon as possible to include additional parameters which will be useful in assessing the effectiveness of natural attenuation.

Sites where the Air Force has selected Alternative 3 for using off-base dissolved plume remediation will be given first priority, and design and installation of the groundwater extraction, treatment, and discharge facilities will commence as soon as funding allows.

There is potential for contaminated groundwater to migrate along storm sewer lines and other preferential pathways. The Air Force will implement Alternative 3 at some sites to control migration of contaminated groundwater along preferential pathways. At other sites where the Air Force has deferred the remedy selection until the final ROD, the Air Force will employ monitoring and a contingency plan to ensure that preferential migration does not occur. At all

sites with known or potential interface between the storm sewer and contaminated groundwater, the Air Force will investigate the interface during the RD. At locations where the Air Force has found the contaminated groundwater to be migrating to the storm sewer or creek, the Air Force will use an interim remedial action such as pump and treat to control migration. Where pump and treat is used, the Air Force will monitor the effectiveness of this action; if the Air force finds that the pump and treat action is not adequately controlling the migration, the Air Force will initiate a contingency action such as repair or lining of the storm sewer.

As allocated funds become available, the Air Force will incorporate into the NEWIOU groundwater remediation action the remaining sites where Alternative 3 has been selected for migration control and source control. At SD036 AFCEE is currently conducting a natural attenuation study. This study will evaluate the site using the AFCEE document "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater" (Wiedemeier, et. al., 1996). The Air Force will defer migration and source control interim actions selected for this site until results of the study are reviewed, estimated to be late 1998. Based on the results, the Air Force will implement or reevaluate the migration control and source control interim actions.

5.5 Documentation of Significant Changes

There have not been any significant changes to the selected remedies since the Air Force submitted the Proposed Plan for public comment on 25 September 1996.

Section Tab

6

6.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND PERFORMANCE STANDARDS

6.1 Overview

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), remedial actions designed to cleanup or abate contaminants in the groundwater, in surface waters, or in soils, must be designed, constructed, and operated to comply with all federal and more stringent state Applicable or Relevant and Appropriate Requirements (ARARs). ARARs include federal requirements under any federal environmental laws and state requirements under state environmental or facility-siting laws which are more stringent than federal requirements, and that have been identified by the State of California in a timely manner.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility-siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements include those that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, nevertheless address problems or situations sufficiently similar to those encountered at the CERCLA site to indicate their use is well-suited to the particular site. If a given requirement is both relevant and appropriate to a particular site, it constitutes a valid legal requirement for that site. A requirement must either be applicable or both relevant and appropriate to be an ARAR. If no ARAR addresses a particular situation, or if an ARAR is insufficient to protect human health or the environment, then non-promulgated standards, criteria, guidance, and to be considered (TBC) advisories are identified as additional performance standards in the Record of Decision (ROD).

In general, on-site actions need comply only with the substantive aspects of these requirements, not with corresponding administrative requirements (such as, but not limited to, permits, recordkeeping, and reporting).

All laws and statutes identified as ARARs for a particular site or action must be considered and applied during the design, construction, and operation of any remedial action at the particular site. ARARs are identified on a site-specific basis from data and information concerning that site. Data and information concerning the objectives of site remediation, specific actions that are being considered as remedies at that site, the hazardous substances located upon the site, the physical and geological characteristics of the site, and the potential human and ecological receptors at or near the site must be analyzed and considered in order to properly identify ARARs at a particular site. All federal and more stringent state requirements which address or impact any of these conditions must be included as site ARARs.

There are three categories of ARARs. Some ARARs establish numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. Development of these ARARs (often referred to as chemical-specific ARARs) involve the identification of contaminants at a site which pose a threat to human health or the environment and must be remediated. Chemical-specific ARARs determine acceptable concentrations of specific hazardous substances, pollutants, and contaminants in the environment and establish the levels to which the ground or surface water at the affected site must be cleaned or restored in order to protect human health and the environment. Chemical-specific ARARs also establish the levels at which certain actions must be taken while transporting, treating, or storing hazardous wastes recovered during remediation.

Other ARARs (referred to as location-specific ARARs) are designed to protect the unique characteristics of the site or other areas potentially affected by site activities during the design, construction, or operation of remedial activities. Location-specific ARARs place restrictions on the concentration of hazardous substances or the conduct of activities solely

because the site occurs in, or may affect, a special location. Some examples include the protection of wetlands and vernal pools; protection of endangered or threatened species and their habitats; and the protection of fish and game from unauthorized taking.

Still other ARARs (referred to as action-specific ARARs) are technologically or activity-based requirements or limitations on the particular remedial actions at the site. Some examples include prohibitions or restrictions against the discharge of chemicals or contaminants to the air, water, or soil and the proper transfer, treatment, or storage of chemicals and contaminants.

6.2 ARARs Identification, Development, and Evaluation

Methodology

As lead agency, the Department of the Air Force has performed each of the following actions consistent with CERCLA and the National Contingency Plan (NCP):

- Identified federal ARARs for each remedial action alternative addressed in the Feasibility Study (FS), taking into account site-specific information for the NEWIOU;
- Reviewed potential state ARARs identified by the state in order to determine whether each potential ARAR identified satisfied CERCLA and NCP criteria that must be met in order to constitute state ARARs;
- Evaluated and compared federal ARARs and their state counterparts in order to determine which state ARARs are more stringent or are in addition to the federal ARARs; and
- Reached a conclusion as to which federal and state ARARs were the most stringent and/or "controlling" ARARs for each alternative.

Solicitation, Identification, and Evaluation of State ARARs

The Department of the Air Force followed the procedures of the process set forth in 40 CFR Section 300.515 and the Federal Facilities Agreement (FFA) for remedial actions in seeking state assistance in identification of state ARARs.

The CERCLA, NCP, and FFA requirements for remedial actions provide that the lead federal agency request that the state identify chemical- and location-specific state ARARs upon completion of site characterization, and again request identification of all categories of state ARARs (chemical-, location-, and action-specific) upon completion of identification of remedial alternatives for detailed analysis. The lead agency requested chemical- and location-specific ARARs from the state agencies on 30 August 1995. Following submission of the Detailed Analysis of Alternatives (DAA), the lead agency requested identification of ARARs to include action-specific ARARs from the state agencies. The state responses included comments from:

- California Integrated Waste Management Board;
- Department of Toxic Substances Control Board;
- State Water Resources Control Board;
- California Regional Water Resources Control Board;
- Bay Area Air Quality Management District; and
- California Department of Fish and Game.

During the review and analysis of ARARs identified by the State, including the Regional Water Board, and following considerable discussion with the representatives from the various state agencies, many of the requirements identified by the state as potential ARARs were determined to be valid ARARs by the lead agency. Upon completion of the FS, some issues between the lead agency and the state concerning final groundwater cleanup levels had not yet

been resolved on the scope and/or applicability of several groundwater ARARs. These potential ARARs will impact the duration of cleanup activity.

6.3 Interim Record of Decision Concept

Pursuant to Section 121(d)(1) of CERCLA, remedial actions must attain a degree of cleanup which assures protection of human health and the environment. However, to expedite remedial action, it was agreed between the Air Force and the regulatory agencies that the use of an Interim Record of Decision (IROD) would be a prudent course of action. The IROD will allow the implementation of remedial actions and associated reductions of contamination during the period in which the establishment of final cleanup levels will be determined. The data obtained from the interim remedial actions will play an integral part in establishing the factual basis for establishing final cleanup levels. An evaluation of the interim actions will be made as part of the CERCLA "five year review." Data obtained will be reviewed to determine the effectiveness of the actions and changes in the actions will be made, if necessary. The additional information obtained from these interim remedial actions should expedite the development of a final ROD by providing documentation supportive of final cleanup levels that are protective, realistic, and achievable.

6.4 Determination of ARARs for the Interim Action

Methodology

The list of ARARs identified in the North, East, and West Industrial Operable Unit (NEWIOU) FS was used as a starting point for identifying groundwater ARARs. From that list, those requirements applicable or relevant and appropriate to groundwater remediation were identified for inclusion in the IROD, while those which had no relevancy to the interim groundwater remediation were excluded from consideration. Specifically excluded were statutory and regulatory provisions which:

1. Were applicable or relevant and appropriate only to soils remediation sites;

2. Were applicable or relevant and appropriate only to action alternatives not utilized in groundwater remediation actions;

3. Addressed location-specific conditions not present at groundwater remediation sites; and

4. Established final cleanup standards.

The list of ARARs for NEWIOU groundwater remedial actions is provided in Tables 6-1 through 6-5. The ARARs identified in Tables 6-1 through 6-4 are state ARARs and are grouped by the state regulatory agency exercising regulatory authority over the particular ARAR. Table 6-5 includes federal ARARs identified by the lead agency.

6.5 ARARs Evaluation and Discussion

Action-Specific ARARs

These ARARs place restrictions on remedial activities which may negatively impact the surrounding environment. The potential NEWIOU groundwater remedial alternatives were analyzed to identify potential impacts to the environment. Considered were:

Hazardous Waste Treatment, Storage, and Disposal – These requirements are technology- or activity-based requirements which place limitations on actions taken with respect to the hazardous waste. Regulations promulgated under the applicable provisions of the state authorized federal Resource Conservation and Recovery Act (RCRA) and more stringent provisions of the California Hazardous Waste Control Law (HWCL) are either applicable or relevant and appropriate to RCRA-permitted storage facilities and proper characterization of hazardous waste, and storage and disposal of such waste. If any hazardous wastes are identified which will be transported off-site, they will be disposed of and handled under applicable

provisions of the state authorized federal RCRA program. Actions which might generate these wastes include well installation (i.e., disposal of soils generated during construction) or active treatment processes.

Many of the HWCL provisions are either applicable or relevant and appropriate because they describe requirements for the safe handling of regulated materials and precautions for preventing further contamination. These requirements are identified in Table 6-1.

Effects of Actions on Water Resources – Several California statutes and regulations which protect the waters of the State have been identified and incorporated as ARARs. These ARARs establish the remedial objectives and requirements for contaminants of concern (COCs) present at NEWIOU groundwater remediation sites.

The Porter-Cologne Water Quality Control Act (PCWQCA) is one of the statutory bases for regulation of discharges of waste to land that could impair either surface water or groundwater quality in California. It establishes the authority of the State and Regional Water Quality Control Boards to protect the quality of surface water and groundwater. Regulations promulgated pursuant to the PCWQCA that have been determined to be either applicable or relevant and appropriate are identified in Table 6-4. A further discussion of water remediation requirements is included in the chemical-specific ARARs section below.

Effects of Groundwater Extraction – Portions of Union Creek adjoining sites SD001 and SD033 are considered to be both a floodplain and a wetland. Drainage ditches and a few low lying areas at or near sites FT004, LF006, LF007, and SD031 are also considered wetlands. Potential impacts resulting from removal of groundwater and the resultant lowering of the groundwater table were considered. However, it has been determined that any change in groundwater levels will not impact vernal pools or wetlands. The increased flow rates in Union Creek due to the surface discharge of treated water was also considered and determined to not significantly impact Union Creek.

Effects of Actions on Air Resources – State legislation divided the state into local air pollution control districts and allowed each district to enforce the requirements of the state Clean Air Act within its jurisdictional boundaries. Travis AFB is located in the Bay Area Air Quality Management District (BAAQMD). The applicable air regulations incorporated into the IROD as ARARs are identified in Table 6-3. In addition, most of these rules in the State Implementation Plan (SIP) are adopted pursuant to the federal Clean Air Act, and these rules are federal ARARs. That table contains the requirements, a brief description of the substantive requirements and the applicability to either the site, remedial action, or technology used to clean up the site.

Technological Requirements for Remedial Equipment – The remediation of groundwater at sites where Alternative 3 is the selected remedy will incorporate the use of a combination ("tool kit") of five different technologies. These technologies include air stripping, ultraviolet oxidation, catalytic oxidation, activated carbon adsorption, and ion exchange, and will comprise the remediation "tools." One or more of these "tools" will be used at each site, depending upon the particular facts of the site. The unique requirements triggered by each technology and its associated equipment have been identified and are included as ARARs in Tables 6-1 through 6-5.

Location-Specific ARARs

These ARARs place restrictions on remedial activities which may be conducted on-site because of the presence of unique site features. The location of the NEWIOU groundwater sites and surrounding areas were analyzed for unique site features to identify ARARs. The unique site features considered were:

Habitats of Rare, Threatened, Endangered, and Special Status Species – Vernal pools which contain an endangered species, including the Vernal Pool Tadpole Shrimp and the Vernal Pool Fairy Shrimp have been identified at or near Site LF007. Other endangered species, including the Black-Shouldered Kite, Boggs Lake Dodder, Burrowing Owl, Coopers Hawk,

California Gull, Golden Eagle, Loggerhead Shrike, Northern Harrier, Red Fox, Tri-colored Blackbird, Contra Costa Goldfields, Northwestern Pond Turtle, and San Francisco Forktail Damselfly have been observed at some time at Travis AFB and have the potential to be at remedial sites.

Several federal ARARs were identified by impact to site ecology. The Endangered Species Act and implementing regulations set forth in Table 6-5 apply to those remedial actions at NEWIOU sites where impact to endangered wildlife could occur. The groundwater cleanup activities are not expected to impact any endangered species; however, associated cleanup activities (e.g., construction of pipelines for groundwater extraction) could affect these resources should they be present. To ensure that regulatory requirements are followed and impacts are avoided or mitigated, all sites will be surveyed for the presence of these resources immediately prior to the commencement of remedial activities at the site.

Several state ARARs protective of site ecology have also been identified. The California Fish and Game Code (CFGC) and regulations promulgated under this Code protect rare, endangered, or threatened species or habitats, and require alternative actions at sites where impacts have the potential to occur. In addition to these state counterparts to the Endangered Species Act, the CFGC also establishes several requirements to protect site wildlife by prohibiting or restricting the unauthorized taking of other wildlife. The CFGC also regulates to protect aquatic life living in the waters of the state. All remedial activities that have the potential to cause a discharge to any stream, lake, or other body of water must comply with the requirements of the CFGC. CFGC ARARs are found in Table 6-3. United States Environmental Protection Agency (U.S. EPA) does not concur that all CFGC requirements are more stringent than federal requirements.

Historically or Culturally Significant Properties – Some buildings on Travis AFB have recently been identified as Cold War Era buildings and historically significant. However, none of these buildings are affected by NEWIOU remedial activities.

Wilderness Areas, Wild and Scenic Rivers, and Coastal Zones – No wilderness areas, wild and scenic rivers, or coastal zones exist within the boundaries of Travis AFB. Therefore, requirements related to these areas are not applicable or relevant to NEWIOU sites and actions.

Earthquake Faults – Although the Vaca-Winters and the Vaca-Kirby faults are located in the Travis AFB area, NEWIOU sites are not located on these faults.

Chemical-Specific ARARs

Discharges of Treated Effluent – Surface water at Travis AFB includes Union Creek, a minor tributary to the Suisun Marsh. Sites FT005, SS016, SS029, SS030, SD033, SD034, SD036, and SD037 are located adjacent to Union Creek. However, design, construction, and operation of remedial actions will not have an impact upon surface water. One of the options at all sites for which groundwater treatment has been selected is the discharge of treated groundwater to Union Creek. Provisions of 40 CFR Part 122 regulate discharge to surface waters. National Pollutant Discharge Elimination System (NPDES) requirements establish standards for discharges to surface waters of the United States. The substantive requirements of federal or more stringent state ARARs for discharge to surface waters have been evaluated and are included as ARARs. (See Tables 6-6, 6-7, and 6-8.)

State Water Resources Control Board Resolution 68-16 has been identified by the state as an ARAR for the protection of both surface waters and groundwaters of the state. All parties agree that Resolution 68-16 is an ARAR with respect to active discharges to surface water. However, the United States Air Force and U.S. EPA do not agree with the state on the full applicability of all the substantive requirements of this resolution and its impacts on the remedial action activities. This disagreement will not impact the implementation of the interim groundwater remedial actions at NEWIOU sites.

Reinjection of treated water into the groundwater is not contemplated as part of the remedial action.

Discharge of Effluent to Land – Irrigation is the designated beneficial use of treated groundwater at Travis AFB. The use of reclaimed and treated groundwater for irrigation activities shall meet the substantive standards set forth by the Regional Water Quality Control Board order which establishes the general discharge requirements for treated groundwater. These substantive standards ensure that reclaimed water is segregated from potable water sources and does not migrate or escape from the area of irrigation. Standards for irrigation discharges are set forth in Table 6-8.

Aquifer Remediation Objectives – For purposes of the IROD, State Water Resources Control Board (SWRCB) Resolution 92-49, Section III.G is not an ARAR since final aquifer cleanup levels are not being established in this IROD. The scope and applicability of SWRCB Resolution 92-49 will be addressed in the final NEWIOU ROD.

Table 6-1
Federal ARARs* - Groundwater Remediation (IROD)
Waste Transfer, Treatment, and Storage and Disposal Requirements

*** (California Statutes and Regulations Comprising Federal Authorized RCRA Program)**

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 22 CCR Chap 12, Art 1	66262.11	Applicable	Requires a facility to make a determination as to whether waste is hazardous.	Applicable to wastes excavated or resulting from treatment processes.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
Title 22 CCR Chap 14, Art 6	66264.94	Applicable	Establishes general groundwater monitoring requirements and concentration limits.	Relevant and appropriate at groundwater site for development of a comprehensive monitoring program for the site.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.96(c)	Applicable	Establishes monitoring requirements upon removal of all waste and contaminated material from a management unit. Requires monitoring showing all levels in compliance with water quality standards for three consecutive years.			
	66264.97	Applicable	Establishes groundwater monitoring requirements during the closure and post-closure periods.			
Title 22 CCR Chap 14, Art 9 (Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities - Use and Management of Containers)	66264.171	Relevant and Appropriate	Sets standards for containers holding hazardous waste for chemicals recovered from sediments, surface soils, or groundwater.	Sections in this article are relevant and appropriate to sites or actions where waste containers are used. Containers will be used to transfer and store wastes generated by construction activities or the operation of remedial actions. Examples include spent carbon from treatment plants, drill cuttings from well installation, free product removed from a plume, etc.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.172	Relevant and Appropriate	Requires use of containers that are compatible with the recovered material for the storage of that material.			
	66264.173	Relevant and Appropriate	Requires containers used to transport material to be closed during transport and that waste be handled to minimize damage to containers.			
	66264.174	Relevant and Appropriate	Establishes requirements for inspecting containers weekly.			
	66264.175	Relevant and Appropriate	Establishes requirement to ensure adequate secondary containment for stored waste.			
	66264.176	Relevant and Appropriate	Requires isolating waste from sources of ignition if waste is ignitable.			

Table 6-1
Federal ARARs* - Groundwater Remediation (IROD)
Waste Transfer, Treatment, and Storage and Disposal Requirements (continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 22 CCR Chap 14, Art 9 (cont'd)	66264.177	Relevant and Appropriate	Requires segregation of waste from incompatible waste.			
	66264.178	Relevant and Appropriate	Establishes the requirement to remove all hazardous waste and waste residue at closure.	Section 66264.178 is relevant and appropriate when sites are closed and any wastes or residue, as described above, are on-site at closure.		
Title 22 CCR Chap 14, Art 10 Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities - Use and Management of Tank Systems	66264.192	Relevant and Appropriate	Establishes design/installation requirements for new tank systems and components.	Sections in this article are relevant and appropriate to alternatives which incorporate the use of tanks or tank systems as part of the remedial equipment. Tanks will be used at treatment plants to store contaminated water prior to treatment. Tanks will also be used for temporary storage of free product, if necessary. Alternatives which utilize tanks or tank systems include UV oxidation, air stripping, activated carbon adsorption, catalytic oxidation, and ion exchange technologies. Section 66264.197, paragraphs (a), (c)(3), and (c)(4) are not relevant and appropriate with respect to cost estimates and financial responsibility requirements. Section 66264.198 is relevant and appropriate to sites with ignitable wastes (i.e., free product) or reactive waste. Remedies utilizing reactive oxidizers, such as ultraviolet oxidation or catalytic oxidation, would trigger this requirement.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.193	Relevant and Appropriate	Delineates requirements for tank systems including containment and detection of releases.			
	66264.194	Relevant and Appropriate	Delineates requirements for tank systems including general operating requirements.			
	66264.195	Relevant and Appropriate	Delineates requirements for tank systems including inspections.			
	66264.196	Relevant and Appropriate	Delineates requirements for tank systems including response to leaks or spills.			
	66264.197	Relevant and Appropriate	Delineates requirements for tank systems including closure and post-closure care.			
	66264.198	Relevant and Appropriate	Delineates requirements for tank systems including special care requirements for reactive wastes.			
	66264.199	Relevant and Appropriate	Delineates requirements for tank systems including special requirements for incompatible wastes.			

Table 6-1
Federal ARARs* - Groundwater Remediation (IROD)
Waste Transfer, Treatment, and Storage and Disposal Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 22 CCR Chap 14, Art 13 Incinerators	66264.341	Applicable	Requires analysis of the waste feed sufficient to provide all information required by section 66270.62(b) or 66270.19.	Applicable to all sites where catalytic oxidation may be used to treat vapor phase contaminants. The permitting requirements of sections 66264.343, 66264.344, and 66264.345 are not ARARs. Only substantive requirements of section 66264.344, subsection (a) are ARARs.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.342	Applicable	Requires Principal Organic Hazardous Constituents (POHCs) in the waste feed be treated to the extent required by the performance standard of section 66264.343.			
	66264.343	Applicable	Establishes maintenance, construction, and design requirements to ensure proper operation.			
	66264.344	Applicable	Establishes types of waste which can be burned and operating conditions for those wastes.			
	66264.345	Applicable	Requires incinerators be operated in accordance with operating requirements.			
	66264.347	Applicable	Establishes monitoring during hazardous waste incineration.			
	66264.351	Applicable	Establishes closure requirements for the incinerator site and residual wastes.			
Title 22 CCR Chap 14, Art 16	66264.601	Applicable	Specifies performance standards for miscellaneous units that transfer, treat, store or dispose of hazardous waste.	Applicable at Travis AFB sites where air strippers are used as part of the remedial action. Section 66264.602 requirements related to response and reporting procedures are procedural and do not apply.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.602	Applicable	Establishes analysis, inspection, response, reporting, monitoring, and corrective action standards for miscellaneous units.			
	66264.603	Applicable	Establishes maintenance standards for miscellaneous units.			

Table 6-1
Federal ARARs* - Groundwater Remediation (IROD)
Waste Transfer, Treatment, and Storage and Disposal Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 22 CCR Chap 14, Art 27 (Air Emission Standards for Process Vents)	66264.1032	Relevant and Appropriate	Establishes emission limits when process vents are used.	Relevant and appropriate to alternatives where closed vent systems are used. At NEWIOU groundwater sites, this would include remediation systems which have vents in the system to include air strippers, UV oxidation and catalytic oxidation equipment, and carbon treatment vessels.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.1033	Relevant and Appropriate	Establishes standards for closed vent systems and control devices.			
	66264.1034	Relevant and Appropriate	Establishes test methods and procedures for closed vent systems.			
	66264.1035	Relevant and Appropriate	Establishes recordkeeping requirements for closed vent systems and parameters for design analysis and performance.			
Title 22 CCR Chap 14, Art 28 (Air Emission Standards for Equipment Leaks)	66264.1054	Relevant and Appropriate	Establishes that pressure relief devices in gas/vapor service shall be operated with no detectable emissions.	Relevant and appropriate for actions where gas/vapor extraction systems are used. Actions include air stripping, activated carbon adsorption, and catalytic oxidation equipment.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66264.1063	Relevant and Appropriate	Establishes leak detection monitoring requirements.			
	66264.1064	Relevant and Appropriate	Establishes recordkeeping requirements for gas/vapor extraction systems.			
Title 22 CCR Chap 18, Art 1 (Land Disposal Restrictions - General)	66268.3	Applicable	Establishes land disposal restrictions, including a prohibition of using dilution as a substitute for treatment.	Applicable to hazardous wastes generated from site construction activities. Places restrictions on site disposal activities in unauthorized areas. Section 66268.7, paragraphs (a)(1), (b)(1), (2), and (3), and (c)(2) are substantive requirements. The remainder of the section is procedural and not ARARs.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	66268.7	Applicable	Establishes land disposal restrictions, including requirements for waste analysis and recordkeeping.			
	66268.9	Applicable	Establishes land disposal restrictions including special rules for wastes that exhibit a characteristic.			

Table 6-1
Federal ARARs* - Groundwater Remediation (IROD)
Waste Transfer, Treatment, and Storage and Disposal Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 22 CCR Chap 18, Art 2	All Sections	Applicable	Establishes treatment technology for disposal of waste to land for RCRA and non-RCRA wastes identified in Section 66268.106.	Applicable to sites where material or secondary waste from construction activities (includes excavation for well installation, pipeline installation, and foundations for treatment facilities), or excavation material is classified as hazardous or state regulated waste. Wastes identified will be managed in accordance with these standards using the characterization process.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
Title 22 CCR, Chap 18 Art 3 (Prohibitions on Land Disposal)	66268.30	Applicable	Establishes waste-specific LDRs.	Applicable to groundwater remediation sites where media excavated for equipment installation is classified hazardous waste and disposed of or treated on-site. Requires identification of waste through the proper characterization process.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 037	3
	66268.31	Applicable	Establishes LDRs for wastes containing dioxin.			
	66268.32	Applicable	Establishes LDRs for certain hazardous wastes.			
	66268.33	Applicable	Establishes LDRs - First Third Wastes.			
	66268.34	Applicable	Establishes LDRs - Second Third Wastes.			
	66268.35	Applicable	Establishes LDRs - Third Third Wastes.			
	66268.36	Applicable	Prohibits land disposal of newly listed wastes.			
	66268.37	Applicable	Prohibits land disposal of ignitable and corrosive characteristic wastes whose treatment standards were vacated.			
	66268.38	Applicable	Identifies waste specific prohibitions on newly identified organic toxicity characteristic wastes and newly listed coke by-product and chlorotoluene wastes.			

Table 6-1
Federal ARARs* - Groundwater Remediation (IROD)
Waste Transfer, Treatment, and Storage and Disposal Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 22 CCR Chap 18, Art 4	All Sections	Applicable	Identifies treatment standards for halogenated organic compounds regulated by Section 66268.32.	Applicable to sites where excavated material is classified as hazardous waste. Identified waste will be managed in accordance with these standards. Applicable at groundwater sites where contaminated soils are excavated in order to install remediation equipment.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
Title 22 CCR Chap 18, Art 5	All Sections	Applicable	Establishes prohibitions on storage of hazardous wastes restricted under Article 3 of this chapter or RCRA Section 3004 (42 USC 6924).			
Title 22 CCR Chap 18, Art 10	66268.100	Applicable	Establishes land disposal prohibitions for non-RCRA hazardous wastes.			
Title 22 CCR Chap 18, Art 11	All Sections	Applicable	Establishes disposal restrictions, prohibitions, and treatment standards for certain identified hazardous wastes.			
Title 22 CCR Chap 43 (Management of Extremely Hazardous Wastes)	67430.3	Applicable	Establishes requirements for the removal of spilled or improperly deposited extremely hazardous wastes.	Applicable to NEWIOU groundwater sites where unintentional spills may occur.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3

Table 6-2
State ARARs - Groundwater Remediation (IROD)
Air Remediation Requirements

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Regulation 2, Rule 1 (Bay Area Air Quality Management District Regulations)	308	Applicable	Establishes that fugitive emissions from equipment or facilities must comply with all applicable requirements.	Applicable to actions where air strippers or other systems using pressurized components (UV oxidation, carbon adsorption, catalytic oxidation, and ion exchange) could result in fugitive VOC emissions.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	316	Applicable	Establishes maximum levels for toxic air contaminants, which, if exceeded, require a risk screening analysis.	Applicable to actions which have the potential to emit toxic air contaminants (e.g., TCE). Substantive provisions are applicable to actions including air stripping, UV oxidation, carbon adsorption, catalytic oxidation, and ion exchange.		
	501	Applicable	Establishes that continuous emission monitors meet certain requirements.	Applicable to all sites or actions where air stripping, UV oxidation, carbon adsorption, catalytic oxidation, and ion exchange technologies are used in the remedial action.		
Regulation 2, Rule 2	112	Applicable	Establishes exemptions for emissions of secondary pollutants from abatement control equipment which complies with BACT or BARCT requirements.	Applicable to actions where BARCT or BACT abatement devices are used (i.e., carbon adsorption is used together with catalytic oxidation or UV oxidation or ion exchange) but where secondary emissions from the abatement equipment still exist.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	301	Applicable	Establishes BACT requirement for new sources which emit in excess of 10 lbs per day of precursor organic compounds, non-precursor organic compounds, NO_x, SO_x, PM_{10} or $C0_2$.	Applicable to all actions with potential to discharge to air. Not applicable for permitting requirements or authority to construct but applicable for determining the applicability of BACT to a new source. Remedial alternatives using air strippers must ensure BACT is used (i.e., air stripping, catalytic oxidation with carbon adsorption) to control emissions in excess of levels specified in the rule.		

Table 6-2
State ARARs - Groundwater Remediation (IROD)
Air Remediation Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Regulation 6	301	Applicable	Establishes limitations on visible emissions and opacity.	Applicable to sites where excavation or construction activities have the potential to release particulate matter into the air (i.e., dirt and dust), or at sites where portable soldiering, brazing, welding equipment is used. Also applicable at sites where portable combustion engines of < 25 liters of displacement are used.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	302	Applicable	Establishes limitations on opacity.			
	303	Applicable	Establishes limitations on emission rates, concentration, visible emissions, and opacity.			
	501	Applicable	Establishes requirements for sampling facilities and instruments.	Applicable to all actions subject to Regulation 6.		

Table 6-3
State ARARs - Groundwater Remediation (IROD)
Fish and Game Requirements

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
California Fish and Game Code	1908	Applicable	Prohibits the import, taking or possession of rare or endangered native plants.	Applicable to active groundwater remediation sites where rare or endangered native plants exist. Requires site surveys prior to action to determine presence of endangered/threatened plants at the site and consideration of potential impact at sites where impact to endangered or threatened species may occur. Will be considered at all groundwater sites where active remediation occurs.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	2080	Applicable	Prohibits the import, taking or sale of threatened or endangered native plants.			
	2091	Relevant and Appropriate	Requires state agencies to use alternative actions where impact to threatened or endangered species or habitat is found.			
	2092	Relevant and Appropriate	Requires state agencies to adopt reasonable alternative actions where project would result in the extinction of a species.			
	3005	Applicable	Prohibits taking of birds or animals with net, pound, cage, trap, set line, wire, or poison.	Applicable at all groundwater remediation sites where birds, animals, or other wildlife identified by the applicable statutory provision exist.		
	3511	Applicable	Prohibits taking of birds identified as "fully protected."			
	3513	Applicable	Prohibits taking or possession of mammals identified as "fully protected."			
	5050	Applicable	Prohibits taking or possession of reptiles and amphibians identified as "fully protected."			
	5515	Applicable	Prohibits taking or possession of fish identified as "fully protected."			
	5650	Applicable	Prohibits deposit or placement of specified materials and substances into places where it can pass into the waters of the state.	Applicable to all groundwater remediation actions or sites where substances have a pathway to state waters.		

Table 6-3
State ARARs - Groundwater Remediation (IROD)
Fish and Game Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
California Fish and Game Policies	Management and Utilization of Fish and Wildlife on Federal Lands	Performance Standard	Establishes management policies and defines methodologies used in protecting all fish, wildlife, and threatened and endangered species.	Although these policies are not promulgated regulations and therefore, cannot be legally defined as ARARs, these policies do contain substantive provisions which will be relied upon in the decision process, consistent with applicable federal laws and statutes. Will be followed at all groundwater sites where active remediation occurs.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	Wetlands Resource Policy	Performance Standard	Establishes management policies and defines methodologies to assure no net loss of wetland habitat value or acreage.	The Wetlands Resource Policy will be followed at sites where wetland habitat occurs.	007, 033	3
Title 14 CCR	40.00	Applicable	Prohibits the taking of possession of native reptiles and amphibians.	Applicable to all site and action alternatives where identified mammals, fish, reptiles or amphibians, or plants exist. Will be considered at all groundwater sites where active remediation occurs. Requires site surveys prior to action to determine presence of endangered/threatened plants at the site. Species found at Travis AFB which are covered by these sections include the Black-Shouldered Kite, Boggs Lake Dodder, Burrowing Owl, Coopers Hawk, California Gull, Golden Eagle, Loggerhead Shrike, Northern Harrier, Red Fox, Tri-colored Blackbird, Vernal Pool Fairy Shrimp, Contra Costa Goldfields, Northwestern Pond Turtle, San Francisco Forktail Damselfly, Vernal Pool Tadpole Shrimp.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	40.10	Applicable	Prohibits the taking of possession of native reptiles and amphibians.			
	460	Applicable	Prohibits the taking of certain fur bearing mammals at any time.			
	640	Applicable	Establishes requirement for fish and wildlife planning to optimize fish and wildlife resources.			
	670.2	Applicable	Establishes species, subspecies, and varieties of native California plants as endangered, threatened, or rare.			
	670.5	Applicable	Establishes species, subspecies, and varieties of native California plants as endangered, threatened, or rare.			

Table 6-4
State ARARs - Groundwater Remediation (IROD)
Water Board Requirements

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Federal Water Pollution Control Act Section 402, Porter Cologne Water Act; California Water Code, Division 7, Sections 13000, 13140, 13240, Water Quality Control Plan for the San Francisco Bay Basin	SWRCB Resolution 68-16	Applicable	Establishes policy that whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated that any change will be consistent with maximum benefit to the people of the State, won't unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than prescribed in the policies. Discharges or proposed discharges to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that a pollution or nuisance will not occur and the highest water quality consistent with maximum benefit to the people of the State will be maintained.	Applicable to sites where groundwater IROD actions will cause active discharges to surface water (i.e., Union Creek). The lead agency, U.S. EPA, and water board agree to disagree as to the applicability of this section with respect to passive discharge and plume migration. Throughout the IROD, plumes at these sites will be monitored and evaluated to ensure migration is not present. San Francisco Bay Region Order Number 94-087 establishes requirements for discharge or reuse of extracted and treated groundwater which was contaminated by VOCs. Contaminants in treated groundwater shall not exceed the more stringent of the substantive standards set forth in Order 94-087, MCLs, or such levels necessary to preclude degradation of the receiving water quality. The numeric effluent limitations for discharges to treated water that comply with Resolution 68-16 are specified in Table 6-6. The discharge must also comply with paragraphs A.1, A.2, and A.3 (prohibitions) of General Waste Discharge Order 94-087.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3

Table 6-4
State ARARs - Groundwater Remediation (IROD)
Water Board Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Regional Water Quality Control Board, San Francisco Bay Area	RWQCB Resolution 88-160	Applicable	Urges the dischargers of extracted groundwater from groundwater cleanup projects to reclaim their effluents to the extent technologically and economically feasible, and if not technologically and economically feasible, urges discharge to POTWs. Where neither reclamation or POTW discharge is technically or economically feasible, discharge in accordance with NPDES requirements will be authorized by the board.	Applicable to all groundwater sites where groundwater extraction occurs. Board NPDES permitting requirements identified by the resolution are procedural and not ARARs. The reused water must comply with para D of General Waste Discharge Order 94-087 and effluent treatment levels listed in Table 6-8.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
Title 23 CCR Chapter 15 (CWC Sections 13140 - 13147, 13260, 13263, 13267, 13304)	2511(d)	Relevant and Appropriate	Establishes exemption from provisions of this subsection for actions taken by/at the direction of public agencies to clean up or abate conditions of pollution resulting from unintentional or unauthorized releases of waste or pollutants to the environment. Requires wastes, pollutants, or contaminated materials removed from the immediate place of release to be discharged according to Art 2. Remedial actions intended to contain such wastes at the place of release shall implement provisions of this subchapter to the extent feasible.	Relevant and appropriate to monitoring requirements and other specific actions which are not related to final cleanup levels or goals at both sites where active remediation will occur and where natural attenuation has been selected as the interim remedy.	006, 007	2, 3

Table 6-4
State ARARs - Groundwater Remediation (IROD)
Water Board Requirements
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Regional Water Quality Control Board	S.F. Bay Basin Water Quality Control Plan, Chapter 2, Beneficial Uses	Applicable	Establishes beneficial uses of surface waters of the state.	Applicable to define beneficial uses of surface waters where treated effluent may be discharged. Beneficial uses of Union Creek and downstream receiving waters include navigation, contact and non-contact recreation, fish spawning, warm fresh-water habitat, and wildlife habitat.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	S.F. Bay Basin Water Quality Control Plan, Chapter 3 (Water Quality Objectives)	Applicable	Establishes discharge to surface water requirements, including receiving water quality objectives and receiving water limits.	Applicable where effluent is discharged to surface water. Surface waters shall not contain concentrations of constituents in amounts that affect any beneficial use or the objectives for selected toxic pollutants identified in Tables 3-3 and 3-4. Incorporates requirements of General Order 94-087, paragraph C (receiving water limitations for discharges to surface water - see Table 6-7) and paragraph F.5 (prohibitions on radiological, biological, and chemical warfare agent waste).		
U.S. Office of Solid Waste	RCRA Ground Water Monitoring, Draft Technical Guidance, Nov. 1992 (EPA /530-R-93-001	Performance Standard	Sets forth requirements for the development of a groundwater monitoring program.	Applies to the development of a comprehensive monitoring program for the site (also reference Table 6-1, 22 CCR Section 66264.94, 66264.96, and 66264.97).	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3

Table 6-5
Federal ARARs - Groundwater Remediation (IROD)
Requirements under the US Code and Related Regulations

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 16 USC (Endangered Species Act)	1531(c)	Applicable	Requires action to conserve endangered species and critical habitats upon which endangered species depend. Includes consultation with the Department of Interior to gather substantive information necessary to ensure compliance with this requirement.	Activities at all remedial sites must be performed in such a manner as to identify the presence of and protect endangered or threatened plants and animals at the site. Species present at Travis AFB include the Black-Shouldered Kite, Boggs Lake Dodder, Burrowing Owl, Coopers Hawk, California Gull, Golden Eagle, Loggerhead Shrike, Northern Harrier, Red Fox, Tri-colored Blackbird, Vernal Pool Fairy Shrimp, Contra Costa Goldfields, Northwestern Pond Turtle, San Francisco Forktail Damselfly, Vernal Pool Tadpole Shrimp.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3
	1536(a)	Applicable				
Title 50 CFR	Part 402	Applicable				
Title 16 USC (Fish and Wildlife Coordination Act)	662	Applicable	Regulates site actions affecting fish or wildlife in lakes, stream, or other water bodies by requiring coordination between lead agency and the U.S. Fish and Wildlife Service, Department of the Interior, and applicable state agencies.	Applicable to active groundwater remediation actions and effluent discharges at sites which are located at or near, or which may impact, Union Creek and pond.	004, 005, 016, 029, 030, 033, 036, 037	3
Title 16 USC (Migratory Bird Treaty Act)	703	Applicable	Prohibits unlawful taking, possession, and sale of almost all species of native birds in the United States.	Species at Travis AFB include Black-Shouldered Kite, Burrowing Owl, Coopers Hawk, California Gull, Golden Eagle, Loggerhead Shrike, Northern Harrier, Tri-colored Blackbird, Contra Costa Goldfields.	004, 005, 007C, 016, 029, 030, 031, 032, 033, 034, 036, 037	3

Table 6-5
Federal ARARs - Groundwater Remediation (IROD)
Requirements under the US Code and Related Regulations
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Federal Clean Water Act, Section 404, Title 33 CFR Part 330, Appx A, Subpart B Army Corps of Engineers Nationwide Permit Programs (NWP)	Paragraph 12	Applicable	Establishes Nationwide Permit for discharges material for backfill or bedding of utility lines, including outfall and intake structures affecting the waters of the United States.	The substantive portions of these paragraphs are applicable to activities related to construction and installation of remedial equipment. The permitting requirements are not ARARs.	004, 005, 016, 029, 030, 033, 034, 036, 037	3
	Paragraph 13	Applicable	Establishes Nationwide Permit for bank stabilization activities necessary for erosion prevention.			
	Paragraph 27	Applicable	Establishes requirements for activities in waters of the United States associated with the restoration of altered and degraded non-tidal wetlands and creation of wetlands on private lands.			
Federal Clean Water Act, Section 404, Title 33 CFR Part 330, Appx A, Subpart C Army Corps of Engineers Nationwide Permit Conditions (NWP)	Paragraph 2	Applicable	Requires any structure or fill authorized be properly maintained, including maintenance to ensure public safety.	The substantive portions of these paragraphs are applicable to activities related to construction and installation of remedial equipment. The permitting and notification requirements are not ARARs.	004, 005, 006, 007, 015, 016, 029, 030, 031, 032, 033, 034, 035, 036, 037	3
	Paragraph 4	Applicable	Requires that no activity may substantially disrupt the movement of those species of aquatic life indigenous to the water body.			
	Paragraph 5	Applicable	Requires heavy equipment working in wetlands must be placed on mats or other measures be taken to minimize soil disturbance.			
	Paragraph 11	Applicable	No activity is authorized under any NWP if likely to jeopardize the continued existence of a threatened or endangered species or species proposed for such designation, as identified under the Federal Endangered Species Act, or which is likely to destroy or adversely modify the critical habitat of such species.			

Table 6-5
Federal ARARs - Groundwater Remediation (IROD)
Requirements under the US Code and Related Regulations
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 40 CFR Part 122 (Federal Clean Water Act - EPA Administered Programs) The National Pollutant Discharge Elimination System	122.26	Applicable	Requirements to ensure stormwater discharges from remedial activities do not contribute to a violation of surface water quality standards.	Applicable at all sites where there will be discharge to the stormwater system and to discharges to Union Creek. These sections relate to effluent limitations and monitoring requirements to be applied during the development of a monitoring plan. Incorporates requirements of General Order 94-087, paragraph F.6 (100-year frequency flood). The SRWQCB is authorized to implement the NPDES program in the State of California. (See California Regional Water Quality Control Board, San Francisco Bay Region Order 94-087 for substantive discharge standards.) Only substantive portions of Part 122 are ARARs; reporting requirements are procedural. Incorporates substantive requirements of Order 94-087, Self Monitoring Requirements, paragraphs D through H.	004, 005, 007C, 016, 030, 031, 032, 033, 034, 036, 037	3
	122.41(d)	Applicable	Requires all reasonable steps be taken to minimize or prevent discharges which have a reasonable likelihood of causing adverse impacts on surface water quality.			
	122.41(e)	Applicable	Requires proper operation and maintenance of treatment and control systems/equipment.			
	122.41(j)(1)(3)&(4)	Applicable	Establishes requirements for monitoring and recordation of monitoring results.			
	122.41(l)(6)	Applicable	Establishes informational requirements for any noncompliance which may endanger health or the environment.			
	122.41(m)	Applicable	Establishes prohibitions, limitations, and restriction on treatment plant bypass.			
	122.41(n)	Applicable	Defines and establishes parameter for upset conditions in a treatment plant.			
	122.44(d)	Applicable	Requires that discharges to surface water must achieve federal and state water quality standards.			
	122.44(g)	Applicable	Identifies certain toxic pollutants as hazardous substances.			
	122.44(i)	Applicable	Establishes monitoring requirements to assure compliance with permit limitations and requirements to monitor.			
	122.45(c)	Applicable	Establishes techniques and methodologies for monitoring effluent levels of metals.			

Table 6-5
Federal ARARs - Groundwater Remediation (IROD)
Requirements under the US Code and Related Regulations
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
Title 40 CFR Part 122 (Cont.)	122.45(d)	Applicable	Establishes format for reporting effluent limitation standards and prohibitions.	(Cont.)	004, 005, 007C, 016, 030, 031, 032, 033, 034, 036	3
	122.45(e)	Applicable	Establishes format and limit criteria for non-continuous discharge.			
	122.45(f)	Applicable	Establishes requirements and exceptions for pollutants expressed in terms of mass.			
	122.45(g)	Applicable	Establishes credits for pollutants in the dischargers intake water.			
	122.48(a)	Applicable	Establishes requirements for proper use, maintenance, and installation of monitoring equipment or methods.			
	122.48(b)	Applicable	Establishes requirements for monitoring including type, intervals, and frequency sufficient to yield data which are representative of the monitored activity including, when appropriate, continuous monitoring.			

Table 6-5
Federal ARARs - Groundwater Remediation (IROD)
Requirements under the US Code and Related Regulations
(continued)

Source	Requirement, Standard, or Criterion	Type	Description	Remarks	Sites and Alternatives	
40 USC Section 300, et seq. (National Primary Drinking Water Standards) Title 40 CFR Part 141	141.11	Relevant and Appropriate	Establishes the federal allowable maximum contaminant levels (MCLs) for arsenic in community water systems and nitrates in non-community water systems.	Relevant and appropriate to sites where discharge of treated groundwater to potential sources of drinking water will occur. Establishes effluent treatment standards for certain constituents which are not addressed by the substantive requirements of California Regional Water Quality Control Board, SF Bay Region, Order Number 94-087.	004, 005, 007C, 016, 030, 031, 032, 033, 034, 036, 037	3
	141.12	Relevant and Appropriate	Establishes federal MCLs for trihalomethanes.			
	141.61	Relevant and Appropriate	Establishes MCLs for organic contaminants. Requires the best technology, treatment technique, or other means available for achieving compliance with MCLs.			
	141.62	Relevant and Appropriate	Establishes MCLs for inorganic contaminants. Requires the best technology, treatment technique, or other means available for achieving compliance with MCLs for identified contaminants, except fluoride.			

Table 6-6

NPDES Effluent Limitations for Treated Groundwater

Constituent	Instantaneous Maximum (ug/l)	30-Day Median[1] (ug/l)
Halogenated Volatile Organics		
Bromodichloromethane	100.0[2]	0.5
Carbon Tetrachloride	0.5[2]	0.5
Chlorobenzene	70.0[2]	0.5
Chloroform	100.0[2]	0.5
Chloromethane		0.5
Dibromochloromethane	100.0[2]	0.5
1,4-Dichlorobenzene	5.0[2]	0.5
1,2-Dichloroethane	0.5[2]	0.5
1,1-Dichloroethylene	6.0[2]	0.5
cis-1,2-Dichloroethylene	6.0[2]	0.5
trans-1,2-Dichloroethylene	10.0[2]	0.5
1,2-Dichloropropane	5.0[2]	0.5
Ethylene Dibromide	0.05[2]	0.5
Tetrachloroethylene (PCE)	5.0[2]	0.5
Trichloroethylene (TCE)	5.0[2]	0.5
Vinyl Chloride	0.5[2]	0.5
Total Halogenated Volatile Organics		1.0
Non-Halogenated Volatile Organics		
Benzene	1.0[2]	0.5
Ethylbenzene	29.0[3]	0.5
Toluene	42.0[3]	0.5
Xylenes	17.0[3]	0.5
TPH - Gasoline	50.0[4]	50.0[4]
Semi-Volatile Organics		
Aldrin	TBD[5]	TBD[5]
Alpha-BHC	TBD[5]	TBD[5]
Beta-BHC	TBD[5]	TBD[5]
Gamma-BHC (Lindane)	TBD[5]	TBD[5]
Bis(2-ethylhexyl)phthalate	TBD[5]	TBD[5]

Table 6-6

(Continued)

Constituent	Instantaneous Maximum (ug/l)	30-Day Median[1] (ug/l)
Chlordane	TBD[5]	TBD[5]
4,4'DDT	TBD[5]	TBD[5]
4,4'DDD	TBD[5]	TBD[5]
Dieldrin	TBD[5]	TBD[5]
Dioxins	TBD[5]	TBD[5]
Endosulfan	TBD[5]	TBD[5]
Heptachlor epoxide	TBD[5]	TBD[5]
PCBs (Arochlors)	TBD[5]	TBD[5]
Total Polynuclear Aromatics (PAHs)	TBD[5]	TBD[5]
TPH - Diesel	100.0[3]	50.0[4]
Inorganics[6]		
Arsenic	190[9]	190[9]
Cadmium	1.1	1.1
Chromium VI	11.0[7]	11.0[7]
Total Chromium	11.0	11.0
Copper	12.0	12.0
Lead	3.2	3.2
Mercury	0.012[8]	0.012[8]
Nickel	160.0	160.0
Selenium	5.0	5.0
Silver	4.1	4.1
Zinc	110.0	110.0

1 Best Available Technology for Volatile Organics.

2 California Primary MCL.

3 Taste and odor threshold in water - USEPA.

4 Practical Quantitation Limit.

5 To Be Determined: The Air Force agrees to sample for these constituents prior to discharge of effluent. When one or more of these constituents are found, the parties will agree on instantaneous maximum and 30-day median effluent limitations. These constituents (even if not detected initially) will be included in the monitoring program.

6 Both instantaneous maximum and monthly median limitations are based on USEPA Freshwater Ambient Water Quality Criteria for Protection of Aquatic Life, expressed as total recoverable metal.

7 Compliance with the Chromium VI limitation may be met as Total Chromium.

8 Compliance is achieved by meeting the Reporting Limit using EPA Method 7470/7471. The effluent shall not contain more than 1 gram/day of mercury.

9 Discharge limitation of 10ug/l for arsenic still applies to SS016.

690 169

Table 6-7

Discharge Limitations

1. The discharge of waste shall not cause the following conditions to exist in the waters of the State at any place:

   a) floating, suspended, or deposited macroscopic particulate matter or foam;

   b) bottom deposits or aquatic growths;

   c) alteration of temperature, turbidity, or apparent color beyond present natural background levels;

   d) visible, floating, suspended, or deposited oil or other products of petroleum origin;

   e) toxic or deleterious substances to be present in concentrations or quantities which will cause deleterious effects on aquatic biota, wildlife, or waterfowl, or which render any of these unfit for human consumption either at levels created in the receiving waters or as a result of biological concentration.

2. The discharge of waste shall not cause excursions of the following limits in waters of the State in any place within one foot of the water surface:

   a) Dissolved oxygen;

      For all tidal waters, upstream of Carquinez Bridge, 7.0 mg/l minimum; downstream of Carquinez Bridge, 5.0 mg/l minimum.

      For nontidal waters, waters designated as cold water habitat, 7.0 mg/l minimum; waters designated as warm water habitat, 5.0 mg/l minimum.

      The median dissolved oxygen concentration for any three consecutive months shall not be less than 80% of the dissolved oxygen content at saturation.

   b) pH: The pH shall not be depressed below 6.5 nor raised above 8.5, nor caused to vary from normal ambient pH levels by more than 0.5 units.

3. The discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Board or the State Water Resources Control Board as required by the Federal Clean Water Act and regulations adopted thereunder.

Source: California Regional Water Quality Control Board, San Francisco Bay Region, Order No. 94-087

Table 6-8

Effluent Treatment Levels for Beneficial Reuse

Discharges to Land for Irrigation Purposes

Water reclaimed for beneficial use shall meet the following limits:

Constituent	Instantaneous Maximum Limit (µg/L)
Volatile Organic Compounds	
Vinyl Chloride	0.5
Benzene	0.5
Dichloroethane	0.5
All Others, Per Constituent	5.0
Semi-Volatile Organic Compounds	
Per Constituent	5.0
Total Petroleum Hydrocarbons	50

The following limitations shall apply:

1. Water reclamation activities shall be limited to irrigation.
2. No reclaimed water shall be allowed to escape from the authorized use area by airborne, nor by surface flow except in minor amounts associated with good irrigation practice, nor from conveyance facilities.
3. Reclamation involving irrigation shall not occur when the ground is saturated.
4. The use of reclaimed water shall not impair the quality of waters of the State, nor shall it create a nuisance as defined by Section 13050(m) of the California Water Code.
5. Adequate measures shall be taken to minimize public contact with reclaimed water and to prevent the breeding of flies, mosquitoes, and other vectors of public health significance during the process of reuse.
6. Appropriate public warnings must be posted to advise the public that the water is not suitable for drinking. Signs must be posted in the area, and all reclaimed water valves and outlets labeled, as appropriate.
7. There shall be no cross-connection between the potable water supply and piping containing treated groundwater intended for reuse.

Source: California Regional Water Quality Control Board, San Francisco Bay Region, Order No. 94-087

Section Tab

7

7.0 REFERENCES

BioSystems Analysis, Inc., 1992. *Assessment of Special Status Animal and Plant Species at Travis AFB, California.* BioSystems Analysis, Inc. Tiburon, CA.

BioSystems Analysis, Inc., 1993. *Assessment of Special Status Plant and Animal Species at Travis AFB, Solano County, California: Phase II Surveys.* BioSystems Analysis, Inc. Tiburon, CA.

California Division of Mines and Geology, 1981. *Sacramento Quadrangle Map No. 1A.* 1981.

CH2M HILL, 1996. *Tier Two Ecological Risk Assessment.* March 1996.

Cherry, 1996. *Conceptual Models for Chlorinated Solvent Plumes and their Relevance to Intrinsic Remediation*, in Symposium on Natural Attenuation of Chlorinated Organics in Groundwater, EPA/540/R-96/509, pages 29-30, September 1996.

Earth Technology, 1994. *Installation Restoration Program (IRP) Engineering Evaluation and Cost Analysis (EECA) and Environmental Assessment in Support of a JP4 Non-Time-Critical Removal Action - IRP Site SS01 West Industrial Operable Unit.* March.

Freeze and Cherry, 1979. *Groundwater.* R. Allan Freeze and John A. Cherry. Prentice-Hall, Inc. 1979.

Marchard, D.E., and Allwardt, A., 1977. *Late Cenozoic Stratigraphic Units of the Northeastern San Joaquin Valley.* USGS Open File Report 77-748, 136p.

Olmsted and Davis, 1961. *Geologic Features and Groundwater Storage Capacity of the Sacramento Valley, California.* United States Geological Survey Water Supply Paper 1497, 241p.

Parsons Engineering Science, Inc., 1996. *Installation Restoration Program Management Action Plan, Travis AFB.* January 1996.

Radian, 1994. *Tower Area Removal Action Environmental Evaluation/Cost Analysis.* 2 September.

Radian 1995a. *Tower Area Removal Action National Pollution Discharge Elimination System Self Monitoring Quarterly Report, Travis AFB, California,* 1995.

Radian 1995b. *North Industrial Operable Unit Remedial Investigation, Travis AFB.* Final. July 1995.

Radian, 1995c. *Addendum to the NOU RI Report*. 2 November 1995.

Radian, 1995d. *Treated Groundwater Use Plan, Travis AFB*. Final. September 1995.

Radian 1996a. *North/East/West Industrial Operable Unit Feasibility Study, Travis AFB*. Final. September 1996.

Radian 1996b. *West Industrial Operable Unit Remedial Investigation, Travis AFB*. Final. February 1996.

Radian, 1996c. *Travis AFB Announces Plan for Interim Cleanup of Contaminated Groundwater in NEWIOU (Travis AFB Groundwater Proposed Plan)*. September 1996.

Radian, 1996d. *Tower Area Removal Action Environmental Evaluation/Cost Analysis, Explanation of Significant Differences*.

Thomasson, H.G., F.H. Olmsted, and E.F. LeRouz, 1960. "Geology, Water Resources, and Useable Groundwater Storage Capacity of Part of Solano County, California." *USGS Water Supply*. Paper 1464, 693p.

U.S. Air Force, 1993. RACER/ENVEST™. *Remedial Action Cost Engineering and Requirements System. Environmental Cost Engineering*. Technical Contact: Dr. Rita A. Gregory. AFCESA/DC. Tyndall AFB, Florida. 10 May 1993.

U.S. EPA, 1992. *Time Critical Removal Action*. 15 December.

U.S. EPA, 1996. *Final Guidance: Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites*. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. October 1996.

Wagner, 1982. *Geologic Map of the Santa Clara Quadrangle*. California Division of Mines and Geology.

Weston, 1990. *Stage 2 Draft Technical Report Travis AFB*. January 1990.

Weston, 1992. *Technical Information Report. Conceptual Site Models, Travis AFB, California*. Volumes I and II.

Weston, 1995a. *East Industrial Operable Unit Remedial Investigation, Travis AFB*. Final. October 1995.

Weston, 1995b. *Basewide Ecological Habitat Survey*. Draft. June 1995.

Wiedemeier, T. H., Wilson, J.T., Kampbell, D.H., Miller, R.N., and Hansen, J.E., 1995. *Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater*, San Antonio TX, U.S. Air Force Center for Environmental Excellence.

Wiedemeier, T. H., Swanson, M.A., Moutoux, D.E., and Gordon, E. Kinzie, Wilson, J.T., Wilson, B.H., Kampbell, D.H., Hansen, J.E., Haas, P., and Chapelle, F.H., 1996. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*, San Antonio TX, U.S. Air Force Center for Environmental Excellence. November 1996.

Section Tab

PART 3

PART III: RESPONSIVENESS SUMMARY

The primary avenues of public input have been through the Proposed Plan and public comment period. The Proposed Plan for groundwater was issued to the public on 25 September 1996. To encourage public comment, the U.S. Air Force (USAF) held a public meeting on 17 October 1996, distributed Proposed Plans to libraries in the area, and included the phone numbers and e-mail addresses of USAF and agency representatives.

The public meeting to receive comments on the Proposed Plan was attended by various community members. Oral comments were received from one person: Bill Petersen. Following the public meeting, and prior to the conclusion of the public comment period, written comments were submitted by one individual: Carl Freitas of Oakland, California.

All comments received are documented in the administrative record file for the site. A transcript of the public meeting is available for public review at the site information repository. The repository is located off-base at the Vacaville Public Library, 1020 Ulatis Drive. Public comments, relevant to contaminated groundwater in the NEWIOU and/or the environmental restoration program at Travis AFB, are presented below and have been paraphrased for greater clarity. This IROD is based on the documents in the Administrative Record and comments received from the public.

Public Comment 1a: There was a concern that contaminants on base could impact neighboring property by contaminants migrating off base or by discharge of treated water to storm drains and creeks.

USAF Response: The USAF has identified three areas where contamination has migrated off-base: two on the south base boundary and one on the North. At these sites, the USAF proposes putting in wells to clean the contaminated off-base groundwater to drinking

water standards and prevent any future migration of contaminated groundwater off-base. The primary contaminant in the off-base groundwater is Trichloroethene (TCE) which is a solvent used at Travis until 1980. At the other sites (where all contamination is on-base), the proposed cleanup actions and monitoring will minimize the migration of contaminated groundwater and ensure there will not be any additional off-base migration.

Areas of past fuel spills at the base have been investigated and have resulted in some contamination of on-base groundwater but no contamination of off-base groundwater. One fuel spill in 1978 did temporarily contaminate off-base surface water (Union Creek), but due to removal and dissipation did not have any long term effect to either surface water or groundwater.

Water that is treated and discharged to storm sewers or Union Creek will meet stringent clean water standards (drinking water levels) set by the State of California Regional Water Quality Control Board. The Board will oversee the operation of all treatment plants and verify compliance with the discharge standards.

Public Comment 1b: Additional information was requested on the location of the groundwater contamination south of the base relative to the location of off-base wells and roads.

USAF Response: There are two plumes of contaminated groundwater that have migrated beyond the southern base boundary. The groundwater flow in this area is to the South. The plumes are referred to as site SS030 and FT005 (see figure 5 of the Proposed Plan). The most recent data indicate the southernmost edge of the SS030 plume is approximately 1000 feet north of Creed Road, 1000 feet north-northeast of the nearest production well, and 1300 feet north-northwest of the nearest Travis AFB monitoring well pair on Creed Road. The southernmost edge of the FT005 plume is approximately 2000 feet north of creed road, 1/2 mile west-northwest of the nearest production well, and 1/2 mile north-northwest of the nearest Travis AFB monitoring well pair on Creed Road.

Public Comment 1c: There was a concern that removal of contaminated groundwater would reduce the supply of water on neighboring property.

USAF Response: Pumping will be designed to extract only contaminated groundwater and to minimize the amount of groundwater requiring treatment. The groundwater action is intended to remove only the quantity of water that will achieve capture of the contaminated plume. Based on modeling of the groundwater south of the base, the operation of extraction wells associated with remediation of the off-base plumes would have a minor effect (less than a 3 foot decrease in average water level) on a well 1,000 feet from the remedial extraction wells, a minimal effect (less than a 5 inch decrease in average water level) on a well 1 mile from the extraction wells, and no discernible effect (less than 1 inch decrease in average water level) on wells 1.25 miles or more from the extraction wells. During operation of the extraction wells, the effects on water levels will be monitored and evaluated to ensure there is not a significant impact on the off-base groundwater supply.

Public Comment 2a: The Proposed Plan is based on very limited testing of soil and/or groundwater on the Freitas property (the only testing we are aware of was 5 hydropunch samples taken in one limited area in July, 1995). Is the need for any further testing anticipated? If so, what type of testing and when should it take place? Given the limited testing done, with what degree of confidence has the level of contamination and the extent of the contaminated groundwater plume been established?

USAF Response: The results of on-base soil, sediment, surface water, and groundwater sampling for landfill No. 2 (also known as site LF007) were presented in the North Operable Unit (NOU) Remedial Investigation (RI) Report of July 1995. The report concluded that the contamination and the contamination sources were all on-base except trichloroethene (TCE) groundwater contamination near the northern boundary of the landfill. In order to investigate the level and extent of the off-base groundwater contamination, the five groundwater samples (hydropunch) were taken on the Freitas property. The results of this groundwater sampling are

documented in the NOU RI Report Addendum of October, 1995 and showed one off-base detection of TCE (31 µg/L) surrounded by four locations (east, north-northeast, north-northwest and west) with no detection of TCE. Based on that information, Travis AFB considers the plume to be adequately defined for planning and selection of interim remedial actions. Additional sampling may be needed for specific engineering design purposes. Samples may also be collected at some time in the future (probably several years from now) to confirm that the interim remedial goal has been attained and that the groundwater concentrations meet drinking water standards.

Public Comment 2b: The Proposed Plan does not define a time line for the cleanup process. What level of hazard is presently associated with the Freitas property? What reduction in the level of contamination is targeted, and over what time frame? What are restrictions (as a practical matter) on use of the Freitas property while the cleanup process is taking place?

USAF Response: Our current estimate is that it could take 12 years to reduce the TCE concentration in the off-base plume from 31 µg/L to the drinking water standard of 5 µg/L. There is no current level of hazard (human health risk) from the groundwater contamination because the water is not being used. The groundwater contamination will not affect surface land uses (such as ranching or agriculture). Prior to cleanup, a production well (for household or livestock consumption) should not be installed in the area where the five off-base samples were taken. Also, during any soil excavations that would reach the groundwater in this area, minor precautions should be taken to limit worker exposure to the contaminated groundwater.

Public Comment 2c: Since the source of contamination on the Freitas property is apparently, at least in part, Landfill 2, and since the plan anticipates only natural attenuation and monitoring of Landfill 2, what is the likelihood of further contamination emanating from Landfill 2 and further contaminating the Freitas property?

USAF Response: At Landfill 2 (LF007), wells will be installed to pump and treat the off-base plume to reduce the contamination level to MCLs and to prevent future off-base migration of contaminated groundwater. The remaining portions of Landfill 2 will use natural attenuation as an interim action. This is considered a reasonable approach since the contaminant levels are low and the plume has exhibited limited migration thus far. In addition, although the area in question has groundwater migration to the north, this is a localized anomaly and the overall direction of groundwater migration is generally toward the south. The installation of the extraction well is expected to stop the northward migration and allow the regional southerly migration to dominate.

The results of this approach will be periodically monitored and reviewed by the regulatory agencies, and more aggressive action will be implemented if it appears there is any potential for future migration onto the Freitas property. Also, the anticipated remedial action for the soil at Landfill 2 (capping) will reduce the infiltration of rainwater into the landfill and will route drainage away from the landfill areas. This action will reduce the groundwater flow potential and the movement of contaminants and will also reduce the localized flow direction to the north.

Appendix Tab

A

APPENDIX A

SITE-SPECIFIC SUMMARIES

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

APPENDIX A
SITE-SPECIFIC SUMMARIES

Appendix A includes site-specific information for each groundwater site within the North, East, and West Industrial Operable Unit (NEWIOU). The site-specific information is presented as text as well as on a composite figure showing the general conceptual site model, the extent of groundwater contamination, and the conceptual layout for the extraction strategy. These site-specific summaries include background and contaminant information from the individual Operable Unit (OU) Remedial Investigation (RI) reports, a brief description of the Feasibility Study (FS) evaluation, including specific costs, and a description of the selected interim remedial actions and objectives.

A detailed description of the alternatives developed in the FS is included in Section 4.0 of this Interim Record of Decision (IROD). The Air Force developed the FS alternatives, as described in Section 3.0 of the NEWIOU FS, to meet the Remedial Action Objectives (RAOs) to compare alternatives based on cleanup of the contaminated groundwater to drinking water standards. The Air Force evaluated the alternatives with a scoring system developed in the FS. Each interim remedial action was scored on the basis of seven Comprehensive Environmental Response Compensation and Liability Act (CERCLA) criteria (see Figure 4-1 and Table 4-4). Scores for each action are discussed in the site summaries.

Additionally, the Air Force estimated costs in the FS for the extraction, treatment, and discharge alternatives and these costs are presented for each site in this appendix. (The Alternative numbers 3 through 9 in this section are the numbers used in the FS for the treatment alternatives. These alternatives have been combined into Alternative 3 [Extraction, Treatment, and Discharge] in the Groundwater IROD.) The interim remedial actions selected for the Groundwater IROD are the most cost-effective approach; the cost for the interim action may differ from the costs developed for the comparison of alternatives in the FS. However, these costs are included to allow comparison of alternatives. Final costs for each site will be developed

during the design phase, and will reflect the groundwater extraction strategy and the combining of extracted water from different sites for treatment at one or more locations.

Also, the Air Force will finalize the layout and design of the extraction wells (vertical or horizontal) during the design phase; the layout of extraction wells presented on the site-specific figures is conceptual. The Air Force will specify monitoring wells for all groundwater sites during the design phase and may include existing or new locations. The Air Force will use these wells to collect data at all sites for natural attenuation. The aerial extent of contamination is indicated on the site-specific figures, and an estimated volume of contaminated groundwater is included for general comparisons. The Air Force will use data obtained during the remedial design/remedial action (RD/RA) phase and analysis of site-specific data to optimize locations of extraction and monitoring wells.

The Air Force will provide the monitoring data from all sites to the regulatory agencies and the Restoration Advisory Board (RAB) for their review and comment. At sites where natural attenuation is assessed, the Air Force will also provide each site's data summary and assessment report for review and approval. A formal review at the end of the five-year interim period will address the acceptability of natural attenuation as a final cleanup action. After this five-year review, a Basewide Groundwater Proposed Plan will present the preferred final cleanup action (natural attenuation, pump and treat, or other) for each site. This Proposed Plan will have a minimum 30-day public comment period. Following the Proposed Plan, a final Groundwater Record of Decision (ROD) will finalize the cleanup decision. The Air Force will submit the Draft Final Groundwater ROD to the agencies and the RAB for review and comment. The regulatory agencies will review and approve the Draft Final Groundwater ROD.

Other chemicals that are not contaminants of concern (COCs) may also be identified in the site summaries, either in the text or on the figures. Total petroleum hydrocarbons (TPH) are not identified as COCs for any sites in the East Industrial OU (EIOU). Where TPH concentrations are greater than 1,500 µg/L or where TPH may be a potential threat to ecological

receptors, TPH concentrations are presented. In addition, at some sites throughout the NEWIOU, metals, although not COCs, may affect discharge if concentrations are above National Pollution Discharge Elimination System (NPDES) limits. In such cases, the metals that may need treatment are identified. The need for metals treatment to meet NPDES limits will be determined during the RD/RA.

These site-specific summaries present information developed during the CERCLA process to support the selected interim action(s) for each site. This information will be useful in guiding future design decisions, although each OU RI report includes a complete record of the site contaminants that may affect future engineering considerations.

A.1 SITE FT004 (FIRE TRAINING AREA 3)

A.1.1 Site Background

Site FT004 covers approximately 30 acres in the north-eastern portion of the EIOU and consists of the old Fire Training Area 3 (FTA-3). The site was used for fire training exercises from 1953 to 1962 (Weston, 1995a). During these exercises waste fuel, oils, and solvents were dumped onto frames or on the ground and burned. Some soil staining and stressed vegetation was observed during recent investigations at the site, now an unused, open field.

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2.-3 and Appendix A of the RI indicate that groundwater samples were collected from monitoring wells at FT004. The Air Force collected 28 groundwater samples in Rounds 7 through 9 and analyzed them for volatile organic compounds (VOCs), inorganic constituents, semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), and petroleum hydrocarbons. In addition, the Air Force collected subsurface samples from 7 soil borings, 3 sediment samples, and 11 surface soil samples. Sampling locations, constituents analyzed, and results can be obtained in the EIOU RI (Weston, 1995a).

COCs found in the groundwater during the RI conducted at the site are primarily VOCs, with one SVOC and one metal also identified as a COC. VOCs include trichloroethene (TCE), cis-1,2-dichloroethene (DCE), 1,2-dichloroethane (DCA), chloroform, dichlorobromomethane, 1,1-DCE, vinyl chloride, and 1,4-dichlorobenzene. The SVOC identified as a COC at FT004 is bis(2-ethylhexyl)phthalate, and the metal is nickel. Although not a COC, TPH was identified at an average of 1,000 µg/L (maximum 7,700 µg/L). Site location, contaminant concentrations, and a conceptual site model are shown on Figure A-1. Other

contaminants found at the site include dioxins and metals (copper, antimony, cadmium, lead, and zinc) in the soil.

A.1.2 Feasibility Study

The alternatives evaluated in the FS for FT004 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, ultraviolet oxidation [UV-OX], ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 has a capital cost of $18,600, first year operation and maintenance (O&M) cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had similar scores ranging from 27 to 29. Costs were $915,000 capital with $280,000 O&M for Alternative 3; $960,000 capital with $310,000 O&M for Alternative 5; and $3 million capital with $3 million O&M for Alternative 7.

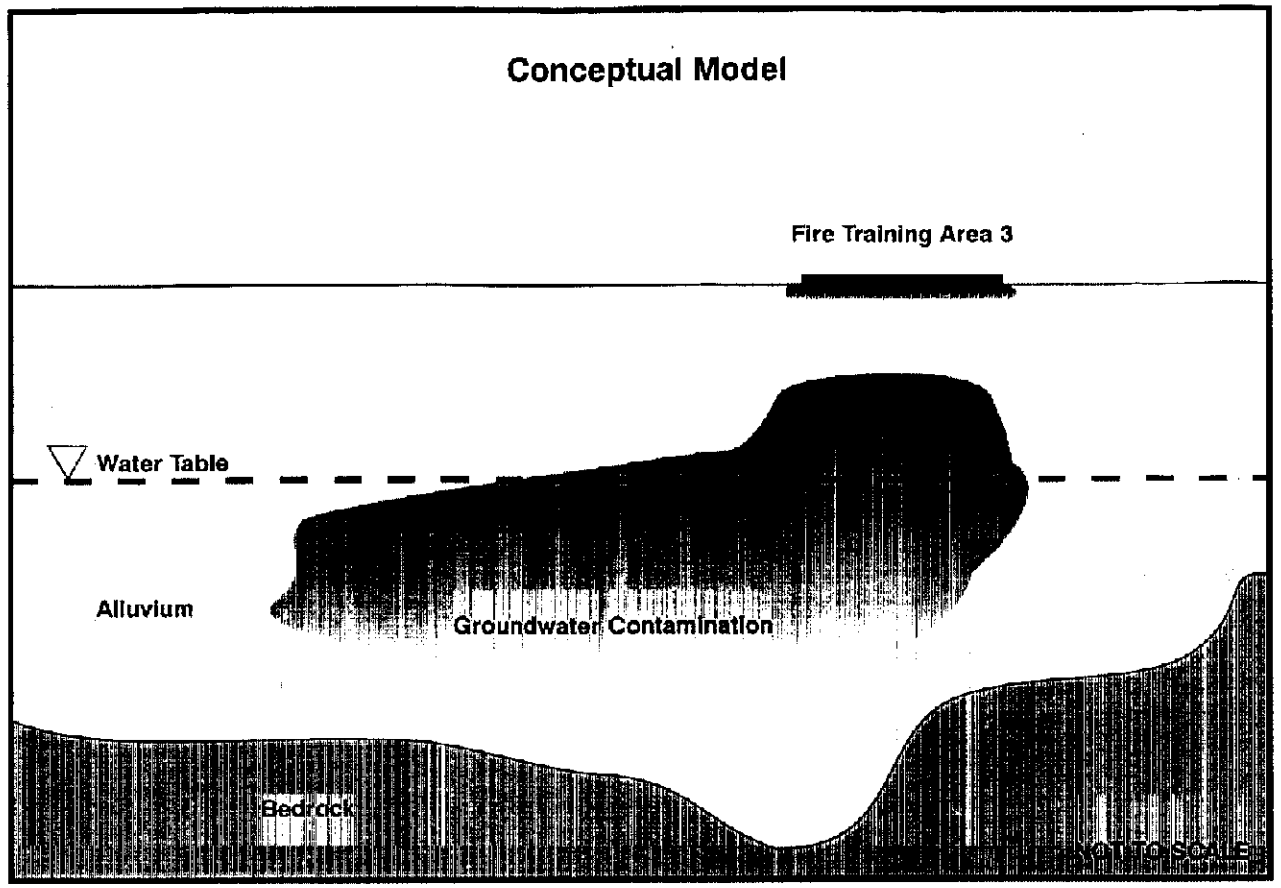
A.1.3 Selected Interim Remedial Actions/Objectives

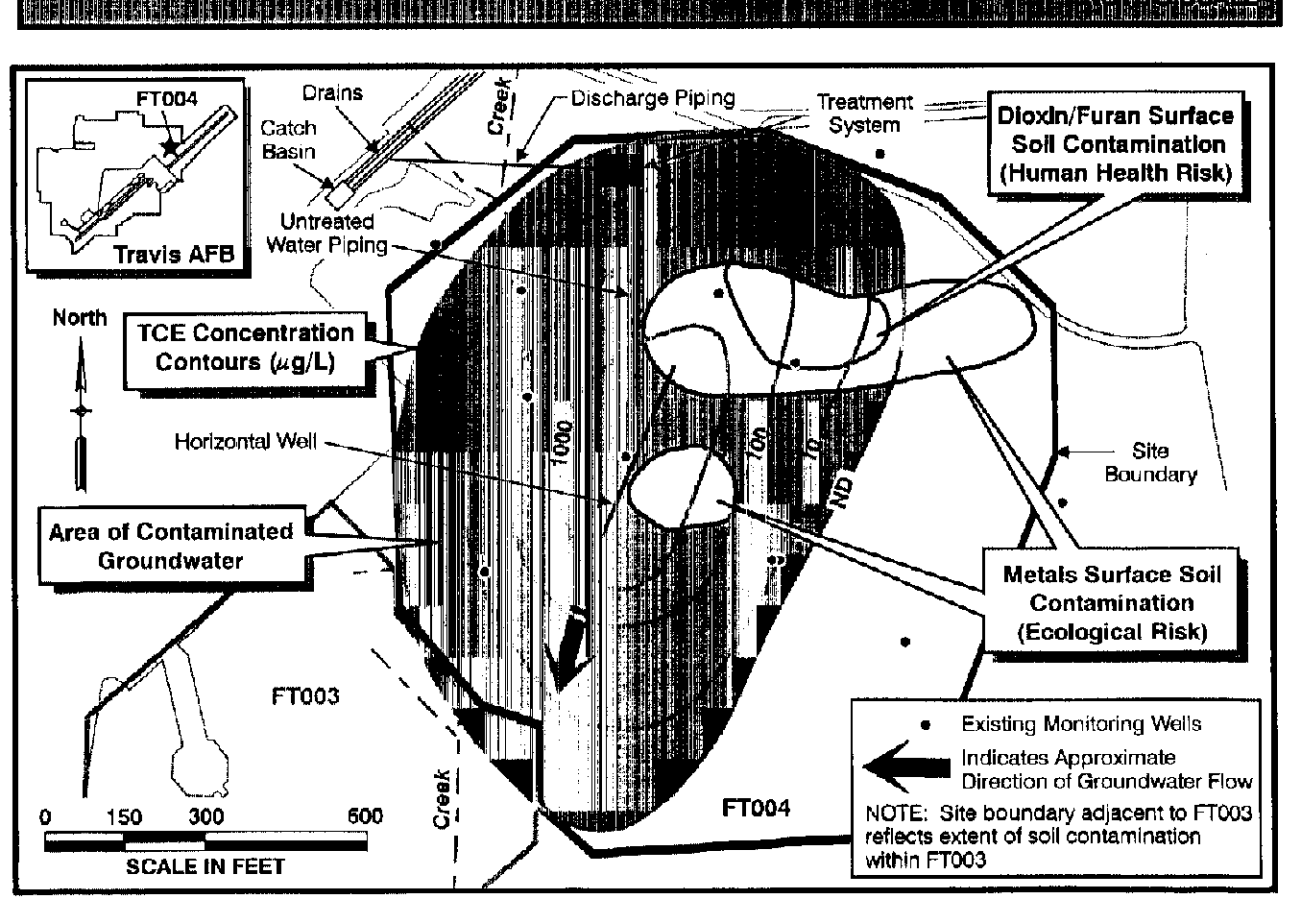
The selected interim action for groundwater at FT004 is Alternative 3, Extraction, Treatment, and Discharge. The Air Force will accomplish this with source control for the TCE. Source control has been selected for this site because the presence of dense non-aqueous phase liquid (DNAPL) is suspected with TCE concentrations greater than 3,000 µg/L.

A.1.4 Conceptual Site Model

Fire training exercises may have led to groundwater contamination at FT004 by leaching from burned material. The groundwater COCs (VOCs, SVOC, and nickel), however, were not identified as COCs in soil. Soil contamination was detected and COCs include dioxins and metals. These contaminants in soil have low mobility and have not impacted groundwater

(i.e., dioxins and the specific metals in soil are not COCs in the groundwater). Any anticipated soil cleanup action is not expected to have an effect on groundwater because the COCs are not the same. The source of the nickel in groundwater is not known and is currently being investigated.





FT004 (Fire Training Area 3)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk for These Contaminants Is HR = 1.69×10^{-3}	TCE	5,200 µg/L
Groundwater	VOCs		cis-1,2-DCE	14.7 µg/L
Groundwater	VOCs		1,2-DCA	5.12 µg/L
Groundwater	VOCs		Chloroform	1.81 µg/L
Groundwater	VOCs		Dichlorobromomethane	3.1 µg/L
Groundwater	VOCs		1,1-DCE	1.28 µg/L
Groundwater	VOCs		Vinyl Chloride	6.1 µg/L
Groundwater	VOCs		1,4-Dichlorobenzene	3.8 µg/L
Groundwater	SVOCs		bis(2-ethylhexyl)phthalate	5.49 µg/L
Groundwater	Metals		Nickel	2,540 mg/L

Site Characteristics

- Open field, less than 10% paved area
- TCE in groundwater — 830 µg/L average, 5,200 µg/L maximum
- Estimated contaminated groundwater surface area = 530,000 ft^2, volume = 4,100,000 ft^3
- Estimated mass of dissolved VOCs equals 230 lb; DNAPL may be present
- Ar, Cr, Cu, Pb, Se, and Ag were measured at concentrations greater than NPDES discharge limits in some monitoring wells
- Depth to groundwater — 10 feet, depth to bedrock — 30 feet
- Silt and clay to 10 feet bgs, silty sand with minor gravel from 10 to 40 feet bgs
- Site also studied for surface soil contamination

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Source Control for TCE

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon
    Capital Cost = $915,000; First Year O & M = $280,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon
    Capital Cost = $960,000; First Year O & M = $310,000
  - FS Alternative 7: Ion Exchange, Activated Carbon
    Capital Cost = $3,000,000; First Year O & M = $3,000,000
- These costs derived from the FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- One horizontal well, 300 feet in screened length
  (NOTE: Location and number of wells will be determined during remedial design phase)
- Extraction rate 15 gpm total
- 700 feet of untreated water piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 200 feet of discharge piping (to storm sewer) — 2 inch ID, sch 80 PVC
- 300 feet from treatment system to existing power line

Figure A-1.
Site Summary Information for FT004, Travis AFB

5FT004.CDR - VMG 8/19/97 SAC 1

A.2 SITE FT005 (FIRE TRAINING AREA 4)

A.2.1 Site Background

Site FT005 covers approximately 30 acres in the southeastern portion of the EIOU. The site is the location of the old Fire Training Area 4 (FTA-4) and was used for fire training exercises from 1962 through 1987, approximately. Historical aerial photographs indicate that the area may have also been used for munitions storage prior to 1958 (Weston, 1995a). From 1962 until the early 1970s, waste fuels, oils, and solvents were burned at the site during training exercises. From the early 1970s until FTA-4 was closed, only waste fuels were burned. An aboveground storage tank was installed around 1976 to hold the waste fuels and is currently located at the site. The site had no berms or dikes to contain runoff, and surface runoff may have flowed into Union Creek during training exercises. During site visits some stressed vegetation was observed in areas bordering the site and drainage swales (Weston, 1995a).

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2.-3 and Appendix A of the RI indicate that groundwater samples were collected from monitoring wells and from CPT locations at FT005 during Rounds 7 through 9. The Air Force collected 78 groundwater samples and analyzed them for VOCs, SVOCs, PCBs, pesticides, petroleum hydrocarbons, and inorganic constituents. In addition, the Air Force collected subsurface soil samples from 7 soil borings, 16 surface soil samples, and 3 sediment samples. Sampling locations, constituents analyzed, and results can be obtained in the EIOU RI (Weston, 1995a).

COCs found in the groundwater during the RI are primarily VOCs, with one SVOC and one metal also identified. VOCs include TCE, 1,2-DCA, cis-1,2-DCE, chloroform, and

dichlorobromomethane. The SVOC identified as a COC is bis(2-ethylhexyl)phthalate, and the metal is nickel. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-2. Contaminants detected in soils at the site include polynuclear aromatic hydrocarbons (PAHs), PCBs, dioxins, pesticides, and metals (chromium, copper, lead, cadmium, nickel, selenium, and zinc) in the surface and subsurface soils.

A.2.2 Feasibility Study

The alternatives evaluated in the FS for FT005 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had similar scores ranging from 29 to 31. Costs were $1.8 million capital with $260,000 O&M for Alternative 3; $1.85 million capital with $295,000 O&M for Alternative 5; and $1.7 million capital with $360,000 O&M for Alternative 7.

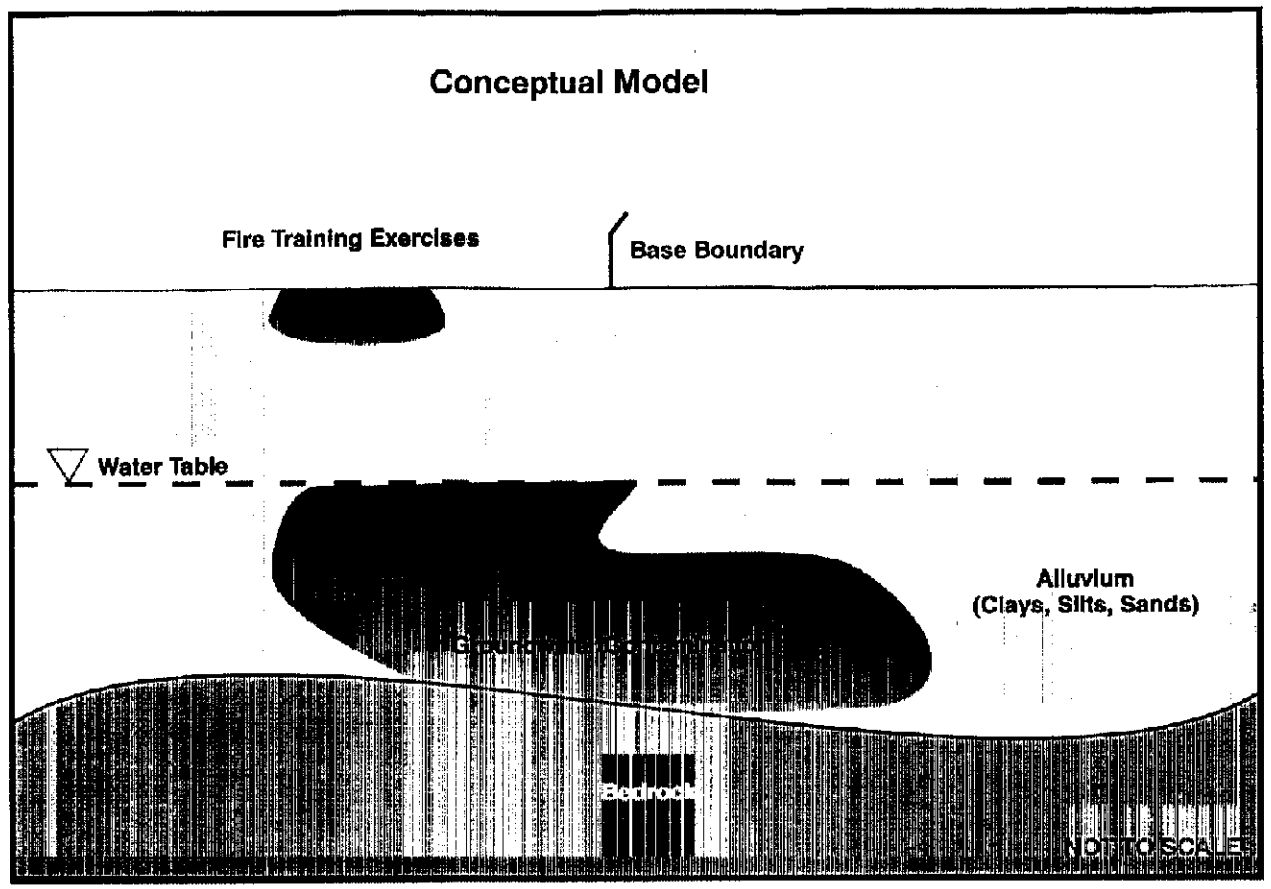
A.2.3 Selected Interim Remedial Actions/Objectives

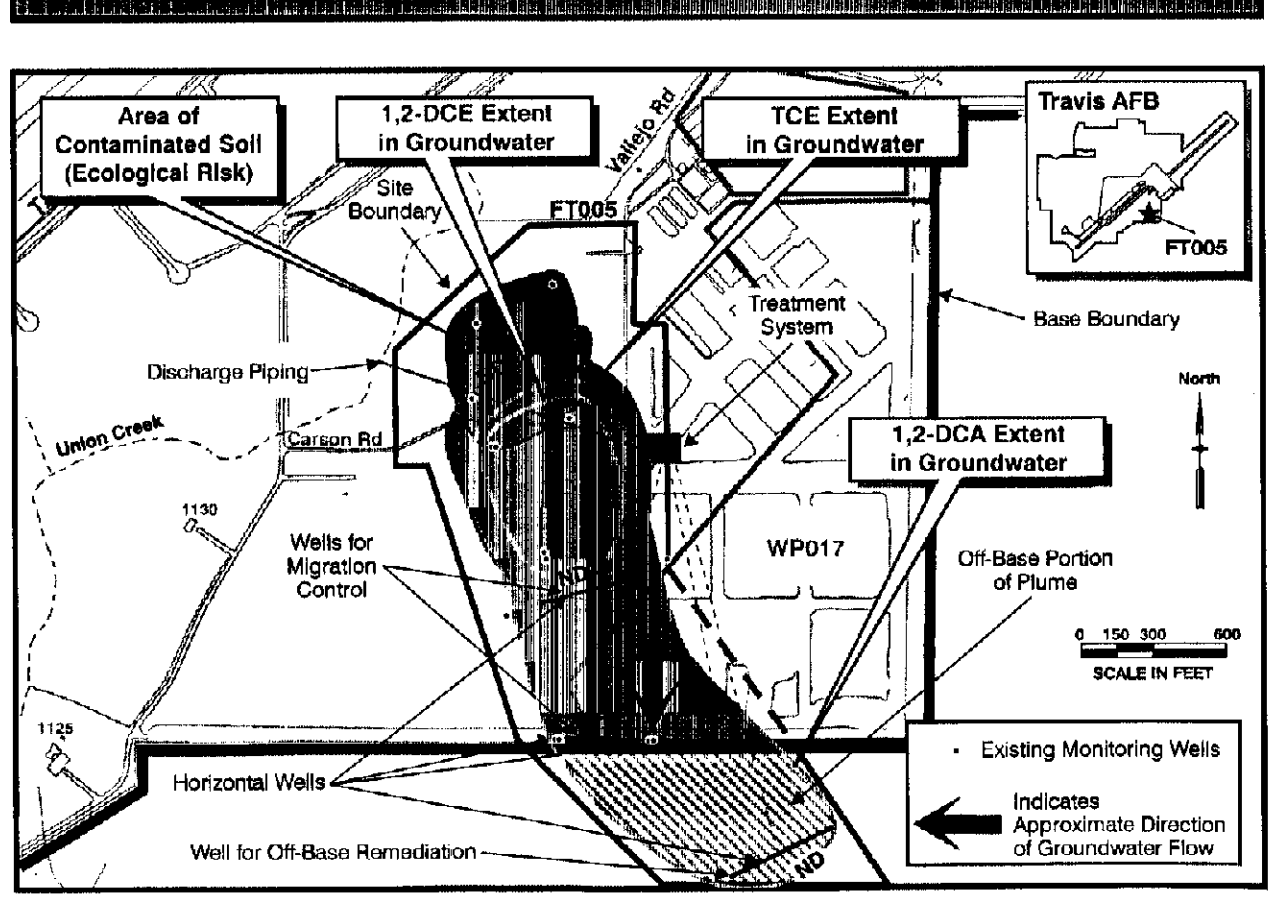
The selected interim action for groundwater at FT005 is Alternative 3, Extraction, Treatment, and Discharge. The Air Force will accomplish this with a combination of off-base remediation for 1,2-DCA and migration control to control movement of contaminated groundwater.

A.2.4 Conceptual Site Model

Fire training exercises may have led to groundwater contamination by leaching of the solvents burned at FT005 but VOCs and fuels were not identified as COCs for soil. Surface soil contamination includes PAHs, PCBs, pesticides, dioxins, and metals. These contaminants in soil have not impacted groundwater, and any anticipated soil cleanup action is not expected to have an effect on groundwater.

Nickel is an identified COC in both the groundwater and the soil. However, the source of the nickel is not known and is currently being investigated. A portion of the groundwater plume with 1,2-DCA has migrated off-base; TCE contamination has remained on-base.





FT005 (Fire Training Area 4)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk for These Contaminants Is $HR = 1.12 \times 10^{-4}$	TCE	120 µg/L
Groundwater	VOCs		1,2-DCA	14.2 µg/L
Groundwater	VOCs		cis-1,2-DCE	19 µg/L
Groundwater	VOCs		Chloroform	10 µg/L
Groundwater	VOCs		Dichlorobromomethane	1.8 µg/L
Groundwater	SVOCs		bis(2-ethylhexyl)phthalate	35.9 µg/L
Groundwater	Metals		Nickel	370 mg/L

Site Characteristics

- Site is located in an area of Travis AFB that is inactive except for explosives detonation
- TCE in groundwater — 3.3 µg/L average, 120 µg/L maximum
- Estimated contaminated groundwater surface area = 1,600,000 ft^2; volume = 12,000,000 ft^3
- Estimated mass of dissolved VOCs equals 3.9 lb; no evidence of DNAPL or LNAPL
- Cr, Cu, and Hg were measured at concentrations greater than NPDES discharge limits in some monitoring wells
- Depth to groundwater — 10 feet; depth to bedrock — 50 feet
- Permeable materials (sand and silt) occur through depths of 20 to 40 feet bgs
- Some low permeability soils (clay and silt) occur between 10 and 30 feet bgs
- Site also studied for surface soil contamination
- The bold dashed line indicates where the FT005 groundwater contamination overlaps the soil site WP017

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Off-base Remediation for 1,2-DCA
  - Migration Control for TCE and 1,2-DCA

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $1,800,000; First Year O & M = $260,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $1,850,000; First Year O & M = $295,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $1,700,000; First Year O & M = $360,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- 4 horizontal wells, 300 feet in screened length
  (NOTE: Location and number of wells will be determined during the remedial design phase)
- Extraction rate 60 gpm total, 15 gpm from each well
- 4,500 feet of untreated water piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 1,000 feet of discharge piping (to Union Creek) — 3 inch ID, sch 80 PVC
- 1,000 feet from treatment system to existing power line

Figure A-2.
Site Summary Information for FT005, Travis AFB

5FT005.CDR - VMG 8/19/97 SAC 1

A.3 SITE LF006 (LANDFILL 1)

A.3.1 Site Background

Site LF006 is the location of old Landfill 1 and covers approximately 17 acres in the North OU (NOU). Landfill 1 was operated as a burn-and-fill landfill from 1943 through 1950. Materials disposed of and burned in the landfill consisted primarily of general refuse such as wood, glass, and construction debris, although some disposal of industrial wastes was reported (Radian, 1995b). A trailer park was built over a portion of the site in 1970 and is still in use.

The Air Force collected groundwater samples in 12 locations at LF006A during the RI. Four soil borings were drilled to groundwater, where HydroPunch® samples were collected; three cone penetrometer (CPT) locations were sampled for groundwater; five monitoring wells were sampled. Groundwater samples were analyzed for petroleum products (diesel, JP4, oil, and TPH-gasoline), pesticides and PCBs, VOCs, SVOCs, dioxins/furans, gross alpha and gross beta, and inorganic constituents (Radian, 1995b).

In addition to groundwater sampling efforts, the Air Force collected the following soil gas, surface emission flux, surface water, sediment, surface soil, and subsurface soil samples from the entire NOU: approximately 286 shallow subsurface soil gas samples at 3 feet depth; 24 surface emission flux sampling locations; 22 sediment samples; 6 surface water samples; surface soil samples from 59 soil boring locations to determine if contamination was present; and subsurface soil from 52 soil borings and 7 monitoring wells. Sampling locations, constituents analyzed, and results are presented in the NOU RI (Radian, 1995b).

VOCs are the only COCs detected in the groundwater at the site during the RI. They include TCE, 1,1-DCE, and TPH.

Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-3. The general extent of groundwater contamination is shown; the sampling results do not indicate plumes that can be defined by concentration isopleths. The detected concentrations indicate pockets of contamination that vary by location and show no increasing or decreasing pattern that could be contoured. The northern area of contamination is related to TPH only; the southern area of contamination includes TCE, TCE degradation by-products, and TPH.

A.3.2 Feasibility Study

The alternatives evaluated in the FS for LF006 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had similar scores ranging from 27 to 29. Costs were $860,000 capital with $100,000 O&M for Alternative 3; $880,000 capital with $130,000 O&M for Alternative 5; and $640,000 capital with $61,000 O&M for Alternative 7.

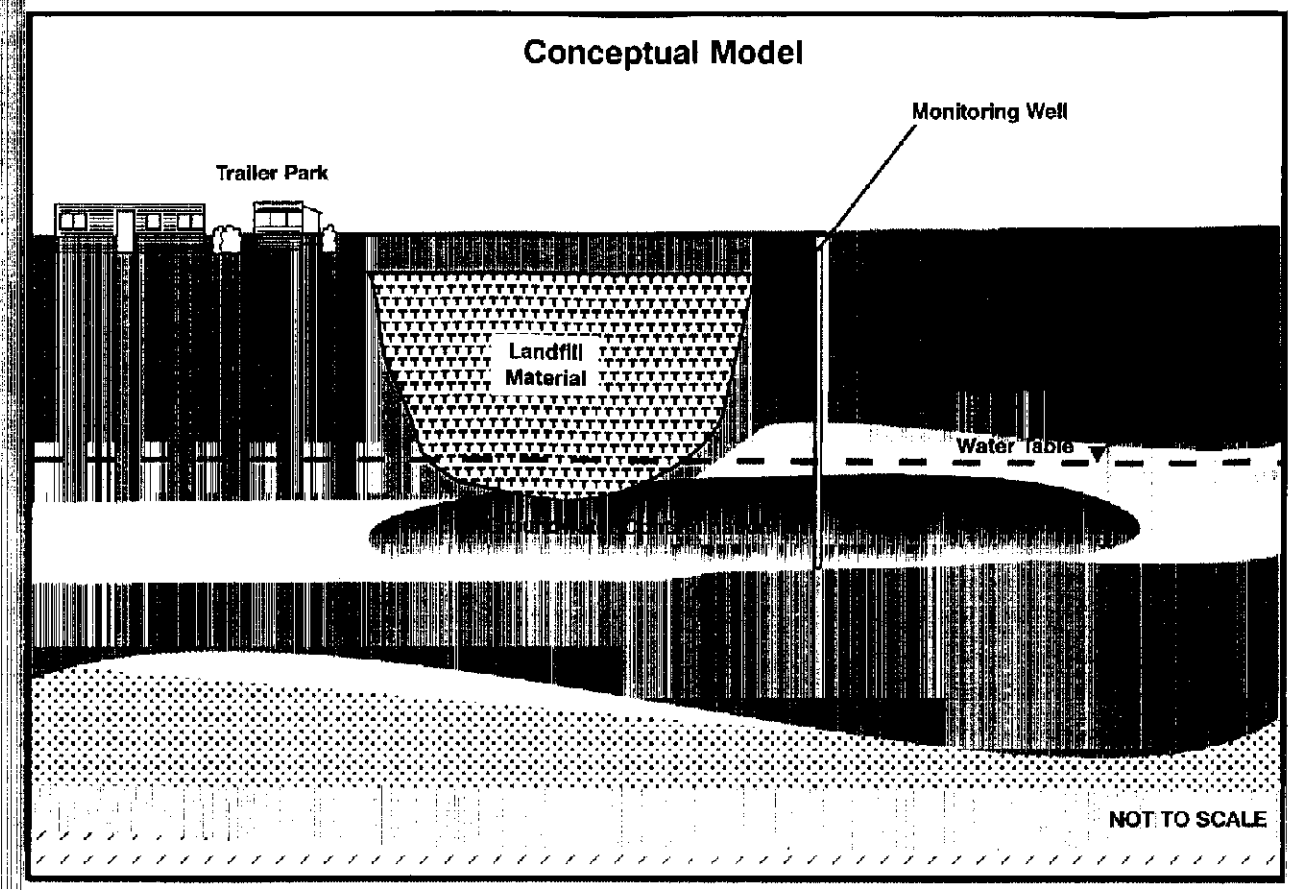
A.3.3 Selected Interim Remedial Actions/Objectives

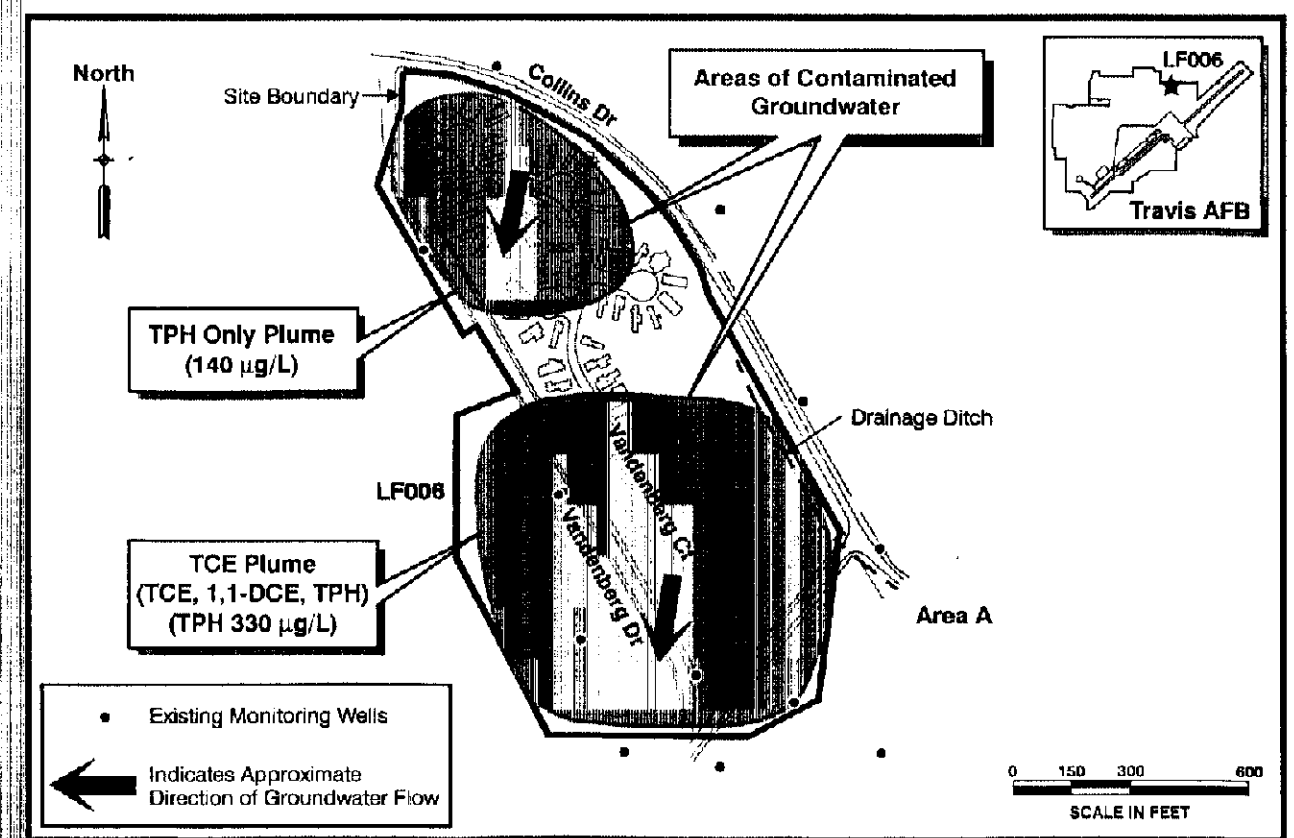
The selected interim action for groundwater at LF006 is Alternative 2, Natural Attenuation in conjunction with groundwater monitoring. Alternative 2 is a cost-effective way to meet CERCLA criteria, though at a slower rate than Alternative 3, for sites that have low concentrations (maximum 330 µg/L TPH, maximum 20 µg/L TCE) and stable plumes. The site-specific characteristics of LF006 and the groundwater sample results from the RI and 1996 quarterly sampling events provide evidence that natural attenuation is a viable remediation alternative. For instance, the clustered areal distribution of TCE concentration results within LF006 were low (highest detection limit was 20 µg/L TCE at location CPT-2) and, therefore, are

susceptible to stabilization via natural attenuation. Also, with the presence of TPH at LF006, TCE may indirectly be cometabolized as TPH is utilized as an energy source by bacteria. Furthermore, dichloroethenes, such as cis-1,2 DCE and 1,1-DCE, daughter products of the biodegradation of TCE, were detected in a number of monitoring wells, soil borings, and CPTs located in the southern portion of Site LF006 (Table A-1). Because dichloroethenes were not a primary/initial contaminant, data suggest that natural attenuation may be occurring via reductive dehalogenation of TCE. The effect of natural attenuation on reducing contaminant toxicity, mobility, and/or volume, will be documented by monitoring at strategic locations. The details of the monitoring will be included in the remedial design for the site.

A.3.4 Conceptual Site Model

Leaching from the buried waste material appears to have been the source of the groundwater contamination at LF006. There are no COCs for subsurface soil or surface soil at this site.





LF006 (Landfill 1, Area A)

690 201

Primary Contaminants, Remediation Driverts and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 6.3×10^{-6}	TCE	20 µg/L
Groundwater	VOCs	HR = 1.7×10^{-6}	1,1-DCE	0.64 µg/L
Groundwater	TPH	NA	NA	330 µg/L

Site Characteristics

- Mostly flat grassland
- Mobile homes cover approximately 40% of the study area (northwest portion)
- Drainage ditches transport surface water to the south and east
- Located over former burn/fill trenches
- TCE in groundwater — 5 µg/L average, 20 µg/L maximum
- TPH in groundwater — 120 µg/L average, 330 µg/L maximum
- Estimated contaminated groundwater surface area = 440,000 ft^2, volume = 2,200,000 ft^3
- Estimated mass of dissolved VOCs equals 0.4 lb; no evidence of DNAPL or LNAPL
- Depth to groundwater — 10 feet
- Depth to bedrock — 50 feet
- Low permeability soils (clay) to about 25 feet bgs
- More permeable material (sands and silts) between 25 feet bgs and bedrock

Interim Remedial Action/Objectives

- Alternative 2: Natural Attenuation/Monitoring for TPH-only and TCE plumes

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $860,000; First Year O & M = $100,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $880,000; First Year O & M = $130,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Captal Cost = $640,000; First Year O & M = $61,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- Monitoring Wells (NOTE: Location and number of wells will be determined during the remedial design phase)
- Sampling to Confirm Stability of Plume Size and Rate of Natural Attenuation

Figure A-3.
Site Summary Information for LF006, Travis AFB

5LF006.CDR - VMG 4/28/97 SAC 1

A.4 SITE LF007 (LANDFILL 2, AREAS B, C, AND D)

A.4.1 Site Background

Site LF007 is located at old Landfill 2 and occupies approximately 73 acres in the NOU. The landfill was operated in a trench-and-fill method beginning in the early 1950s following the closure of Landfill 1. The landfill was used primarily for the disposal of general refuse such as wood, glass, and construction debris. Small amounts of industrial wastes and fuel sludges from tank cleaning operations were also reported to have been disposed of at Landfill 2 (Radian, 1995b). Use of Landfill 2 ceased in 1974. From the early 1950s until 1964, a portion of the eastern part of the landfill was used for storage of excess and waste materials including oils, hydraulic fluid, and solvents for resale or disposal. As determined by aerial photographs, a skeet range was also located at the site around 1953; however, the exact dates of operation are not known (Radian, 1995b). Current operations at the site are limited to those conducted at Buildings 1360, 1365, and 1370. Building 1360 is the Affiliate Radio System, Building 1365 is used for hazardous waste storage, and Building 1370 houses the Small Arms Range. Artificial vernal pools (created by landfill subsidence), which may contain the endangered species fairy shrimp, are located at the site. Groundwater does not discharge to the vernal pools.

The Air Force collected groundwater samples from 30 locations at LF007. Twenty-eight HydroPunch® samples were collected from soil borings, and two monitoring wells were sampled. Groundwater samples were analyzed for petroleum products (diesel, JP4, oil, and TPH-gasoline), pesticides and PCBs, VOCs, SVOCs, dioxins/furans, gross alpha and gross beta, and inorganic constituents (Radian, 1995b).

In addition to groundwater sampling efforts, the Air Force collected the following soil gas, surface emission flux, surface water, sediment, surface soil, and subsurface soil samples from the entire NOU: approximately 286 shallow subsurface soil gas samples at 3 feet depth, 24 surface emission flux sampling locations, 22 sediment samples, 6 surface water samples;

surface soil samples from 59 soil boring locations to determine if contamination was present; and subsurface soil from 52 soil borings and 7 monitoring wells. Sampling locations, constituents analyzed, and results are presented in the NOU RI (Radian, 1995b).

Groundwater contamination has been found in three areas of the site, referred to as Areas B, C, and D. These are general areas of groundwater contamination; plumes with decreasing concentration isopleths could not be identified because of the nature of the landfill operation, and in part to a lack of migration away from the trench areas. Classes of COCs detected in the groundwater during the RI at Area B include VOCs, one SVOC, one PCB, and one dioxin. VOCs in Area B include benzene, 1,4-dichlorobenzene, and chlorobenzene, and the SVOC is bis(2-ethylhexyl)phthalate. PCB-1248 and 2,3,7,8-TCDDeq (a dioxin) were also identified as COCs at LF007B. VOCs make up all COCs detected at Area C during the RI, and include TCE, vinyl chloride, 1,1-DCE, 1,2-DCA, and 1,2-dichloropropane. Due to a local anomaly in the groundwater flow direction beneath Area C, contamination from this area has migrated off base. Classes of COCs identified at Area D include VOCs, one dioxin, one PCB, and one SVOC. VOCs include benzene, vinyl chloride, 1,4-dichlorobenzene, 1,1-DCE, and chlorobenzene. COCs also include bis(2-ethylhexyl)phthalate (a SVOC), PCB-1242, and 2,3,7,8-TCDDeq (dioxin). Site locations, contaminant concentrations, and conceptual site models for the three areas are presented in Figures A-4, A-5, and A-6. In addition, TPH (up to 4,200 µg/L at Area B, 390 µg/L at Area C, and 6,500 µg/L at Area D) has been detected in all three areas during sampling efforts conducted at the site. Contamination including PCBs, metals, and several SVOCs were detected in the surface soils at various location throughout the site during the RI.

A.4.2 Feasibility Study

The alternatives evaluated in the FS for all three areas of LF007 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5

(extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS Alternatives 1 and 2 had similar costs and scores for each of the three areas of LF007 as follows. Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, first year O&M cost of $72,000, and a score of 16. For all three areas evaluated Alternatives 3, 5, and 7 had similar scores, ranging from 27 to 29, but differing costs. For Area B the capital and first year O&M cost for the three alternatives were $770,000 capital with $105,000 O&M for Alternative 3; $815,000 capital with $133,000 O&M for Alternative 5; and $550,000 capital with $72,000 O&M for Alternative 7. For Area C the costs were $615,000 capital with $94,000 O&M for Alternative 3; $675,000 capital with $115,000 O&M for Alternative 5; and $450,000 capital with $58,000 O&M for Alternative 7. For Area D the costs were $1.8 million capital and $224,000 O&M for Alternative 3; $1.8 million capital and $266,000 O&M for Alternative 5; and $1.8 million capital and $266,000 O&M for Alternative 7.

A.4.3 Selected Interim Remedial Actions/Objectives

Selection of an alternative for the on-base Areas B and D at LF007 is deferred until the final Groundwater ROD so that additional data can be collected and evaluated to support the use of natural attenuation as a remedial alternative. Additional site-specific data regarding natural attenuation will be developed and evaluated as part of the Basewide Natural Attenuation Assessment Plan. Natural attenuation appears to be a viable alternative for both of these areas because of the small areal extent of contamination or the irregular distribution of contaminants that would make it difficult to design an extraction system that would be both technically effective and cost-effective. In addition, the presence of TPH (needed for cometabolism) and the presence of TCE degradation products indicate that conditions are present for natural attenuation to occur. Groundwater monitoring will be used to determine if contaminant migration is occurring, and if surface water infiltration has any impact on contaminant concentrations.

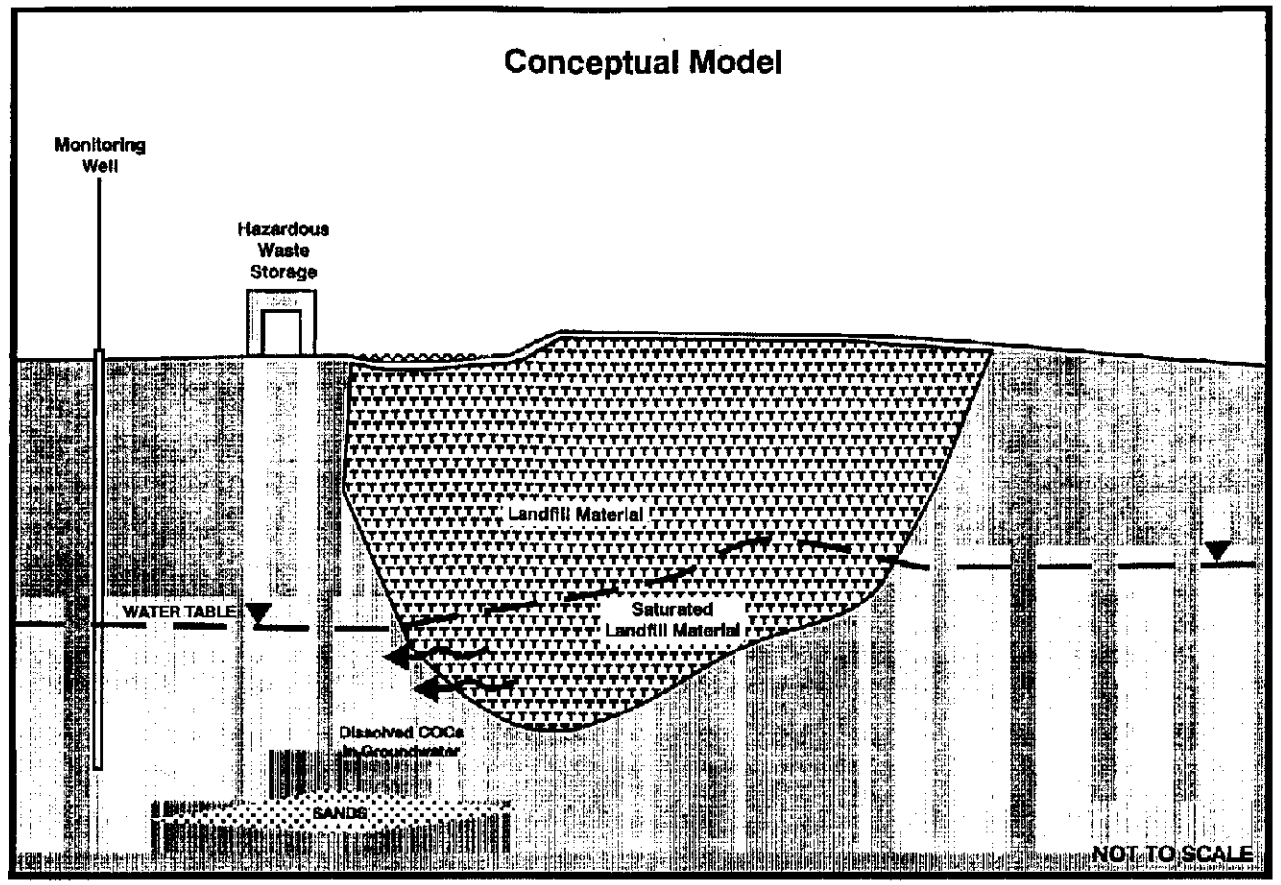
For contamination at Area C, the selected interim action includes a combination of migration control and remediation of off-base contamination. This action will be accomplished through extraction and treatment of the contaminated groundwater. Migration control on base will limit the possibility of further off-base migration of contaminants. Active extraction is the selected interim action because contamination has migrated off-base. If any portion of Area C was on-base, selection of an alternative would be deferred, and natural attenuation would be evaluated. Natural attenuation appears to be a viable alternative because of the small areal extent of contamination, TCE concentration less than 100 µg/L, the presence of TPH for cometabolism and the presence of degradation products that indicate natural attenuation is occurring. Natural attenuation with groundwater monitoring will be assessed for the on-base portion of the plume.

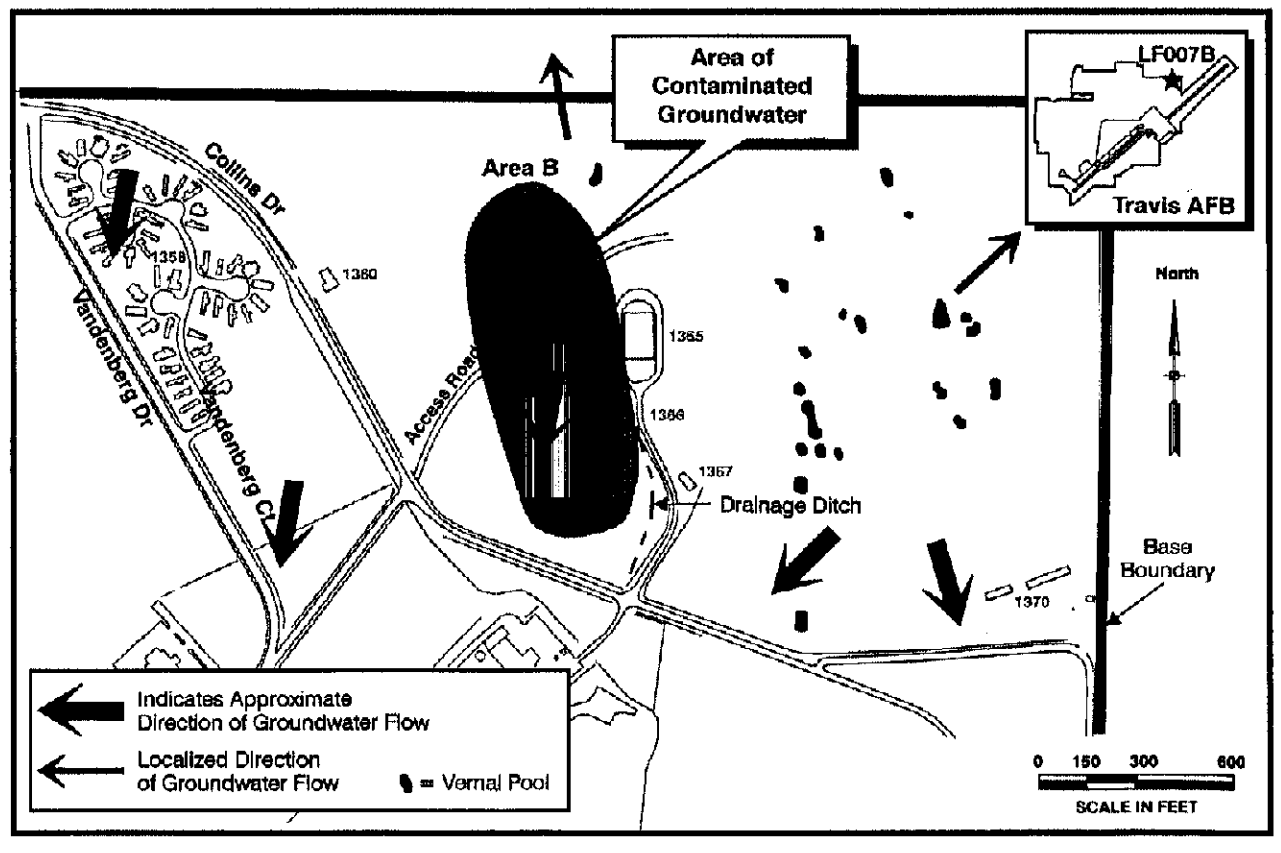
A.4.4 Conceptual Site Model

Soil contamination found in LF007 Areas B and D may be related to contamination in the groundwater found in these areas. Remediation of the surface and subsurface soils in these areas that reduces infiltration of rainwater and improves drainage may reduce the potential for vertical migration of contaminants.

A.4.5 Special Site Conditions

The current specified interim remedial action at LF007C is Alternative 3 for the portion of the plume that is off-base. If the plume were entirely on Travis AFB property, selection of an alternative would be deferred until the final Groundwater ROD.





LF007 (Landfill 2, Area B)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 3.9×10^{-5}	Benzene	59.3 µg/L
Groundwater	VOCs	HR = 1.9×10^{-5}	1,4-dichlorobenzene	30.8 µg/L
Groundwater	VOCs	HI = 1.3	Chlorobenzene	161 µg/L
Groundwater	SVOCs	HR = 4.1×10^{-6}	bis(2-ethylhexyl)phthalate	14.3 µg/L
Groundwater	Pesticides/PCBs	HR = 7.0×10^{-4}	PCBs (PCB-1248)	13.5 µg/L
Groundwater	Dioxins	HR = 1.3×10^{-6}	2,3,7,8-TCDDeq	0.55 pg/L

Site Characteristics

- Mostly grassy flatlands
- Differential settling has resulted in adjacent depressions and ridges up to 6 feet tall
- Unpaved access road
- Benzene in groundwater — 30 µg/L average, 59.3 µg/L maximum
- Chlorobenzene in groundwater — 30 µg/L average, 161 µg/L maximum
- Estimated contaminated groundwater surface area = 400,000 ft^2; volume = 2,000,000 ft^3
- Estimated mass of dissolved VOCs equals 2.3 lb; no evidence of DNAPL or LNAPL
- Depth to groundwater — 10 feet
- Depth to bedrock — 40 feet
- Backfill and landfill material ranging from 0 to 15 feet bgs
- Intermittent layers of clays and sands between landfill material and 25 feet bgs
- Intermittent layers of clays and silts from 25 to 50 feet bgs
- Site also studied for surface and subsurface soil contamination

Selected Interim Groundwater Remedial Action/Objectives

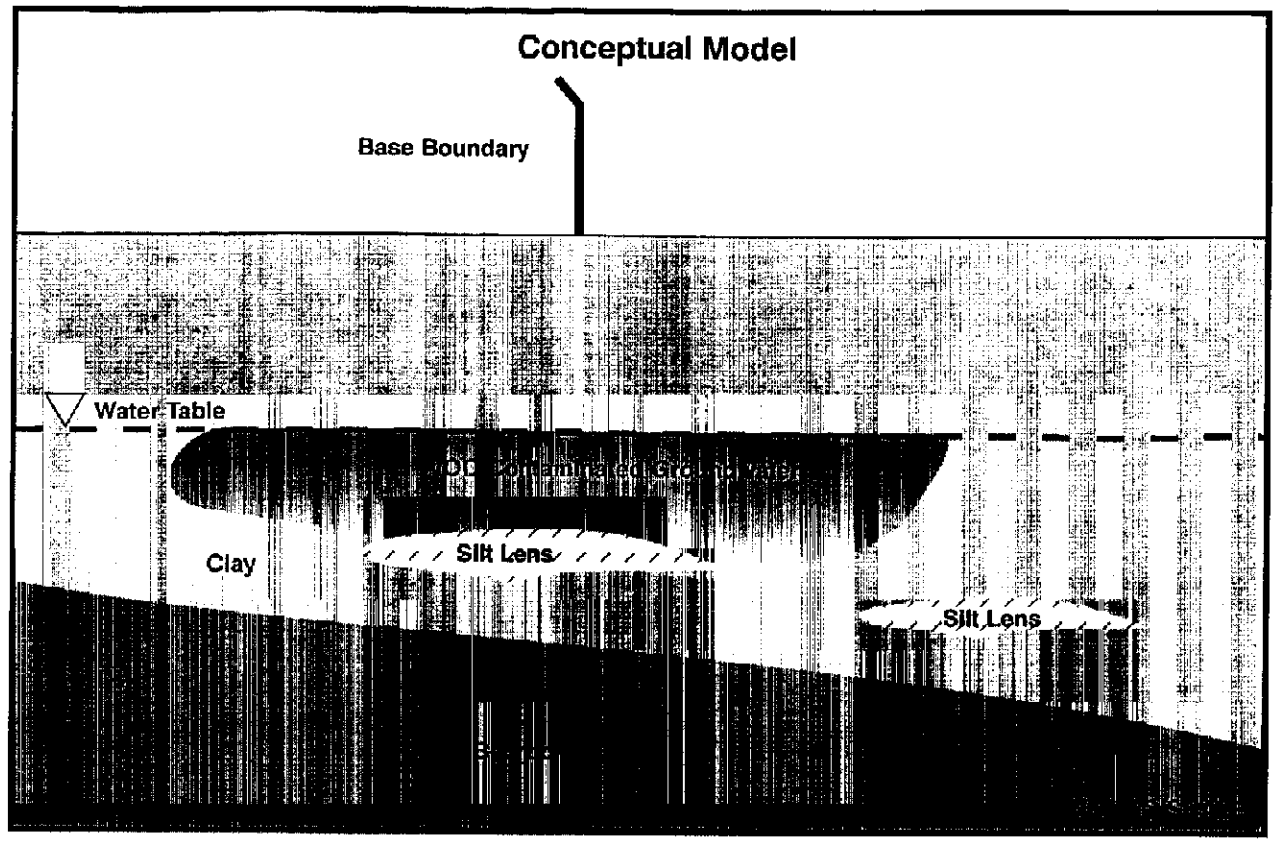
- Deferred: Area will be included in Basewide Natural Attenuation Assessment Plan

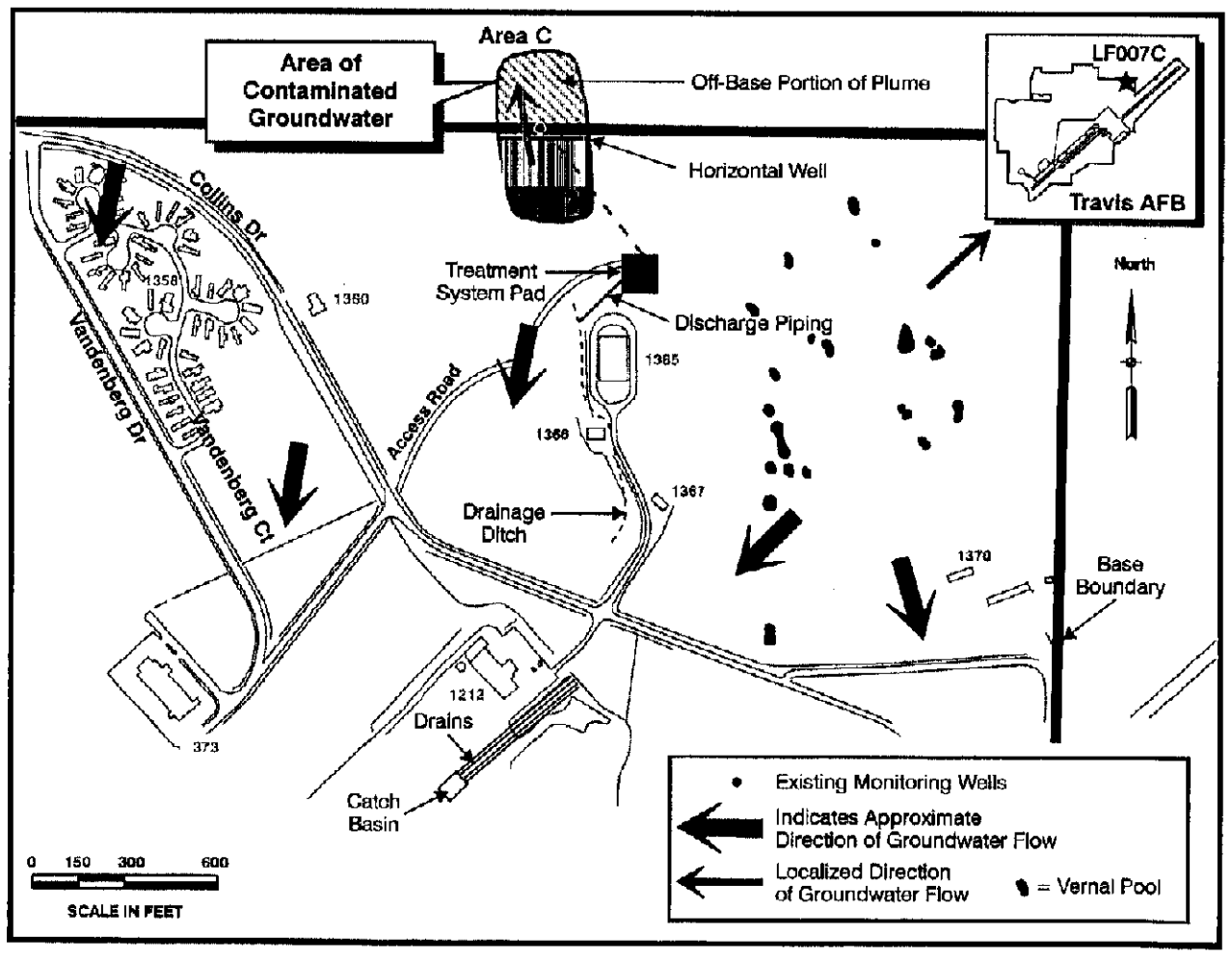
Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $770,000; First Year O & M = $105,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon Capital Cost = $815,000; First Year O & M = $133,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $550,000; First Year O & M = $72,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Figure A-4.
Site Summary Information
for LF007, Area B, Travis AFB

5LF007B.CDR - VMG 9/4/97 SAC 1





LF007 (Landfill 2, Area C)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 1.6×10^{-5}	TCE	49.1 µg/L
Groundwater	VOCs	HR = 5.6×10^{-6}	Vinyl Chloride	0.198 µg/L
Groundwater	VOCs	HR = 3.5×10^{-6}	1,1-DCE	0.297 µg/L
Groundwater	VOCs	HR = 1.3×10^{-6}	1,2-DCA	0.314 µg/L
Groundwater	VOCs	HR = 1.0×10^{-5}	1,2-dichloropropane	3.38 µg/L

Site Characteristics

- Low, grassy, flat swampy area
- Travis AFB boundary bisects the study area with east-west fence
- Northern half of study area is privately-owned property
- TCE in groundwater — 20 µg/L average, 49.1 µg/L maximum
- Estimated contaminated groundwater surface area = 230,000 ft^2; volume = 1,200,000 ft^3
- Estimated mass of dissolved VOCs equals 1.5 lb; no evidence of DNAPL or LNAPL
- Depth to groundwater — varies from 1 to10 feet, depending on season
- Depth to bedrock — 30 feet
- Low permeability soils (clay) to about 20 feet bgs
- Silt lenses between 20 feet bgs and bedrock
- Site also studied for soil contamination

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge (for Off-Base Portion)
  - Migration Control
  - Off-base Remediation
- Selection deferred for on base portion of plume, area will be included in the Basewide Natural Attenuation Assessment Plan (If plume were entirely on base, selection would be deferred for entire plume and included in the Basewide Natural Attenuation Assessment Plan)

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $615,000; First Year O & M = $94,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $675,000; First Year O & M = $115,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $450,000; First Year O & M = $58,000
- These costs derived from FS will be refined during remedial design phase based on combination of alternatives and site specific variables

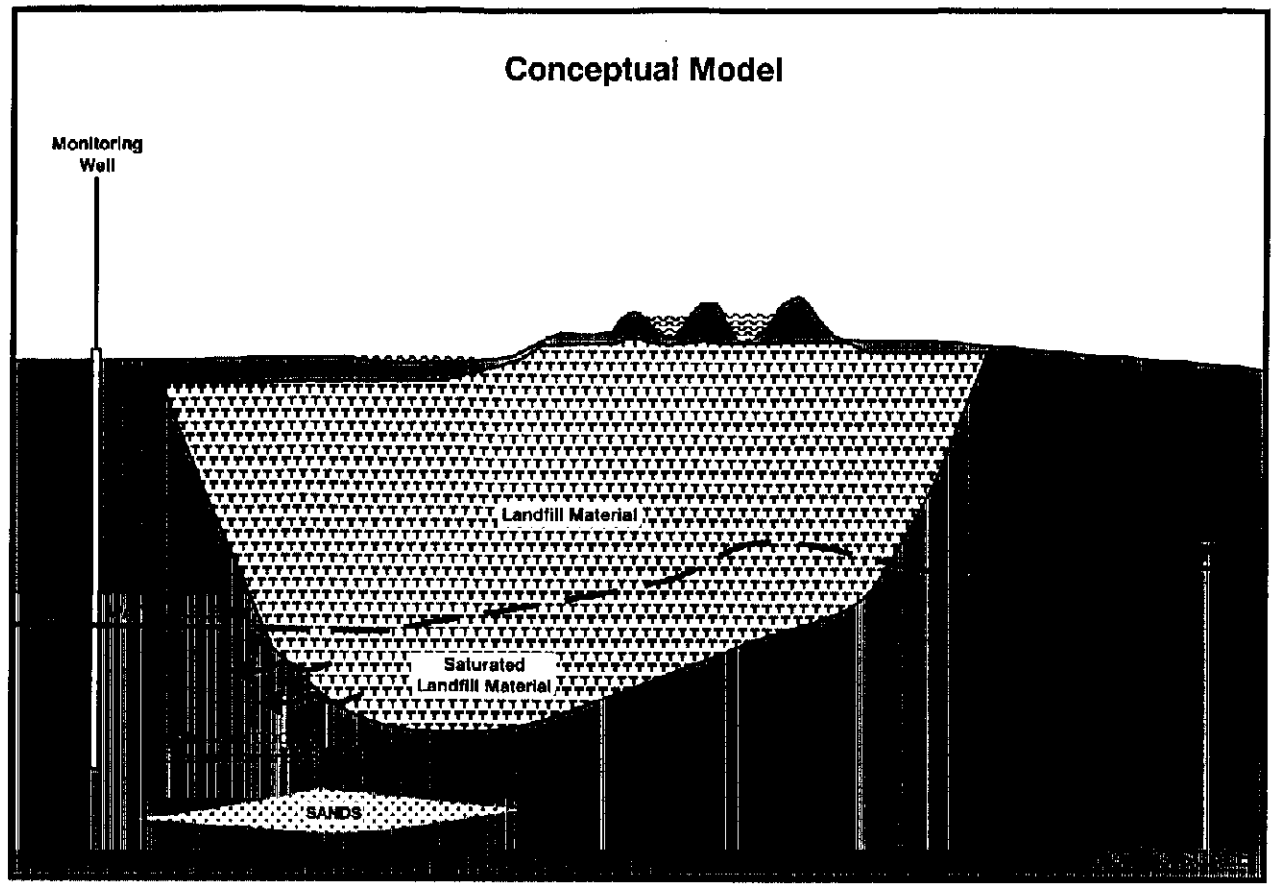
Interim Design Assumptions

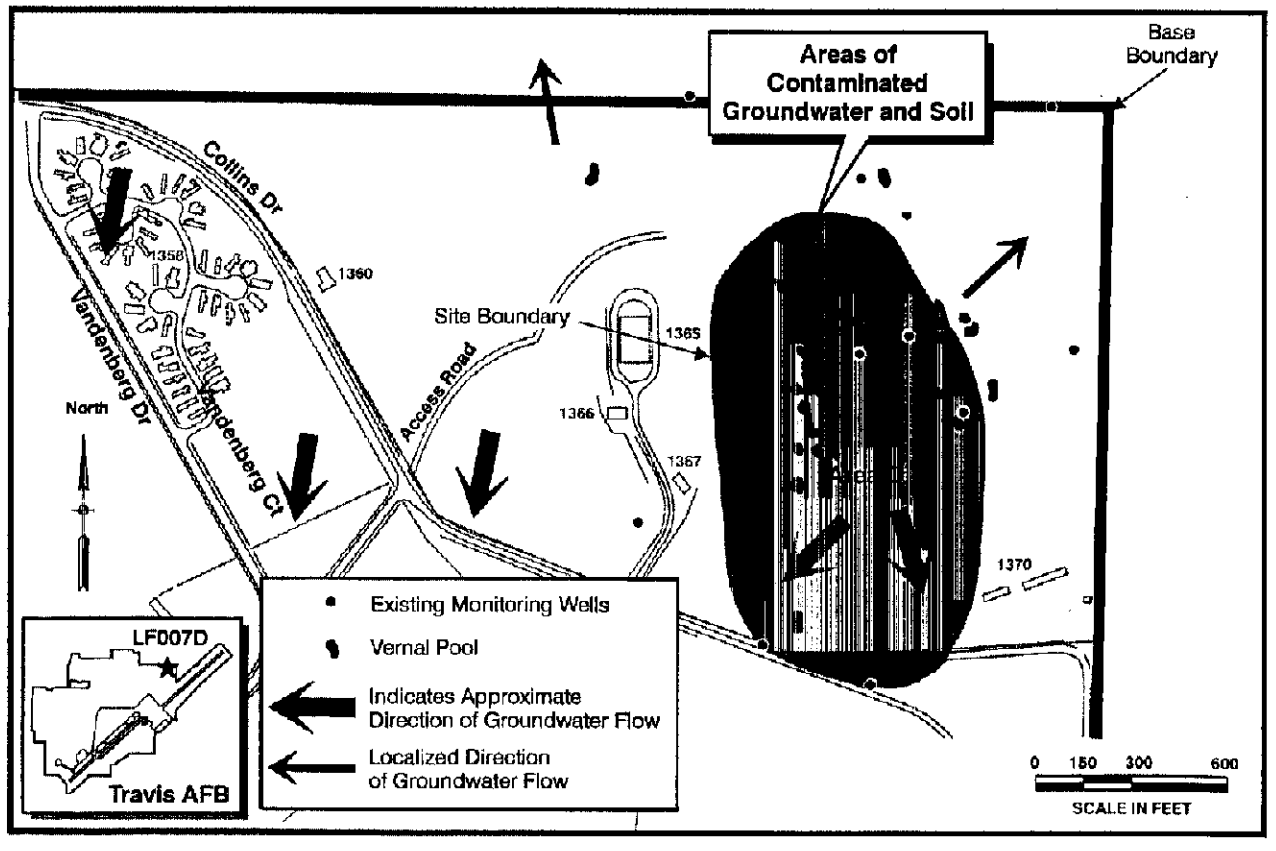
- 1 horizontal well, 300 feet in screened length
  (NOTE: Location and number of wells will be determined during the remedial design phase)
- Extraction rate 15 gpm total
- 600 feet of conveyance piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 300 feet of discharge piping — 1-½ inch ID, sch 80 PVC
- 200 feet from treatment system to existing power line

Figure A-5.
Site Summary Information
for LF007, Area C, Travis AFB

5LF007C.CDR - VMG 9/2/97 SAC 1

LF007 (Landfill 2, Area D)





Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 1.4×10^{-5}	Benzene	25.8 µg/L
Groundwater	VOCs	HR = 2.9×10^{-6}	Vinyl Chloride	1.78 µg/L
Groundwater	VOCs	HR = 2.5×10^{-5}	1,4-dichlorobenzene	43.8 µg/L
Groundwater	VOCs	HR = 1.1×10^{-6}	1,1-DCE	0.96 µg/L
Groundwater	VOCs	HI = 15.5	Chlorobenzene	282 µg/L
Groundwater	Dioxins	HR = 2.4×10^{-4}	2,3,7,8-TCDDeq	16.99 pg/L
Groundwater	Pesticides/PCBs	HR = 2.2×10^{-4}	PCBs (PCB-1242)	14.1 µg/L
Groundwater	SVOCs	HR = 8.2×10^{-6}	bis(2-ethylhexyl)phthalate	124 µg/L

Site Characteristics

- Southwestern portion of the study area is grassy flatland
- Ground surface is as much as 15 to 20 feet above natural ground surface (North-South trending)
- Differential settling in the remaining portions of the study area result in berms and trenches up to 6 feet deep
- Approximately 10-19 vernal pools in the study area
- 1,4 dichlorobenzene in groundwater — 10 µg/L average, 43.8 µg/L maximum
- bis(2-ethylhexyl)phthalate in groundwater — 10 µg/L average, 124 µg/L maximum
- Chlorobenzene in groundwater — 70 µg/L average, 282 µg/L maximum
- Benzene in groundwater — 5 µg/L average, 25.8 µg/L maximum
- Estimated contaminated groundwater surface area = 960,000 ft^2, volume = 4,800,000 ft^3
- Estimated mass of dissolved VOCs equals 26 lb; no evidence of DNAPL or LNAPL
- Depth to groundwater — varies from 1 to 10 feet, depending on season
- Depth to bedrock — 0 to 20 feet
- Landfill and back fill material extends from ground surface to about 15 feet bgs
- Clay layer extends from about 15 feet bgs to bedrock
- Site also studied for soil contamination

Selected Interim Remedial Action/Objectives

- Deferred: Area will be included in the Basewide Natural Attenuation Assessment Plan

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $1,800,000; First Year O & M = $224,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $1,800,000; First Year O & M = $266,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $1,800,000; First Year O & M = $266,000
- These costs derived from FS will be refined during remedial design phase based on combination of alternatives and site specific variables

Figure A-6.
Site Summary Information
for LF007, Area D, Travis AFB

SLF007D.CDR - VMG 9/4/97 SAC 1

A.5 SITE SS015 (SOLVENT SPILL AREA AND FACILITIES 550 AND 552)

A.5.1 Site Background

Site SS015 is located in the northwestern part of the EIOU, covers approximately 3.5 acres, and is comprised of the Solvent Spill Area (SSA) and Facilities 550 and 552. The SSA covers approximately 1.4 acres east of Facility 550 in an area previously used for stripping paint from aircraft. Use of this area is not well documented prior to 1981; however, stained soil, visible in historical aerial photographs indicates that the area was in use prior to 1970. Solvent spills were reported to have occurred in the area east of Facility 550, however actual dates the spills occurred is unknown (Weston, 1995a). Approximately 100 to 150 gallons per month of either methyl ethyl ketone (MEK), toluene, or tetraethylene glycol dimethyl ether (tetraglyme) were reported to have leaked from or splashed out of work trays used for collecting stripping wastes during operations at the site.

Facility 550, constructed in 1952, houses a corrosion control shop, a metals processing shop, a fiberglass shop, and nondestructive inspection operations. Past practices at the corrosion control shop included discharging wastes to a floor drain that was connected to a sanitary sewer (Weston, 1995a). Wastes generated included paints, thinners, methyl ethyl ketone, acids, and stripping wastes.

Facility 552 consists of a fenced, bermed concrete pad constructed in 1964 and currently used as a temporary hazardous waste collection point. Radomes were chemically stripped of paint near Facility 552 from 1964 to 1980. Stored wastes include paint, chromic acid, and solvents generated during aircraft maintenance operations at Facility 550. No documentation of past spills occurring at the site has been found (Weston, 1995a).

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results

from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2-3 and Appendix A of the RI indicate that nine groundwater samples were collected from the SSA during Rounds 7 through 9 of the RI. Samples were analyzed for VOCs, SVOCs, petroleum products, and inorganic constituents.

In addition to groundwater samples, subsurface soil samples were collected from five locations in the SSA, two locations near Facility 550, and four locations near Facility 552. Surface soil samples were collected from five locations in the SSA and from two locations near Facility 552. Sampling locations, constituents analyzed, and results can be obtained in the EIOU RI (Weston, 1995a).

Classes of COCs detected in the groundwater at the site during the RI included various VOCs, one SVOC, and one metal. VOCs include TCE, cis-1,2-DCE, vinyl chloride, 1,4-dichlorobenzene, 1,2-DCA, and PCE. Bis(2-ethylhexyl)phthalate (a SVOC) and nickel (a metal) were identified as COCs. TPH at concentrations up to 4,300 µg/L has also been detected in the groundwater during periodic monitoring well sampling efforts conducted at the site. Some solvents, such as MEK, which were reportedly spilled at SS015 were sampled for in the RI but not detected, or were detected at levels which did not cause human health risks greater than one in one million. Figure A-7 presents site location, contaminant concentration in the groundwater, and a conceptual site model. Contamination detected in the soils at the site included PAHs and metals (molybdenum, antimony, cadmium, chromium, copper, lead, zinc, mercury, and silver).

A.5.2 Feasibility Study

The alternatives evaluated in the FS for SS015 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion

exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had similar scores ranging from 27 to 31. Capital and first year O&M costs for these three alternatives were $750,000 capital with $120,000 O&M for Alternative 3; $850,000 capital with $160,000 O&M for Alternative 5; and $990,000 capital with $520,000 O&M for Alternative 7.

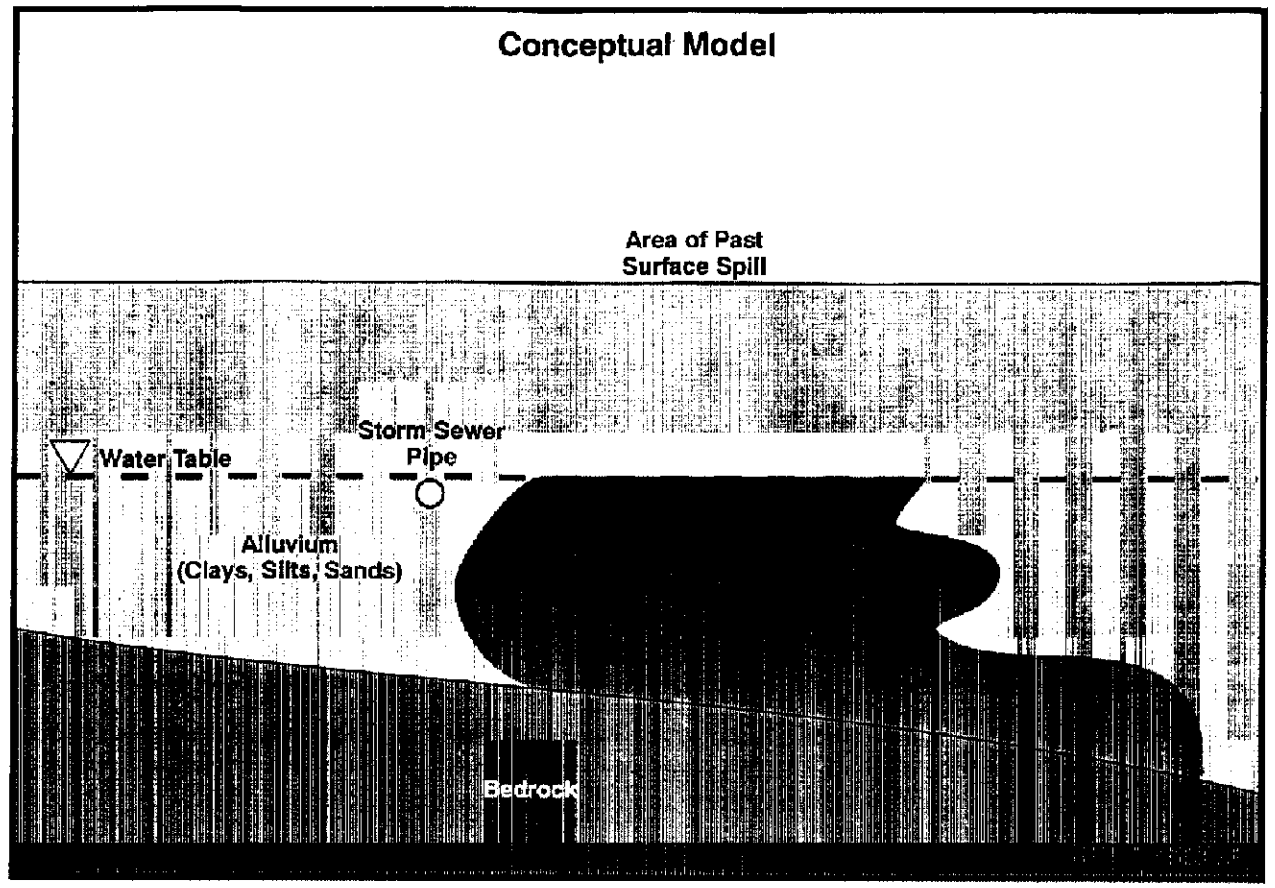
A.5.3 Selected Interim Remedial Actions/Objectives

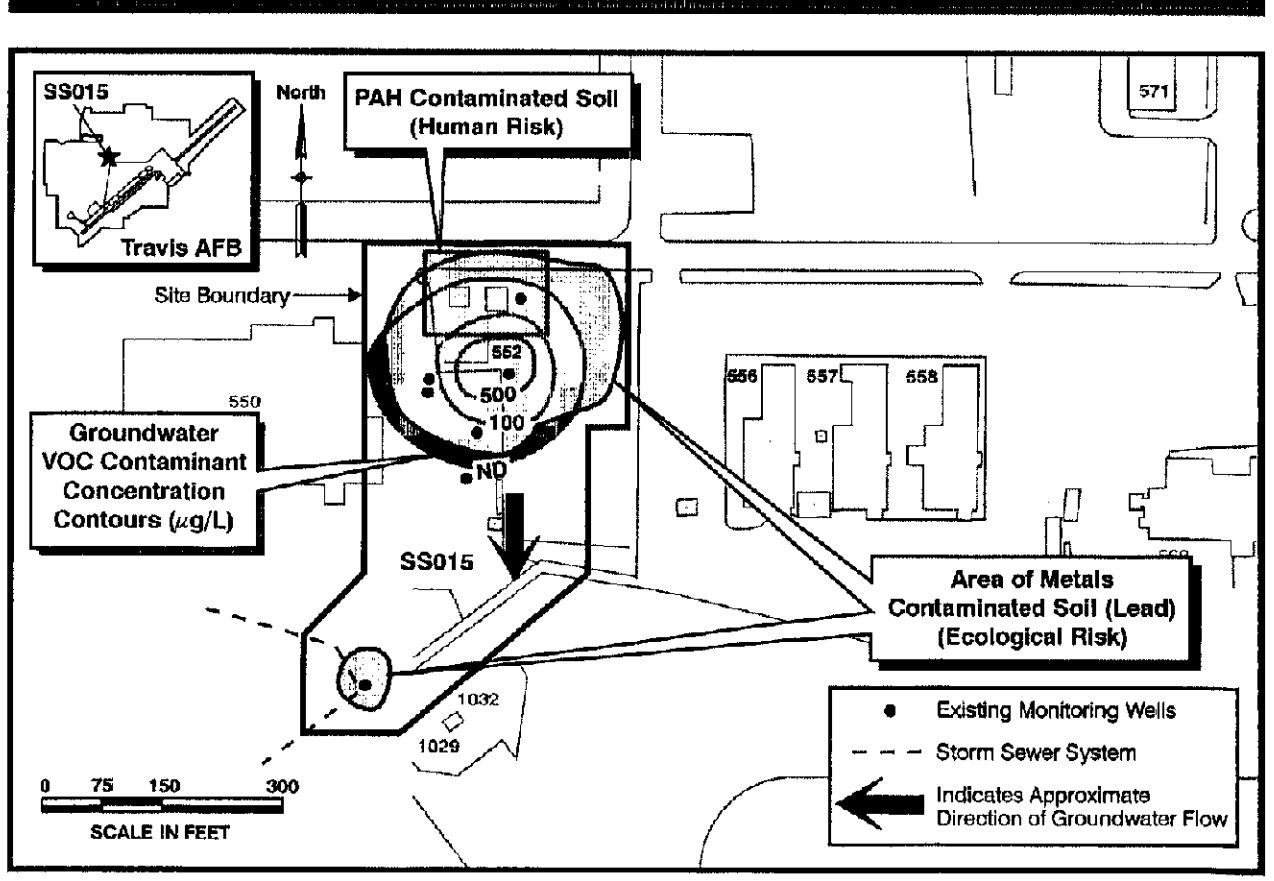
Selection of an alternative for groundwater at SS015 is deferred until the final Groundwater ROD so that additional data can be collected and evaluated to support the use of natural attenuation. Natural attenuation appears to be a viable alternative for this site because of the small areal extent of contamination, low TCE concentrations (maximum 25 µg/L), the presence of TPH for cometabolism, and TCE degradation by-products indicating natural attenuation is occurring. In addition, the site has relatively low permeability soils, low infiltration rates due to asphalt on the surface, and the plume appears stable. Additional site-specific data regarding natural attenuation will be developed for evaluation as part of the final Natural Attenuation Assessment Plan.

The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

A.5.4 Conceptual Site Model

Sources of groundwater contamination appear to be from past spills of materials used or stored at or near Facilities 552 and 550; however, no residual solvents were detected in the unsaturated zone. Surface soil contaminants identified at SS015 include PAHs and metals. These contaminants in soil have not impacted groundwater (i.e., the COC metals in the surface soil are not the same as the groundwater COC [nickel]), and any anticipated soil cleanup action is not expected to have an effect on groundwater. The source of nickel is currently being investigated.





SS015 (Solvent Spill Area and Facilities 550 and 552)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk for These Contaminants Is HR = 7.22 x 10^{-4}	TCE	25 µg/L
Groundwater	VOCs		cis-1,2-DCE	370 µg/L
Groundwater	VOCs		Vinyl Chloride	48 µg/L
Groundwater	VOCs		1,4-DCB	3.8 µg/L
Groundwater	VOCs		1,2-DCA	0.39 µg/L
Groundwater	VOCs		PCE	12 µg/L
Groundwater	SVOCs		bis(2-ethylhexyl)phthalate	6.68 µg/L
Groundwater	Metals		Nickel	1,500 mg/L
Groundwater	TPH	Potential Ecological Risk in Surface Water	NA	4,300 µg/L

Site Characteristics

- Approximately 50% of the area is covered by pavement and buildings
- Site located in an active area of the Base
- Estimated contaminated groundwater surface area = 50,000 ft^2; volume = 200,000 ft^3
- Estimated mass of dissolved VOCs equals 13 lb; no evidence of DNAPL or LNAPL
- Depth to groundwater — 10 feet
- Depth to bedrock — 15 to 25 feet
- Low permeability soils (clay and silt) occur up to a depth of between 15 and 25 feet bgs
- More permeable materials (sand and silt) exist at various intervals, mostly between 10 and 15 feet bgs
- Site also studied for surface and subsurface soil contamination

Selected Interim Remedial Action/Objectives

- Deferred: Site will be included in the Basewide Natural Attenuation Assessment Plan

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $750,000; First Year O & M = $120,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $850,000; First Year O & M = $160,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $990,000; First Year O & M = $520,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- Determine groundwater/surface water interactions and design appropriate responses

Figure A-7.
Site Summary Information
for SS015, Travis AFB

SS015.CDR - VMG 9/4/97 SAC 1

A.6 SITE SS016 (OIL SPILL AREA, FACILITIES 11, 13/14, 18, 20, 42/1941, 139/144, AND SELECTED SECTIONS OF STORM SEWER RIGHT OF WAY)

A.6.1 Site Background

Site SS016 is located in the center of the EIOU, covers approximately 210 acres, and is comprised of the Oil Spill Area (OSA) and Facilities 11, 13/14, 18, 20, 42/1941, 139/144, and sections of the Storm Sewer Right of Way (SSRW).

The OSA originally encompassed an area where waste oil had reportedly been spilled or disposed of on a grassy area which is now paved. Based on interviews with base personnel that indicated past releases from an oil/water separator (OWS) located at Facility 18, the OSA was expanded. The original area was reportedly used from the mid-1940s to the early 1950s (Weston, 1995a).

Facility 18 contains the Cleaning and Degreasing Shop which, based on historical records, once stored large quantities of various solvents. Although Facility 18 is currently still in use, the OWS holding tank has not been used since 1985.

Facility 11 is located between Hangar Avenue and the flightline, west of Second Street. Constructed in 1944, Facility 11 is currently used for servicing and repairing flightline support equipment. Small amounts of hydraulic fluids and oils are used during these activities. Past operations at the facility included a satellite accumulation point for hazardous wastes. Based on interviews with shop personnel, solvents were used during the cleaning of aircraft engines. No documentation of dates of these activities or spills that may have occurred is available (Weston, 1995a).

Facility 13/14 was an aircraft wash rack located south of Hangar Avenue between old Hangars 13 and 14. The Hangars were demolished in 1988 and Building 31 was built at the site. The wash rack was probably in use from the mid-1950s to the mid-1960s (Weston, 1995a).

Facility 20, located southeast of the intersection of second street and Hangar Avenue, is the Base Control Tower and was the site of an underground storage tank (UST) used for fuel for a backup generator. The UST was removed in 1994.

Facility 42/1941, located near Facility 11, includes a hazardous waste storage area and wash rack. The facility consists of a concrete pad, constructed in 1966, which is partially enclosed by corrugated metal walls. In addition to the wash rack, four 250-gallon above-ground storage tanks are located at the facility to hold waste oils and fuels. The wash rack is connected to the sanitary sewer through an OWS.

Facility 139/144 is comprised of two adjacent facilities, located south of Hickam Avenue and east of Broadway. Both house vehicle maintenance activities. Facility 139 was constructed in 1954 and Facility 144 was constructed in 1945. In addition to vehicle maintenance, other activities performed at the facilities include body work, painting, and radiator servicing. A leaking, 2,000-gallon solvent UST was removed from Facility 139 in 1985 (Weston, 1995a). Floor drains in the shop direct spills to two OWSs. Past practices at Facility 144 included emptying the radiator test tank onto the ground at the facility.

The SSRW includes all of the storm sewers, major surface drainage systems, and Union Creek. Portions of the SSRW in SS016 drain industrial areas in the EIOU. Miscellaneous base shops and aircraft parking aprons drain to the storm sewer system. Chemical wastes were potentially released into the system.

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results

from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2-3 and Appendix A of the RI indicate that groundwater samples were collected from 119 locations at SS016 in Rounds 7 through 9. Within SS016, groundwater samples were collected from the following locations:

- 31 locations along the SSRW;
- 32 locations in the OSA;
- 15 locations in the vicinity of Facility 11;
- 11 locations in the vicinity of Facilities 13/14;
- 13 locations in the vicinity of Facility 20;
- 6 locations in the vicinity of Facilities 42/1941;
- 7 locations in the vicinity of Facility 139; and
- 4 locations in the vicinity of Facility 144.

Groundwater samples were analyzed for VOCs, SVOCs, dioxins/furans, petroleum products, inorganic constituents, total dissolved solids, and total organic carbon.

In addition to groundwater samples, the following were collected:

- 14 surface soil samples, 17 surface water samples, subsurface soil samples from 7 soil borings, and 35 sediment samples from the area surrounding the SSRW;
- Subsurface soil samples from 4 soil borings and 3 surface soil samples from the OSA;
- Subsurface soil samples from 6 soil borings in the vicinity of Facility 11;
- Subsurface soil samples from 6 soil borings in the vicinity of Facilities 13/14;

- Subsurface soil samples from 6 soil borings and 3 surface soil samples from the vicinity of Facility 20;
- Subsurface soil samples from four soil borings in the vicinity of Facilities 42/1941;
- Subsurface soil samples from five soil borings and one surface sample in the vicinity of Facility 139; and
- Subsurface soil samples from four soil borings and four surface soil samples from the vicinity of Facility 144.

Sample locations, constituents analyzed, and results can be obtained in the EIOU RI (Weston, 1995a).

Results from the sampling of the Storm Sewer Right-of-Way during the RI indicated that TCE concentrations in surface water within the storm sewer remained fairly consistent between samples collected from the east end of the storm sewer and Outfall III (23 to 55 µg/L). BTEX concentrations were highest in surface water near MW-246 area.

COCs detected in the groundwater at the site during the RI consist primarily of VOCs, and also include one SVOC and one metal. VOCs include TCE, cis-1,2-DCE, vinyl chloride, benzene, chloroform, 1,4-dichlorobenzene, dichlorobromomethane, 1,2-DCA, 1,1-DCE, and PCE. Bis(2-ethylhexyl)phthalate (a SVOC) and nickel (a metal) were also identified as COCs. TPH was identified in the groundwater at concentrations up to 8,500 µg/L. Recent CPT data has detected TCE levels at SS016 up to 180,000 µg/L, but results may not be comparable to monitoring well data. Data from the RI is presented in Figure A-8. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-8. Contaminants identified in the soil at the site include PAHs and PCBs.

An ongoing removal action at SS016 is known as the Tower Area Removal Action (TARA). The TARA system includes extraction wells, a carbon treatment system, and discharge

to irrigation lines or the storm sewer. TARA was designed and operated to remove high concentrations of VOCs in the groundwater and also to protect workers during construction of a hydrant system near the tower. The system has removed over 190 pounds of contaminants since the system began operation in 1995. The TARA extraction system is being expanded to include another area of high concentrations of VOCs at the OSA. The system will extract groundwater from the OSA and link the TARA extraction well with a new treatment system.

A.6.2 Feasibility Study

The alternatives evaluated in the FS for SS016 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. These costs are for the Oil Spill portion of SS016, and do not include the "Remainder of Plume" costs which were calculated separately in the FS. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 all had scores of 27. Capital and first year O&M costs for the three alternatives were $2.88 million capital with $274,000 O&M for Alternative 3; $3 million capital with $312,000 O&M for Alternative 5; and $7.1 million capital with $5.9 million O&M for Alternative 7.

A.6.3 Selected Interim Remedial Actions/Objectives

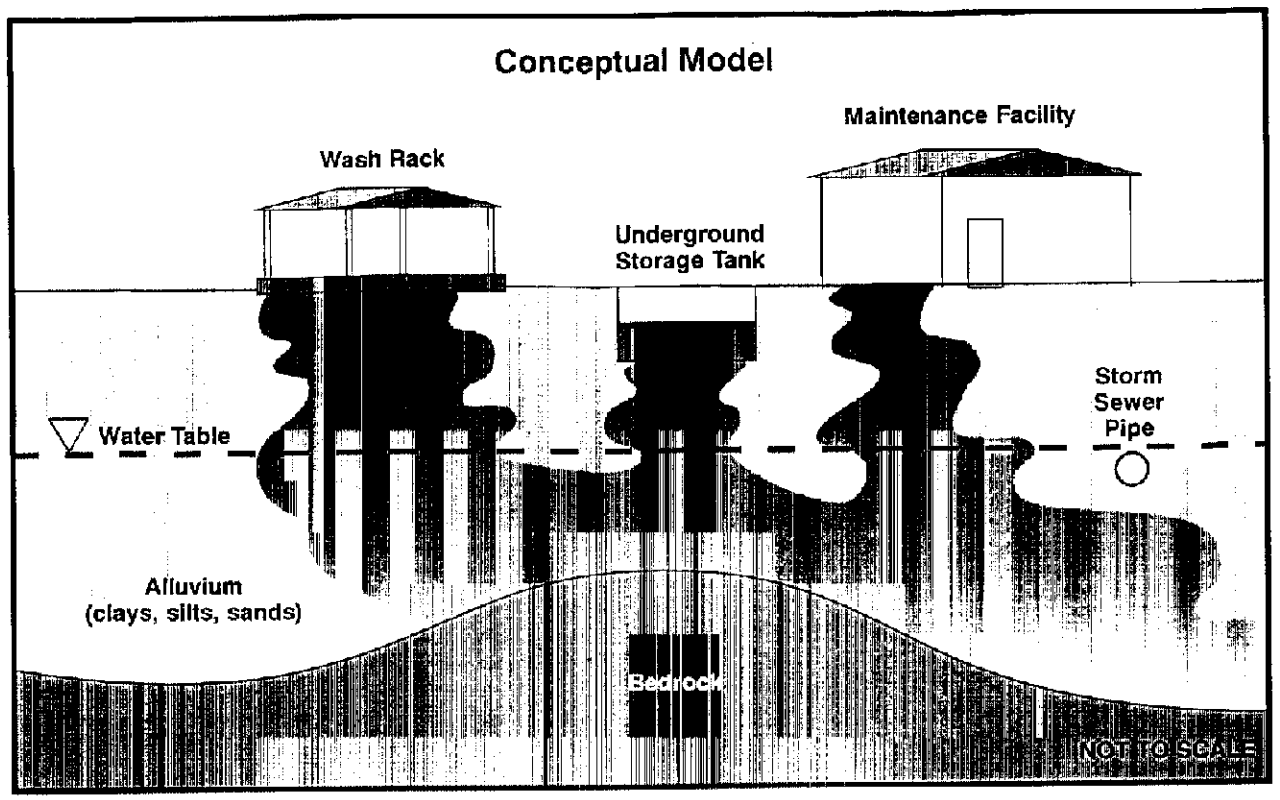
The selected interim action for SS016 is extraction, treatment, and discharge for source and migration control. Source control is selected for SS016 because TCE concentrations are greater than or equal to 3,000 µg/L and DNAPL is suspected in the OSA area. Migration control is necessary in distinct areas with high VOC concentrations. Extraction will control contaminant migration by creating a reversal in both flow and concentration gradients. Monitoring will confirm effectiveness of source and migration control. Additional extraction wells will be

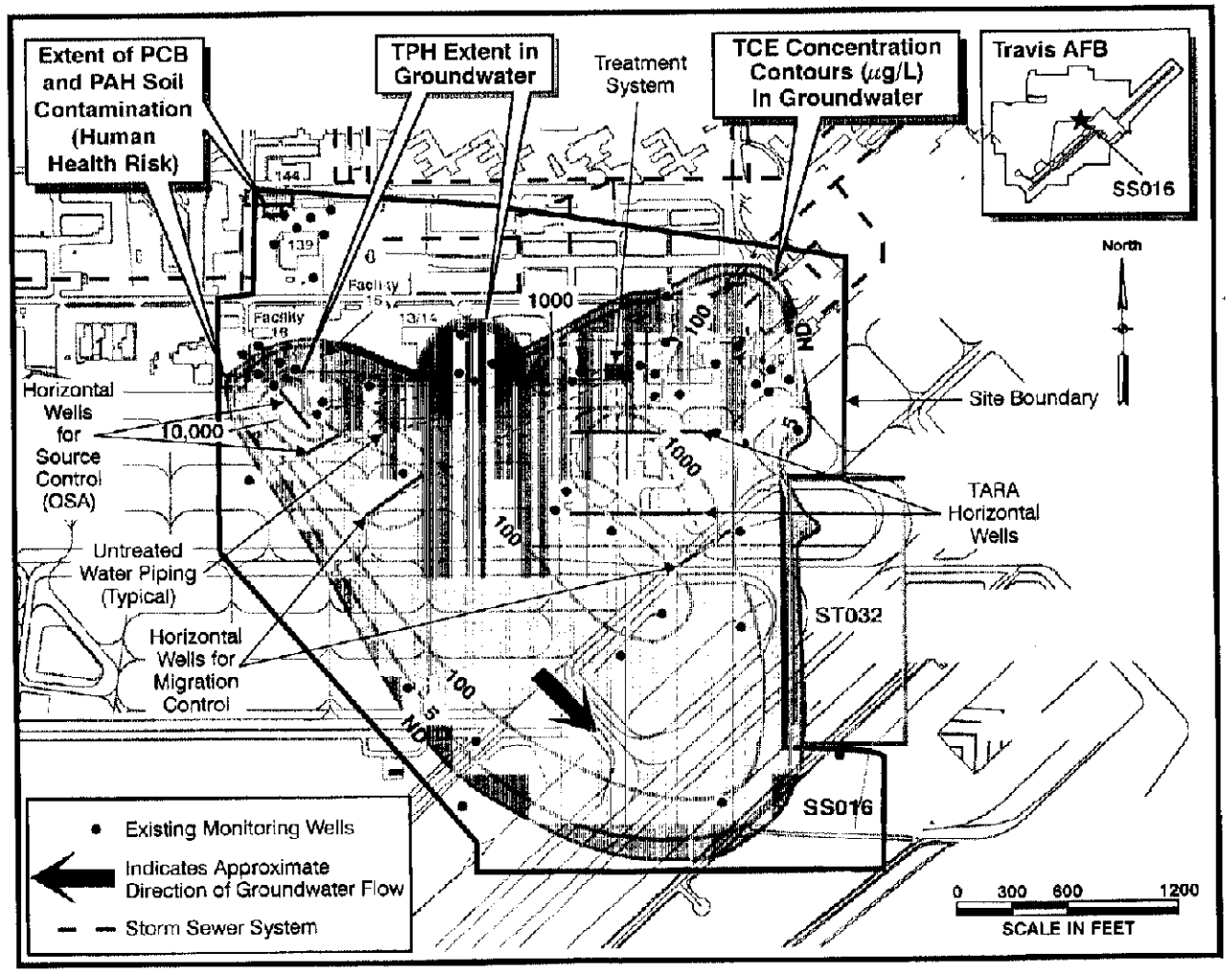
installed if required to ensure the plume is stable. Design installation, operation, and maintenance of the wells will take into consideration the fact that portions of the plume are under active runways and taxiways.

The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

A.6.4 Conceptual Site Model

Groundwater contamination in SS016 is extensive with several areas of higher (greater than 1,000 µg/L) TCE concentrations. There is an area of potential interaction between contaminated groundwater and storm sewers in the southern portion of the site (see Figure 3-6) (Weston, 1995a). Soil contamination, including PAHs and PCBs, was found in a small area of site SS016. These contaminants in soil have not impacted groundwater, and any anticipated soil cleanup action is not expected to have an affect on groundwater.





SS016 (Oil Spill Area, Facilities 11, 13/14, 18, 20, 42/1941, 139/144, and Selected Sections of Storm Sewer Right of Way)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk for These Contaminants Is HR = 1.11 x 10^{-2}	TCE	32,000 µg/L
Groundwater	VOCs		cis-1,2-DCE	4,600 µg/L
Groundwater	VOCs		Vinyl Chloride	56 µg/L
Groundwater	VOCs		Benzene	6.4 µg/L
Groundwater	VOCs		Chloroform	4.7 µg/L
Groundwater	VOCs		1,4-DCB	8.6 µg/L
Groundwater	VOCs		Dichlorobromomethane	0.9 µg/L
Groundwater	VOCs		1,2-DCA	3.97 µg/L
Groundwater	VOCs		1,1-DCE	5.4 µg/L
Groundwater	VOCs		PCE	220 µg/L
Groundwater	SVOCs		bis(2-ethylhexyl)phthalate	67.3 µg/L
Groundwater	Metals		Nickel	460 mg/L

Site Characteristics

- Approximately 100% of the area is covered by pavement and buildings
- Site located in an active area of Travis AFB (maintenance facilities and aircraft parking apron)
- TCE in groundwater in northwest portion of site — 10,000 µg/L average, 32,000 µg/L maximum
- TCE in groundwater in the rest of the plume — 600 µg/L average, 5,000 µg/L maximum
- Estimated contaminated groundwater surface area = 7,500,000 ft^2; volume = 29,800,000 ft^3
- Estimated mass of dissolved VOCs equals 1,200 lb; DNAPL may be present
- Cd, Cr, Cu, Pb, Ag, and Zn were measured at concentrations greater than NPDES discharge limits in some monitoring wells
- Depth to groundwater — 10 feet; depth to bedrock — 30 feet
- Low permeability soils (clay and silt) to a depth of between 15 and 25 feet bgs
- More permeable material (sands and silts) below 15 to 25 feet bgs
- Site also studied for surface and subsurface soil contamination
- Storm sewer is a potential groundwater/surface water pathway

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Source Control for TCE (OSA)
  - Migration Control for VOCs and potentially groundwater/surface water interactions

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,880,000; First Year O & M = $274,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $3,000,000; First Year O & M = $312,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $7,100,000; First Year O & M = $5,900,000
- These costs derived from the FS are for the most contaminated portion of the plume and will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- 4 horizontal wells, 300 feet in screened length (NOTE: Location and number of wells will be determined during remedial design phase)
- Extraction rate 60 gpm total, 15 gpm from each well
- 7,000 feet of untreated water piping (from wells to treatment system) — 1 inch ID, sch 80 PVC
- 50 feet of discharge piping (to existing irrigation system) — 3 inch ID, sch 80 PVC
- 10 feet from treatment system to existing power line
- Determine surface/groundwater interactions; design appropriate response

Figure A-8.
Site Summary Information for SS016, Travis AFB

5SS0~6.CDR - VMG 8/19/97 SAC 1

A.7 SITE SS029 (MW-329 AREA)

A.7.1 Site Background

Site SS029 consists of approximately 5.5 acres around Monitoring Well (MW) 329 in the southern part of the EIOU just south of the runway. The monitoring well was installed at the request of the Air Force Center for Environmental Excellence (AFCEE) to evaluate the source of the TCE plume identified at MW-269 (Weston, 1995a). Historical aerial photographs show aircraft parked in the area; however, activity appears limited and no source for the plume has been identified.

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2-3 and Appendix A of the RI indicate that groundwater samples from Rounds 7 through 9 were collected from three monitoring wells and eight CPT locations at SS029. Samples were analyzed for VOCs, SVOCs, inorganic constituents, and petroleum products. In addition to groundwater sampling, subsurface soil samples were collected from three soil borings at SS029. Sampling locations, constituents analyzed, and results are presented in the EIOU RI (Weston, 1995a).

All COCs identified in the groundwater during the RI were VOCs. They include TCE, 1,2-DCA, cis-1,2-DCE, benzene, chloroform, 1,1-DCE, and vinyl chloride. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-9. Additional contaminants including VOCs, SVOCs, PAHs, and metals were identified in the soils at the site.

A.7.2 Feasibility Study

The alternatives evaluated in the FS for SS029 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 4 (extraction, air stripper/catalytic oxidation, activated carbon, and discharge), Alternative 6 (extraction, UV-OX, activated carbon, and discharge), and Alternative 8 (extraction, activated carbon, and discharge). As evaluated, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 4, 6, and 8 had similar scores ranging from 27 to 29. Capital and first year O&M costs for these three alternatives were $1.6 million capital with $170,000 O&M for Alternative 4; $1.7 million capital with $210,000 O&M for Alternative 6; and $1.75 million capital with $660,000 O&M for Alternative 8.

A.7.3 Selected Interim Remedial Actions/Objectives

The selected interim action for SS029 is Alternative 3, Extraction, Treatment, and Discharge. Migration control is to contain the migration of contaminated groundwater. In addition, portions of the site are deferred until the final Groundwater ROD so that additional data can be collected and evaluated to support the use of natural attenuation.

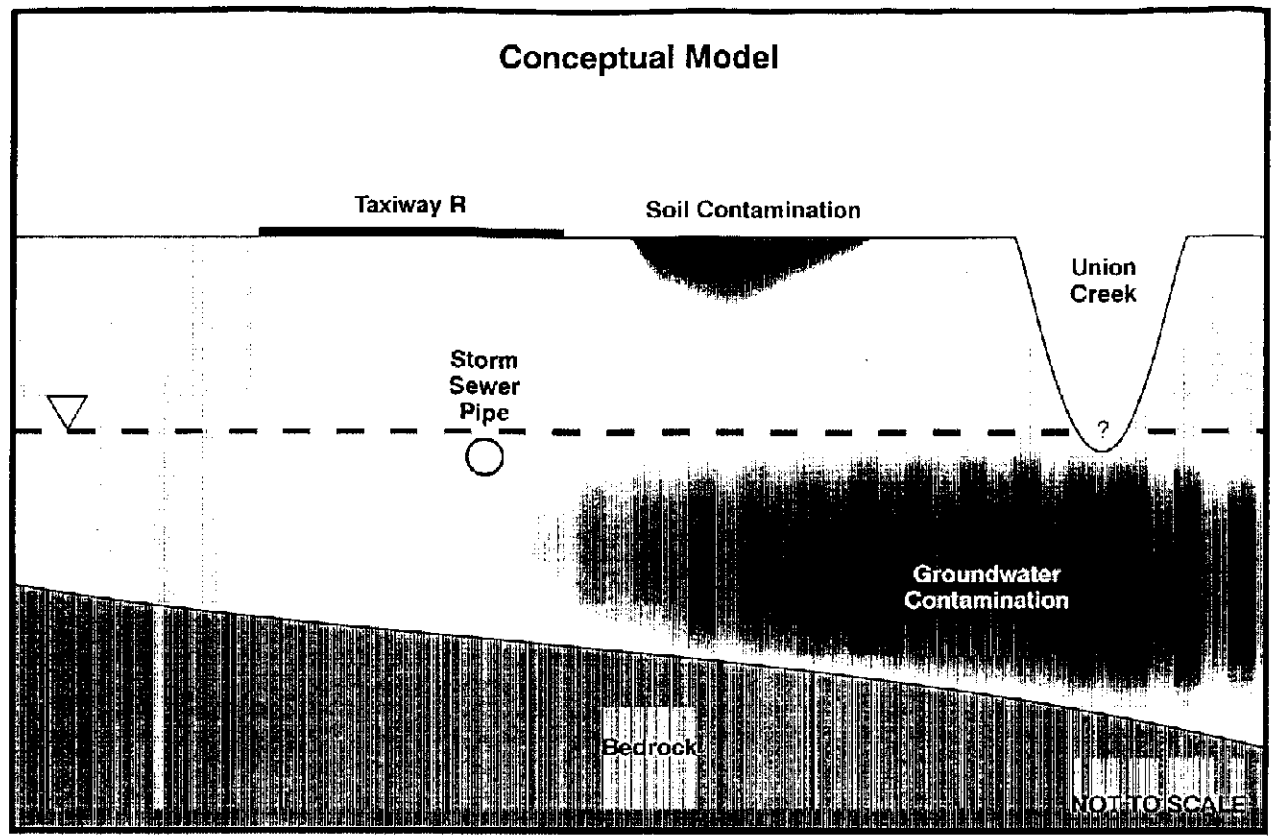
The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

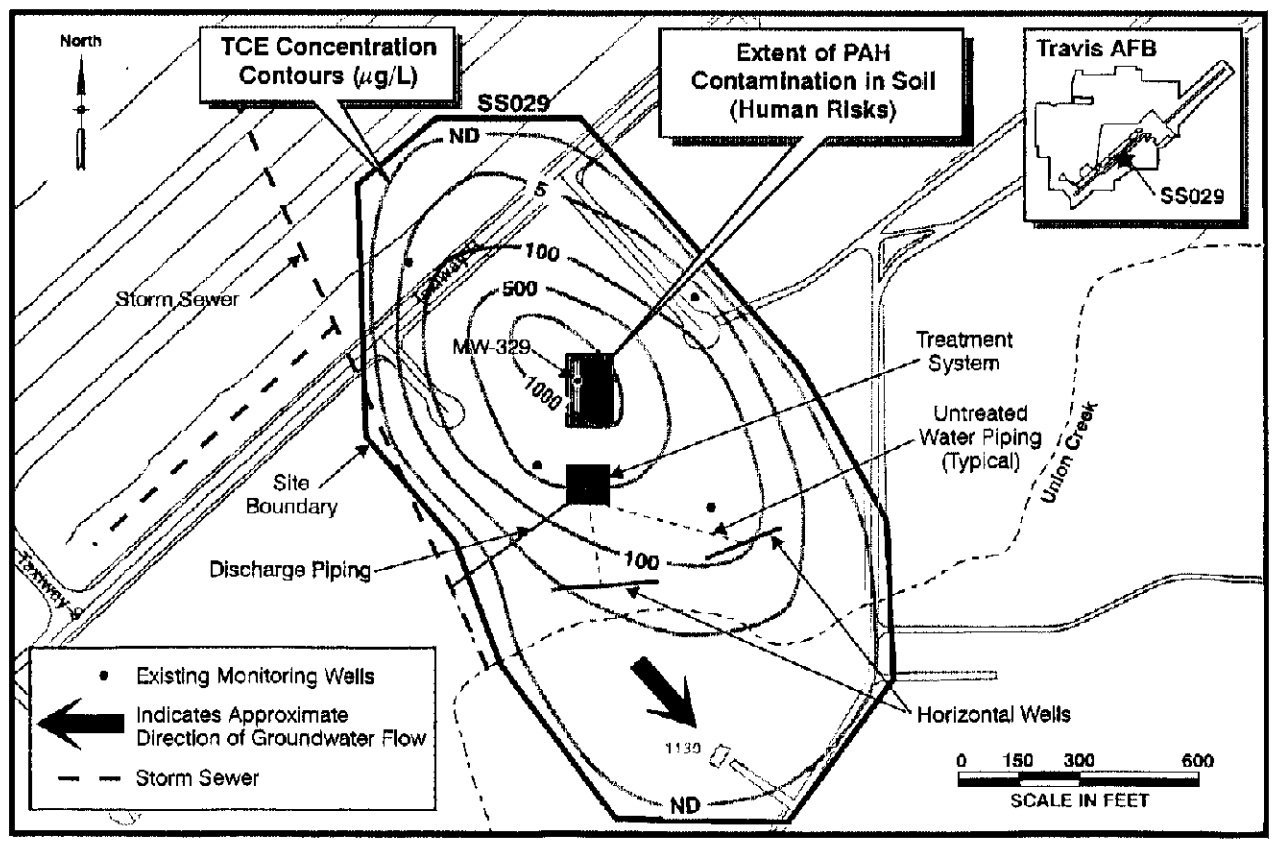
A.7.4 Conceptual Site Model

A source of groundwater contamination in the area of MW-329 has not been identified; however, an aerial photograph of the area indicates that aircraft once parked at the site. Investigations were conducted at SS029 to assess the extent of TCE contamination downgradient of the SS016 plume.

Contaminants found in the soils at site SS029 include TCE, several PAHs, and metals. Based on modeling results, low soil TCE levels (0.12 mg/kg) indicate that the soil is not a source for the TCE groundwater contamination. Therefore, any soil cleanup action is not expected to have an effect on groundwater.

There is a potential for groundwater/storm sewer interaction on the western edge of the site.





SS029 (MW-329 Area)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk for These Contaminants Is HR = 4.22×10^{-4}	TCE	1,300 µg/L
Groundwater	VOCs		1,2-DCA	1.13 µg/L
Groundwater	VOCs		cis-1,2-DCE	80 µg/L
Groundwater	VOCs		Benzene	0.55 µg/L
Groundwater	VOCs		Chloroform	0.61 µg/L
Groundwater	VOCs		1,1-DCE	0.57 µg/L
Groundwater	VOCs		Vinyl Chloride	0.22 µg/L

Site Characteristics

- Open field is located between abandoned taxiway and Union Creek
- TCE in groundwater — 315 µg/L average, 1,300 µg/L maximum
- Estimated contaminated groundwater surface area = 800,000 ft^2, volume = 4,800,000 ft^3
- Estimated mass of dissolved VOCs equals 100 lb; no evidence of DNAPL or LNAPL
- Depth to groundwater — 10 feet
- Depth to bedrock — 30 feet
- Top 10 feet of saturated alluvium is composed of clays and other low permeability material
- Bottom 10 feet of saturated alluvium is composed of sands and other moderate permeability material
- Site also studied for surface soil contamination
- Storm sewer is potential groundwater/surface water pathway on western edge of site

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Migration Control

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 4: Air Stripper/Catalytic Oxidation, Activated Carbon:
    Capital Cost = $1,600,000; First Year O & M = $170,000
  - FS Alternative 6: UV Oxidation, Activated Carbon:
    Capital Cost = $1,700,000; First Year O & M = $210,000
  - FS Alternative 8: Activated Carbon:
    Capital Cost = $1,750,000; First Year O & M = $660,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- 2 horizontal wells, 300 feet in screened length
  (NOTE: Location and number of wells will be determined during the remedial design phase)
- Extraction rate 30 gpm total, 15 gpm from each well
- 1,200 feet of untreated water piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 600 feet of discharge piping (to Union Creek) — 3 inch ID, sch 80 PVC
- 350 feet from treatment system to existing power line

Figure A-9.
Site Summary Information for SS029, Travis AFB

5SS029.CDR - VMG 8/19/97 SAC 1

A.8 SITE SS030 (MW-269 AREA)

A.8.1 Site Background

Site SS030 covers approximately 16 acres in the area around MW-269 in the southern portion of the EIOU near the south base boundary. The monitoring well was originally installed to evaluate the water quality along this base boundary (Weston, 1995a). The site is adjacent to a radar facility (Facility 1125); however, historical aerial photographs do not indicate any staining in the area, or any activities that may have been the source of the groundwater contamination at SS030.

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2-3 and Appendix A of the RI indicate that 17 groundwater samples were collected from monitoring wells and 10 groundwater samples were collected from CPT locations during final sampling rounds. Samples were analyzed for VOCs, SVOCs, PCBs, petroleum products, inorganic constituents, and total dissolved solids. In addition to groundwater sampling, subsurface soil samples were collected from five soil borings, and six surface soil samples were collected from SS030. Sampling locations, constituents analyzed, and results are presented in the EIOU RI (Weston, 1995a).

COCs detected in the groundwater at SS030 during the RI include various VOCs and one metal. VOCs identified as COCs include TCE, chloroform, dichlorobromomethane, and 1,2-DCA. Nickel was identified as a metal COC. The TCE plume extends beyond the base boundary. The maximum reported TCE concentration from the RI is 2,400 µg/L. Samples taken after the RI (November, 1995) indicate a maximum concentration of 3,860 µg/L TCE. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-10.

Contamination identified in the soils at the site include low levels of several VOCs, SVOCs, PAHs, and metals (antimony, beryllium, barium, chromium, copper, lead, nickel, selenium, and zinc). Soil contamination will be addressed separately in a soil ROD.

Early removal actions at this site included a 10-month pump and treat project conducted by Weston in 1993/94 and a week-long 2-phase extraction test conducted by Radian in 1995. The objective of these extraction tests was to develop data to design a system to remediate the groundwater. A Treatability Study is planned for SS030 to extract and treat contaminated groundwater; startup is planned for the summer of 1997.

A.8.2 Feasibility Study

The alternatives evaluated in the FS for SS030 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 all had total scores of 31. Capital and first year O&M costs for these three alternatives were $660,000 capital with $106,000 O&M for Alternative 3; $730,000 capital with $131,000 O&M for Alternative 5; and $490,000 capital with $78,000 O&M for Alternative 7.

A.8.3 Selected Interim Remedial Actions/Objectives

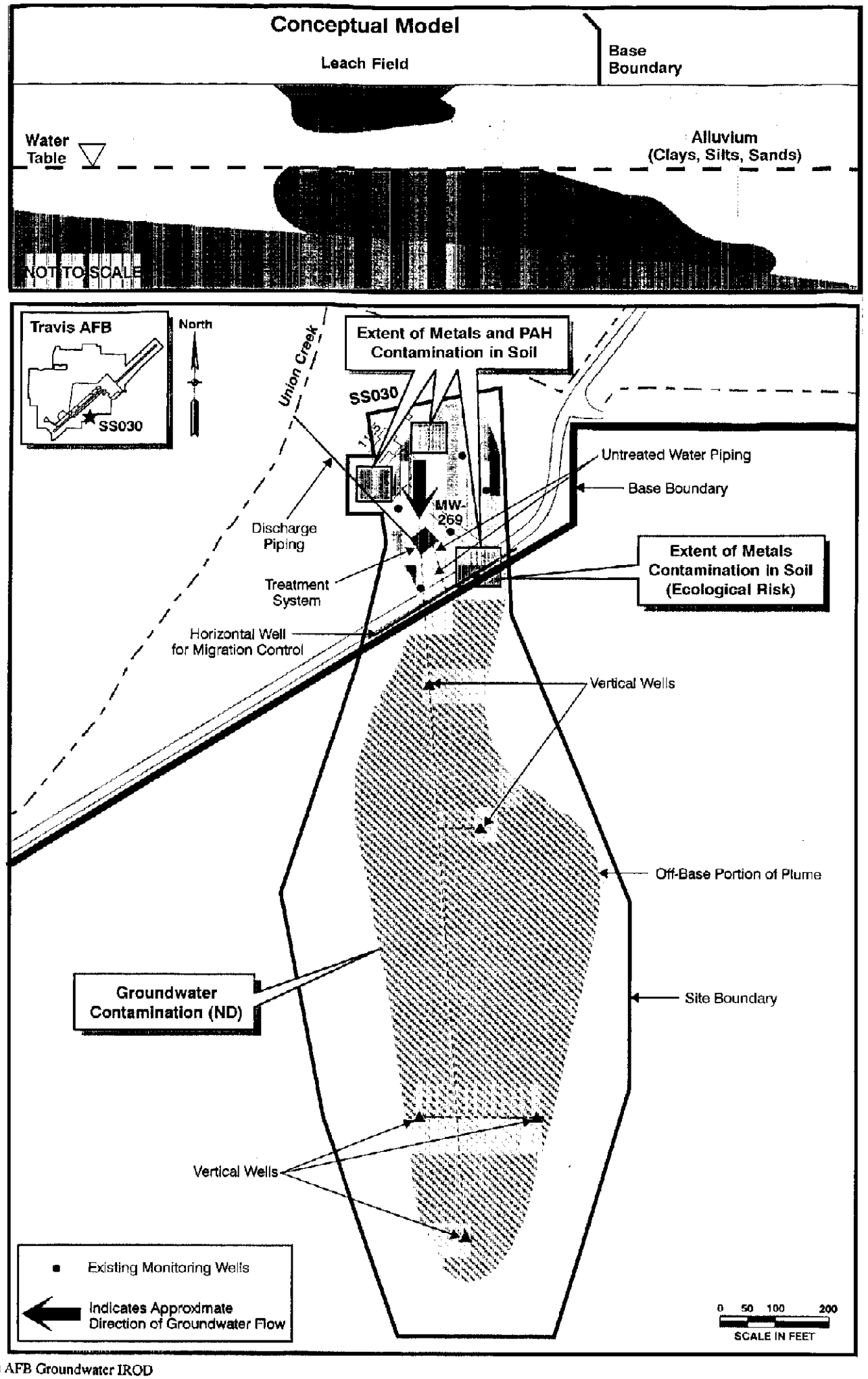
The selected interim action for SS030 is Alternative 3, Extraction, Treatment, and Discharge of the groundwater, a combination of remediation of off-base contamination, source control, and migration control. Source control is necessary to address TCE concentrations

(greater than 3,000 µg/L). Migration control will ensure that further off-base contamination does not occur.

A.8.4 Conceptual Site Model

No specific sources were identified for SS030; a possible source was identified as the septic system or associated leachfield. Groundwater contamination extends approximately 1,100 feet beyond the base boundary.

Contamination found in the soils at SS030 includes several VOCs, SVOCs, PAHs, and metals. Although TCE is found in both the soil and the groundwater, the relatively low levels in the soil (0.197 mg/kg) and modeling results indicate that it is not a source for the groundwater contamination. Although nickel is reported as a COC for both soil and groundwater, the actual origin of the nickel in groundwater is currently being investigated by the Air Force. Any soil cleanup action is not expected to have an effect on groundwater.



SS030 (MW-269 Area)

690 228

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk	TCE	2,400 µg/L
Groundwater	VOCs	for These	Chloroform	1.2 µg/L
Groundwater	VOCs	Contaminants	Dichlorobromomethane	0.53 µg/L
Groundwater	VOCs	Is	1,2-DCA	0.34 µg/L
Groundwater	Metals	HR = 7.6×10^{-4}	Nickel	903 mg/L

Site Characteristics

- Approximately 25% of the area is covered by pavement or buildings
- TCE in groundwater — 958 µg/L average, 2,400 µg/L maximum
- Estimated contaminated groundwater surface area = 425,000 ft^2, volume = 6,375,000 ft^3
- Estimated mass of dissolved VOCs equals 18 lb; DNAPL may be present
- Se and Ag were measured at concentrations greater than NPDES discharge limits in some monitoring wells
- Mix of low permeability soils (clay and silt) and more permeable materials (sands and silts) to a depth of between 20 and 25 feet bgs
- Depth to groundwater — 10 feet
- Depth to bedrock — 20 to 25 feet
- Site also studied for surface and subsurface soil contamination

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Off-base Remediation
  - Source Control for TCE
  - Migration Control

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $660,000; First Year O & M = $106,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $730,000; First Year O & M = $131,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $490,000; First Year O & M = $78,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions*

- Five vertical wells and one horizontal well/extraction trench (NOTE: Location and number of wells will be determined during remedial design phase)
- Extraction rate 92 gpm total, approximately 15 gpm from each well
- 1,300 feet of untreated water piping (from well to treatment system) — 2 to 4 inch PVC or HDPE
- 300 feet of discharge piping (to Union Creek)

* Based on current Treatability Study, RD/RA will refine interim action

Figure A-10.
Site Summary Information for SS030, Travis AFB

5SS030 CDR - VMG 8/19/97 SAC 1

A.9 SITE SD031 (FACILITY 1205)

A.9.1 Site Background

Site SD031 covers approximately 5.5 acres and encompasses Facility 1205 in the northeastern part of the EIOU, southeast of Vandenberg Drive. Operations at the facility, constructed in 1957, include maintenance and repair of diesel-powered generators. A wash rack, located just south of the facility, is used to clean diesel engine parts and discharges to an OWS. Wastes generated at the facility include oils, antifreeze, and solvents. Based on interviews with base personnel, an incinerator may have been located north of the site at one time (Weston, 1995a). Historical aerial photographs taken from 1958 to 1963 indicate that the facility may have been used as an aircraft maintenance hangar during that time. Facility 1205 has handled oils, antifreeze, and solvents from 1957 to the present.

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2-3 and Appendix A of the RI indicate that 20 groundwater samples were collected from monitoring wells and 11 groundwater samples were collected from CPT locations during final sampling rounds. Samples were analyzed for VOCs, petroleum products, and inorganic constituents. In addition to groundwater sampling, subsurface soil samples were collected from seven soil borings and six surface soil samples were collected from SD031. Sample locations, constituents analyzed, and results are presented in the EIOU RI (Weston, 1995a).

Classes of COCs detected in the groundwater at SD031 during the RI include VOCs and one metal. The VOCs identified as COCs include TCE, benzene, 1,1-DCE, cis-1,2-DCE, carbon tetrachloride, chloroform, 1,2-DCA, and vinyl chloride. Nickel was identified as a metal

COC. TPH at concentrations up to 7,000 µg/L was detected in the groundwater at SD031. According to agreements with agencies during the RI, TPH was not considered a COC in the EIOU. TCA was identified in groundwater at SD031 (maximum 12,000 µg/L), but based on health risk assessments, was not considered a COC. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-11. Contamination was not found in the site soils during the RI.

A.9.2 Feasibility Study

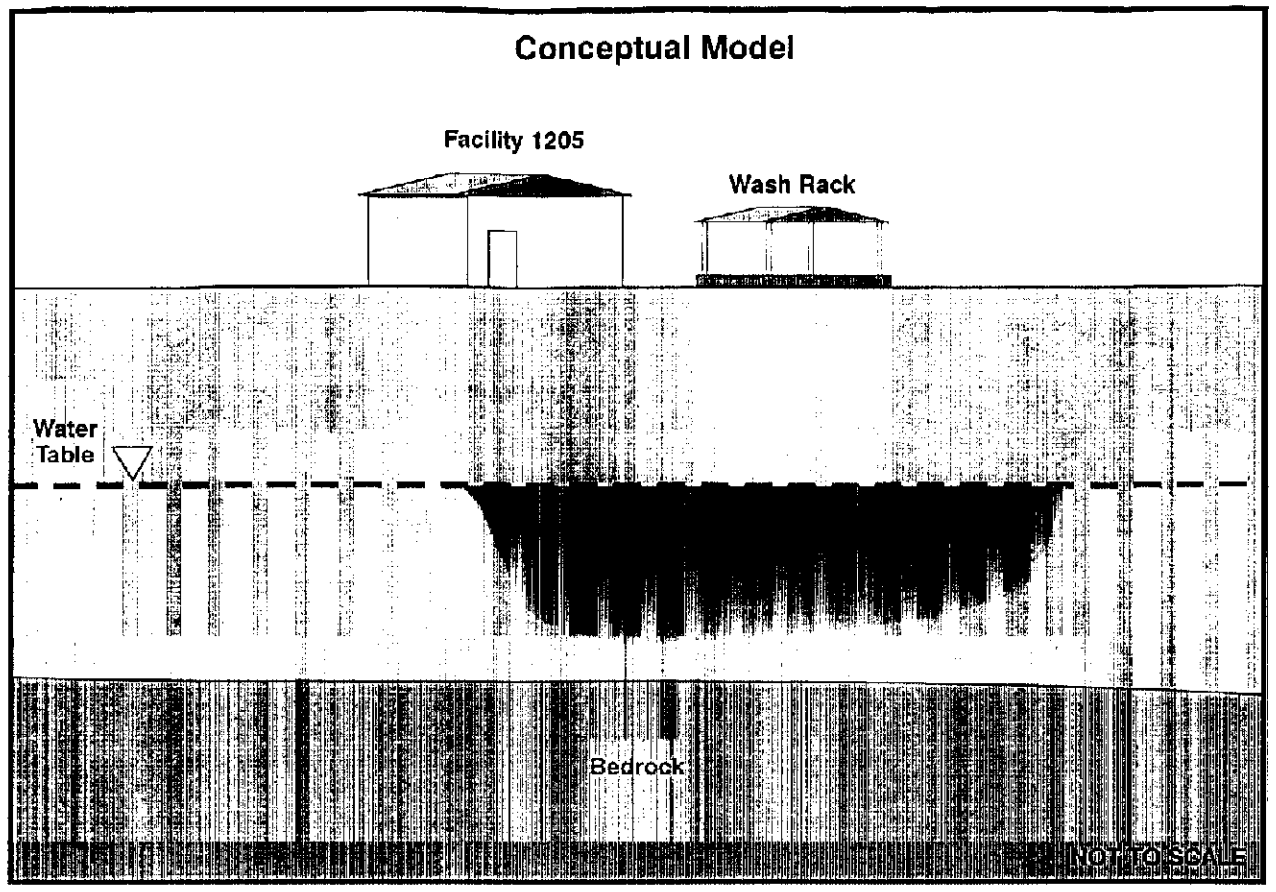
The alternatives evaluated in the FS for SD031 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had scores ranging from 27 to 29. Capital and first year O&M costs for these three alternatives were $620,000 capital with $128,000 O&M for Alternative 3; $700,000 capital with $156,000 O&M for Alternative 5; and $2.58 million capital with $2.4 million O&M for Alternative 7.

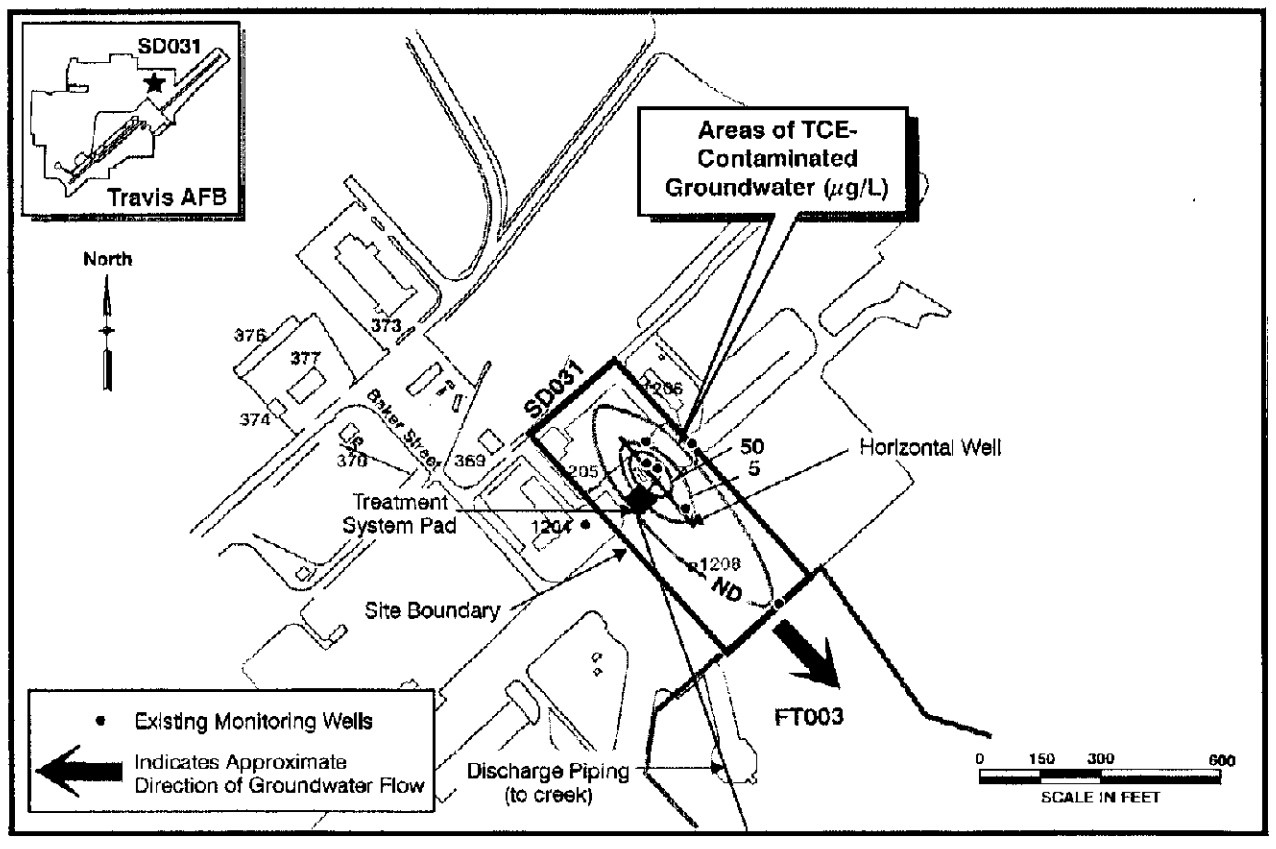
A.9.3 Selected Interim Remedial Actions/Objectives

The selected interim action for SD031 is Alternative 3, Extraction, Treatment, and Discharge of the contaminated groundwater. Concentrations of TCE (greater than 3,000 µg/L) and other VOCs indicate that DNAPL may be present. Source control will ensure that further groundwater contamination does not occur.

A.9.4 Conceptual Site Model

Generator maintenance activities at Facility 1205 may have contributed to fuel-related contamination in the subsurface. Another possible source is an incinerator which was located behind the facility in an open field. The exact location of the incinerator has not been confirmed. Disposal of burned materials from the incinerator may have released contaminants. Although subsurface contamination was detected during the RI, no COCs were identified in the soil or other media at SD031 (Weston, 1995a).





SD031 (Facility 1205)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective Human Risk for These Contaminants Is HR = 5.24×10^{-2}	TCE	8,100 µg/L
Groundwater	VOCs		Benzene	6.75 µg/L
Groundwater	VOCs		1,1-DCE	7,300 µg/L
Groundwater	VOCs		cis-1,2-DCE	3,600 µg/L
Groundwater	VOCs		Carbon Tetrachloride	11 µg/L
Groundwater	VOCs		Chloroform	4.34 µg/L
Groundwater	VOCs		1,2-DCA	0.41 µg/L
Groundwater	VOCs		Vinyl Chloride	0.22 µg/L
Groundwater	Metals		Nickel	2,050 mg/L

Site Characteristics

- Active generator maintenance shop, oil/water separator, and wash racks
- Paved access road, 75% paved area
- TCE in groundwater — 422 µg/L average, 8,100 µg/L maximum
- 1,1-DCE in groundwater — 380 µg/L average, 7,300 µg/L maximum
- Estimated contaminated groundwater surface area = 110,000 ft^2, volume = 330,000 ft^3
- Estimated mass of dissolved VOCs equals 34 lb; DNAPL may be present
- Depth to groundwater — 5 to 15 feet (depending on location)
- Depth to bedrock — 25 feet
- Silt and clay to 10 feet bgs with some fill
- Silty sand with minor gravel from 10 to 25 feet bgs

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Source Control for TCE

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M: $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $620,000; First Year O & M = $128,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $700,000; First Year O & M = $156,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $2,580,000; First Year O & M = $2,400,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- 1 horizontal well, 300 feet in screened length (NOTE: Location and number of wells will be determined during remedial design phase)
- Extraction rate 15 gpm total
- 50 feet of conveyance piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 800 feet of discharge piping — 1-½ inch ID, sch 80 PVC
- 150 feet from treatment system to existing power line

Figure A-11.
Site Summary Information for SD031, Travis AFB

5SD031.CDR - VMG 8/19/97 SAC 1

A.10 SITE ST032 (AREAS OF MW-107 AND MW-246)

A.10.1 Site Background

Site ST032 covers approximately 22 acres and encompasses the areas around MW-107 and MW-246 in the central part of the EIOU. These MWs are placed in the area of Storm Sewer System A, which drains the industrial area of the EIOU. Miscellaneous chemical wastes generated from base shops and waste areas may have been discharged into the storm sewer and surface drainage systems in this area (Weston, 1995).

The Air Force conducted nine sampling rounds at sites within the EIOU during the RI. Results from Rounds 1 through 6 were used for preliminary screening of sites and data. Results from Rounds 7 through 9 were used for risk assessments based on comments from agencies. Sampling efforts are described in Section 2.0 of the EIOU RI (Weston, 1995a). Summary tables 2.2-1 through 2.2-3 and Appendix A of the RI indicate that four groundwater samples were collected from the area surrounding MW-107, and four groundwater samples were taken from the area surrounding MW-246. Samples were analyzed for VOCs, SVOCs, dioxins/furans, petroleum products, inorganic constituents, and total dissolved solids. In addition to groundwater sampling, subsurface soil samples were collected from two soil borings in the area surrounding MW-246. Sample locations, constituents analyzed, and results are presented in the EIOU RI (Weston, 1995a).

Classes of COCs detected in the groundwater at these MWs during the RI include VOCs and one SVOC. VOCs identified as COCs include benzene, TCE, 1,1-DCE, and xylenes. Bis(2-ethylhexyl)phthalate (a SVOC) was also identified as a COC. TPH was present as floating product and in the groundwater at concentrations up to 29,000,000 µg/L near MW-246. Based on the contaminants identified during the RI, groundwater contamination at ST032 is found in two areas, Plume A and Plume B. Plume A is characterized by VOC and SVOC contamination, and is located in the MW-107 area. Plume B is characterized by a light aqueous-phase liquid floating

product (LNAPL) and xylene contamination, and is located in the MW-246 area. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-12. Soil contamination found during the RI includes VOCs, PAHs, pesticides, PCBs, and metals.

A.10.2 Feasibility Study

The alternatives evaluated in the FS for ST032 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), Alternative 7 (extraction, ion exchange, activated carbon, and discharge), and Alternative 9 (extraction, bioslurping, recovered product recycling, and off gas catalytic oxidation). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 all had scores of 31. Capital and first year O&M costs for these three alternatives were $2.2 million capital with $177,000 O&M for Alternative 3; $2.2 million capital with $220,000 O&M for Alternative 5; and $2.0 million capital with $280,000 O&M for Alternative 7. Alternative 9 had a total score of 25, a capital cost of $270,000, and first year O&M cost of $17,000.

A.10.3 Selected Interim Remedial Actions/Objectives

The selected interim action for the groundwater at ST032 (Plume B) is Alternative 3, Extraction, Treatment, and Discharge. This will be accomplished through source control with free product removal such as bioslurping, or other free product removal method. Bioslurping results in groundwater and vapor that requires treatment. Alternative 3 will prevent further contamination of the groundwater from the free product.

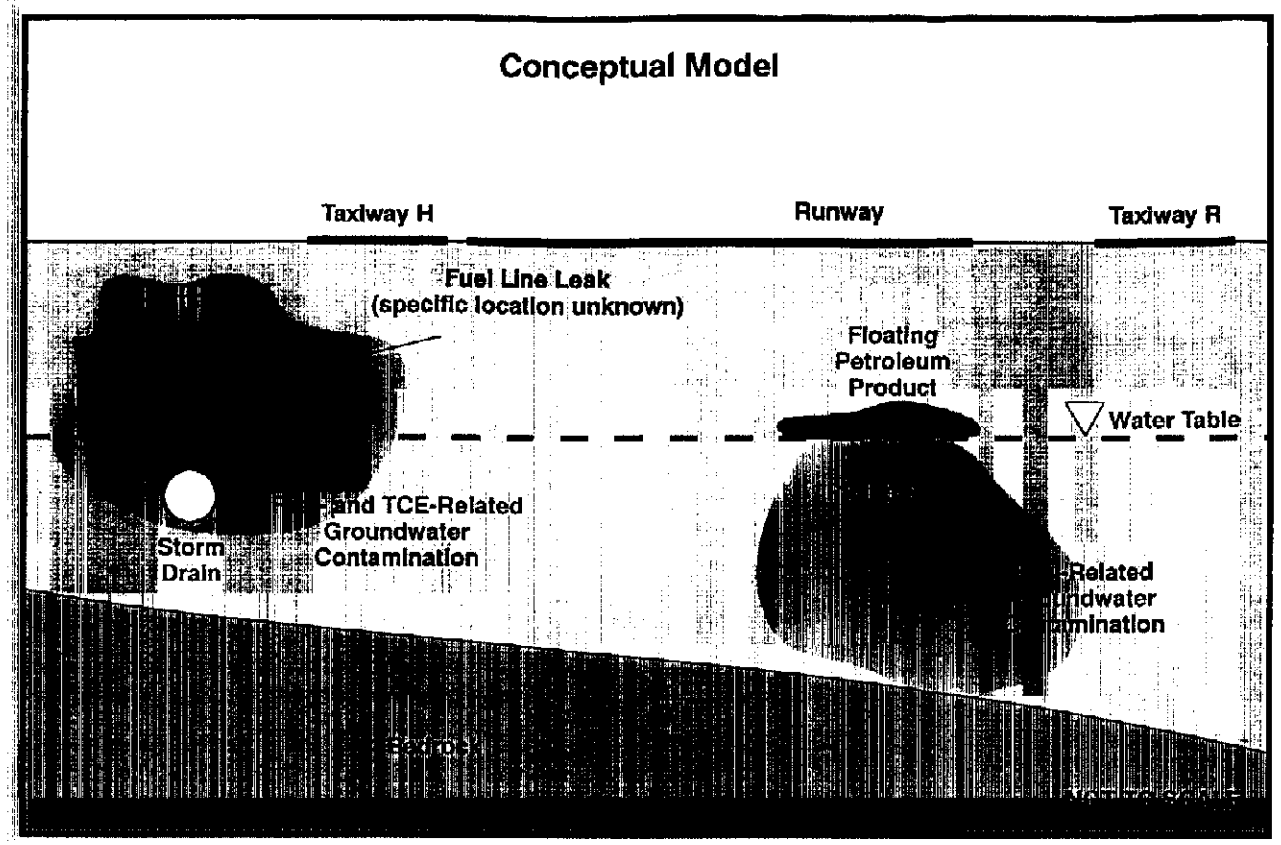
Selection of an alternative for the Plume A groundwater is deferred until the final Groundwater ROD so that additional data can be collected and evaluated to support the use of

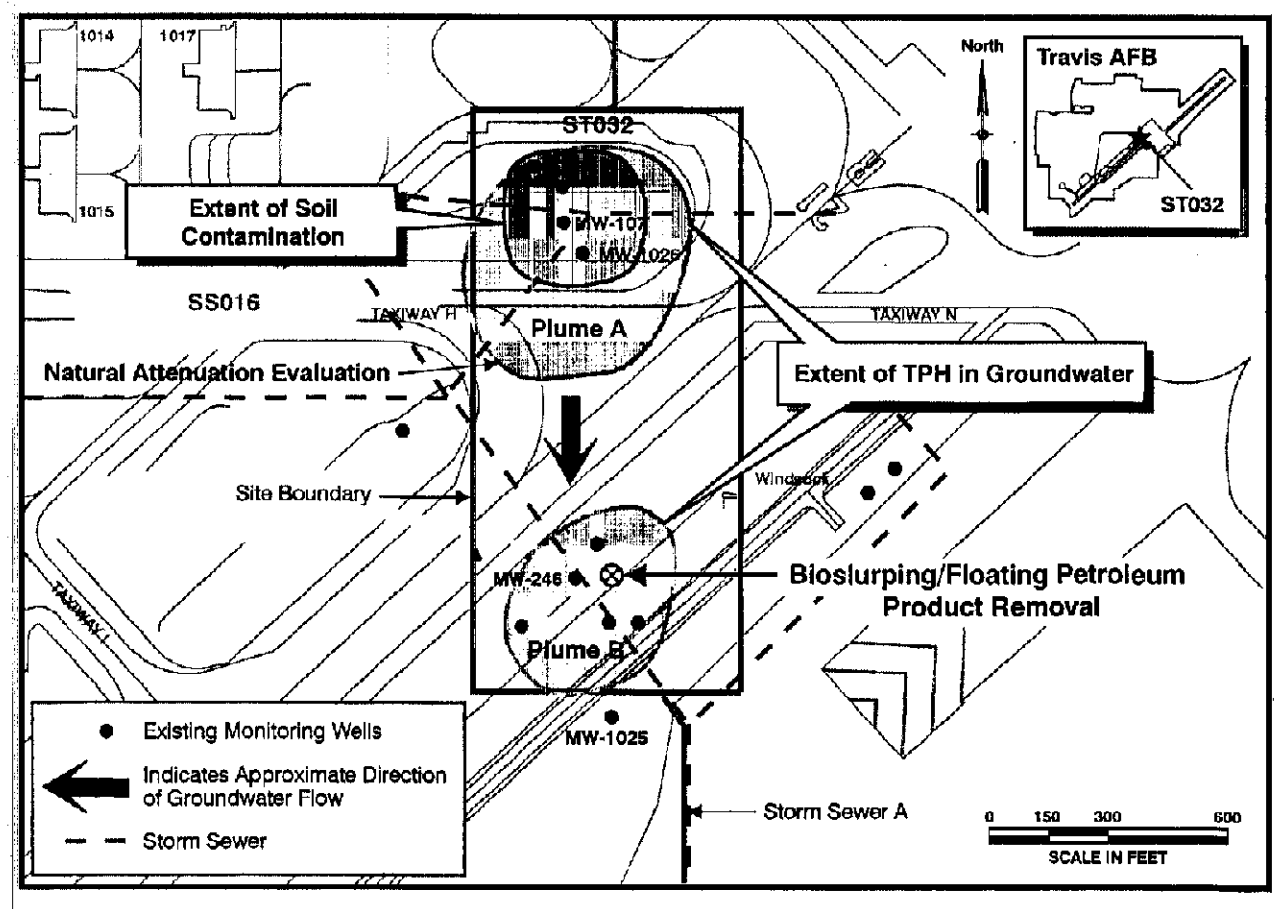
natural attenuation as a remedial action. Additional site-specific data regarding natural attenuation will be developed for evaluation as part of the Basewide Natural Attenuation Assessment Plan. Natural attenuation appears to be a viable alternative for this site as a cost-effective way to meet CERCLA criteria because of the low TCE concentrations (maximum 64 µg/L), and the plume appears to be stable. In addition, the presence of TPH for cometabolism and degradation products indicate natural attenuation is occurring.

The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

A.10.4 Conceptual Site Model

Contamination in the soils at the site include benzene, TCE, and 1,1-DCE, all of which are also found in the groundwater. The main source of groundwater contamination appears to be the floating product. Once this is removed, contaminant concentrations in the soil are expected to degrade naturally. The potential source of TCE was identified in the RI (Weston, 1995a) as an upgradient location (SS016). PCBs and metals are also soil COCs but are not identified as groundwater contaminants.





ST032 (Areas MW-107 and MW-246)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type		Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Collective	Floating Petroleum Product (LNAPL)	NA
Groundwater	VOCs	Human Risk	Benzene	5,040 μg/L
Groundwater	VOCs	for These	TCE	64 μg/L
Groundwater	VOCs	Contaminants	1,1-DCE	0.36 μg/L
Groundwater	VOCs	Is	Xylenes	6,702 μg/L
Groundwater	SVOCs	HR = 1.5×10^{-2}	Bis(2-ethylhexyl)phthalate	153 μg/L

Site Characteristics

- Grassy, open area between a runway and an abandoned taxiway
- Proximities to runway severely restrict land use (and potential remedial actions)
- 20% of MW-107 area covered by runway and taxiway
- 10% of MW-246 area covered by runway and taxiway
- TCE in groundwater — 10 μg/L average, 64 μg/L maximum
- TPH in groundwater — 15,000,000 μg/L average, 29,000,000 μg/L maximum, floating petroleum product is present
- Estimated contaminated groundwater surface area = 220,000 ft^2; volume = 1,000,000 ft^3
- Estimated mass of dissolved VOCs equals 180 lb (does not include TPH); LNAPL is present
- Ca, Cr, Cu, Ni, and Ag were measured at concentrations greater than NPDES discharge limits in some monitoring wells
- Depth to groundwater — 7 feet
- Depth to bedrock — 30 feet
- Site also studied for sub-surface soil contamination
- Storm sewer system is a potential groundwater/surface water pathway (under investigation)

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge (Plume B)
  - Plume B
  - Source Control for Floating Petroleum Product Removal
- Selection deferred for Plume A, area will be included in the Basewide Natural Attenuation Assessment Plan

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,200,000; First Year O & M = $177,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,160,000; First Year O & M = $220,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $2,000,000; First Year O & M = $280,000
  - FS Alternative 9: Bioslurping, Recovered Product Recycling, Off-gas Catalytic Oxidation: Capital Cost = $270,000; First Year O & M = $17,000
- These costs derived from the FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- Bioslurping/Free Product Removal (Plume B)
- Monitoring Wells (NOTE: Location and number of wells will be determined during remedial design phase)
- Determine groundwater/surface water interactions and design appropriate responses

Figure A-12.
Site Summary Information
for ST032, Travis AFB

5ST032.CDR - VMG 9/4/97 SAC 1

A.11 SITE SD033 (STORM SEWER SYSTEM II/FACILITIES 810 AND 1917, SOUTH GATE AREA, AND WEST BRANCH OF UNION CREEK)

A.11.1 Site Background

Site SD033, which covers a total of approximately 24 acres, is located in the West Industrial Operable Unit (WIOU), encompasses parts of Storm Sewer System II (previously called Storm Sewer System B), Facilities 810 and 1917, the area around the South Gate, and the west branch of Union Creek. Storm Sewer System II, comprised of underground piping, and the West Branch of Union Creek collect runoff from within the WIOU and small portions of the EIOU and West Annexes and Basewide Operable Unit (WABOU). Runoff from Storm Sewer II generally flows south and enters Union Creek south of the WIOU in the EIOU. Dissolved contamination in the groundwater at SD033 migrated from broken or damaged areas of the storm sewer and underground piping.

Facility 810, constructed in 1955, is used for aircraft refurbishing activities. An OWS, sump, and wash rack previously existed at the facility and discharged to Storm Sewer System II. This equipment has been abandoned, and the facility no longer discharges to the storm sewer. Wastes generated at the facility in the past have included PD-680, paints, solvents, lubricants, PCBs, and fuels.

Facility 1917 is located south of Facility 810 just west of the flightline apron and was constructed in 1956 for use as an aircraft washdown area (Radian, 1996b). An OWS and wastewater collection sumps, previously used during washdown activities, remain at the facility but are no longer in use. Wastes generated at the facility during past activities include PD-680, soaps, engine oil, hydraulic fluid, and jet fuel.

The Air Force collected groundwater samples from 32 locations at SD033 during the RI. At Facility 810, 10 CPT HydroPunch® samples and 2 monitoring well samples were

collected; at Facility 1917, 2 monitoring wells were sampled; along Storm Sewer System II 10 CPT HydroPunch® samples and 2 monitoring well samples were collected; and at the South Gate area, 6 CPT HydroPunch® samples were collected. Groundwater samples were analyzed for petroleum hydrocarbons, inorganic constituents, pesticides and PCBs, VOCs, and SVOCs (Radian, 1996b). In addition to groundwater sampling, surface water, sediment, and surface soil samples were collected from 10 transect locations in SD033, 16 soil borings were drilled for subsurface investigations, 2 surface flux samples were collected, and video surveying was performed to inspect the quality of the storm sewer. Specific sampling locations, constituents analyzed, and results can be obtained in the WIOU RI (Radian, 1996b).

Classes of COCs identified in the groundwater at the site during the RI include VOCs and one SVOC. VOCs identified as COCs include TCE, 1,1-DCE, 1,2-DCA, cis-1,2-DCE, and TPH-gasoline (TPH-G). TPH-extractable (TPH-E) was identified as a SVOC COC. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-13. Contaminants identified in other media at SD033 include: VOCs in the soil gas and sediment; SVOCs in the sediment; and metals in the sediment, surface soil, and surface water.

A.11.2 Feasibility Study

The alternatives evaluated in the FS for SD033 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had scores ranging from 27 to 31. Capital and first year O&M costs for these three alternatives were $2.6 million capital with $180,000 O&M for Alternative 3; $2.7 million capital with $230,000 O&M for Alternative 5; and $2.3 million capital with $140,000 O&M for Alternative 7.

A.11.3 Selected Interim Remedial Actions/Objectives

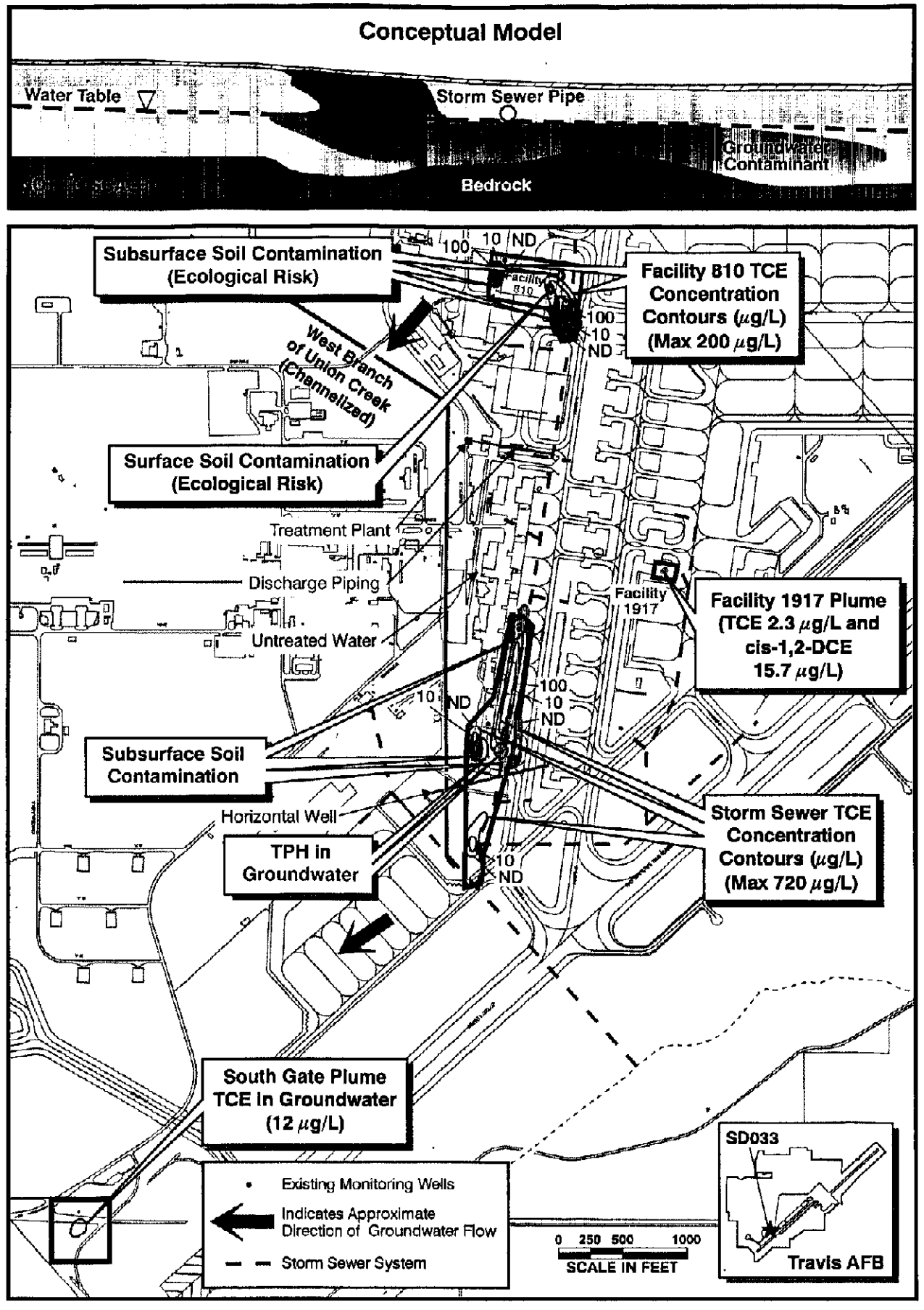
The selected interim action for SD033 is a combination of Alternative 3 for the Storm Sewer area of contamination and Alternative 2, Natural Attenuation with groundwater monitoring, for the remainder of the site. Alternative 3 using migration control is needed for Storm Sewer II because of VOC concentrations (up to 1,000 µg/L) in the groundwater and possible hydraulic connections with subsurface utilities that could lead to further contaminant migration (see also Figure 3-6).

Selection of an alternative for the South Gate, Facility 1917, and Facility 810 plumes has been deferred until the final Groundwater ROD. This will allow site-specific data to be collected and evaluated to support the use of natural attenuation as a remedial action. Natural attenuation appears to be a viable alternative because contaminant concentrations are relatively low and only appear in small isolated areas near the South Gate and Facilities 810 and 1917. The remainder of the plumes also appear relatively stable. Additional data regarding natural attenuation will be developed for evaluation as part of the Basewide Natural Attenuation Assessment Plan.

The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

A.11.4 Conceptual Site Model

Sources of groundwater contamination at SD033 include the storm sewer pipeline for the storm sewer portion, and the OWS, wash rack, and storm sewer pipeline for Facility 810 plume. Contaminants found in the sediments, surface soils, and surface water at SD033 are not related to contaminants detected in the groundwater. Some VOCs identified in the soil gas were also found in the groundwater, including TCE, cis-1,2-DCE, and TPH-G; however, they are not considered to be a source of groundwater contamination.



SD033 (Storm Sewer System II/Facilities 810 and 1917, South Gate Area, and West Branch of Union Creek)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 3.6×10^{-5}	TCE	941 µg/L
Groundwater	VOCs	HR = 1.7×10^{-6}	1,1-DCE	0.42 µg/L
Groundwater	VOCs	Exceeds MCL	1,2-DCA	1.36 µg/L
Groundwater	VOCs	Exceeds MCL	cis-1,2-DCE	199 µg/L
Groundwater	VOCs	Exceeds IRG	TPH-gasoline	1,000 µg/L
Groundwater	SVOCs	Exceeds IRG	TPH-E	1,420 µg/L

Site Characteristics

- Storm sewer system/Facility 810 are both facilities in use
- Contamination in sediment, surface soil, groundwater, and surface water
- cis-1,2-DCE in groundwater — 20 µg/L average, 199 µg/L maximum
- TCE in groundwater — 125 µg/L average, 941 µg/L maximum
- Estimated contaminated groundwater surface area = 160,000 ft^2, volume = 490,000 ft^3
- Estimated mass of dissolved VOCs equals 5.6 lb; no evidence of DNAPL or LNAPL
- VOC (chloromethane) detected in ambient air samples
- Flow in Union Creek is derived from surface runoff, and at times from groundwater
- Depth to groundwater — 13 to 18 feet, depending on location; depth to bedrock — varies
- Site also studied for soil contamination

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge (Storm Sewer Plume)
  - Migration Control for VOCs
- Selection deferred for South Gate, Facility 1917, and Facility 810 Plumes, these will be included in the Basewide Natural Attenuation Assessment Plan

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,600,000; First Year O & M = $180,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,700,000; First Year O & M = $230,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $2,300,000; First Year O & M = $140,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- 1 horizontal well, 300 feet in screened length
  (NOTE: Location and number of wells will be determined during the remedial design phase)
- Extraction rate 15 gpm total
- 12,650 feet of untreated water piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 500 feet of discharge piping — 3 inch ID, sch 80 PVC
- 100 feet from treatment system to existing power line
- Monitoring Wells (NOTE: Location and number of wells will be determined during the remedial design phase)
- Determine groundwater/surface water interactions and design appropriate responses

Figure A-13.
Site Summary Information for SD033, Travis AFB

5SD033.CDR - VMG 9/4/97 SAC 1

A.12 SITE SD034 (FACILITY 811)

A.12.1 Site Background

Site SD034 covers approximately 1.1 acre and encompasses Facility 811, located in the northern portion of the WIOU on Ragsdale Street south of Hangar Avenue. The Facility includes an indoor wash rack, installed in 1979, which is used to wash, strip, and pretreat aircraft parts prior to painting. Wastewater from the wash rack flows into an OWS. Flow from the OWS can be directed into either the sanitary sewer or a concrete-lined overflow pond located just west of the facility. A hole was discovered in the OWS during 1994. The defective OWS was removed and replaced with the current OWS. Chemicals used at this facility include acids, solvents, antifreeze, and the Stoddard solvent PD-680.

The Air Force collected groundwater samples from 14 locations in the area of Facility 811 during the RI. Samples were collected from soil borings, monitoring wells, and CPT locations. Samples were analyzed for petroleum hydrocarbons, inorganic constituents, pesticides and PCBs, VOCs, and SVOCs. In addition to groundwater samples, 2 surface soil samples, 23 soil gas samples, and 14 subsurface soil samples were collected at SD034. Sampling locations, constituents analyzed, and results can be obtained in the WIOU RI (Radian, 1996b).

Classes of COCs detected in the groundwater during the RI include VOCs and SVOCs. VOCs identified as COCs include TCE, vinyl chloride, 1,1-DCE, benzene, cis-1,2-DCE, PCE, and TPH-G. TPH-E and bis(2-ethylhexyl)phthalate were identified as SVOC COCs. A floating product layer of PD-680, a light non-aqueous phase liquid (LNAPL), is also present at the site and is considered a COC. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-14. Additional contaminants detected include TPH-G and TPH-E in the soil, and TCE, PCE, and cis-1,2-DCE in the soil gas (Radian, 1996b).

A.12.2 Feasibility Study

The alternatives evaluated in the FS for SD034 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), Alternative 7 (extraction, ion exchange, activated carbon, and discharge) and Alternative 9 (extraction, bioslurping, recovered product recycling, and off gas catalytic oxidation). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 all had scores of 31. Capital and first year O&M costs for these three alternatives were $490,000 capital with $86,000 O&M for Alternative 3; $570,000 capital with $110,000 O&M for Alternative 5; and $380,000 capital with $79,000 O&M for Alternative 7. Alternative 9 had a total score of 25, capital cost of $270,000, and a first year O&M cost of $3,900.

A.12.3 Selected Interim Remedial Actions/Objectives

The selected interim action for SD034 is Alternative 3, Extraction, Treatment, and Discharge, with both source and migration control. Source control will involve removal of the floating free product (PD-680) through bioslurping or other free product removal method. Migration control will be achieved by groundwater extraction and will be coordinated with interim actions for SD037.

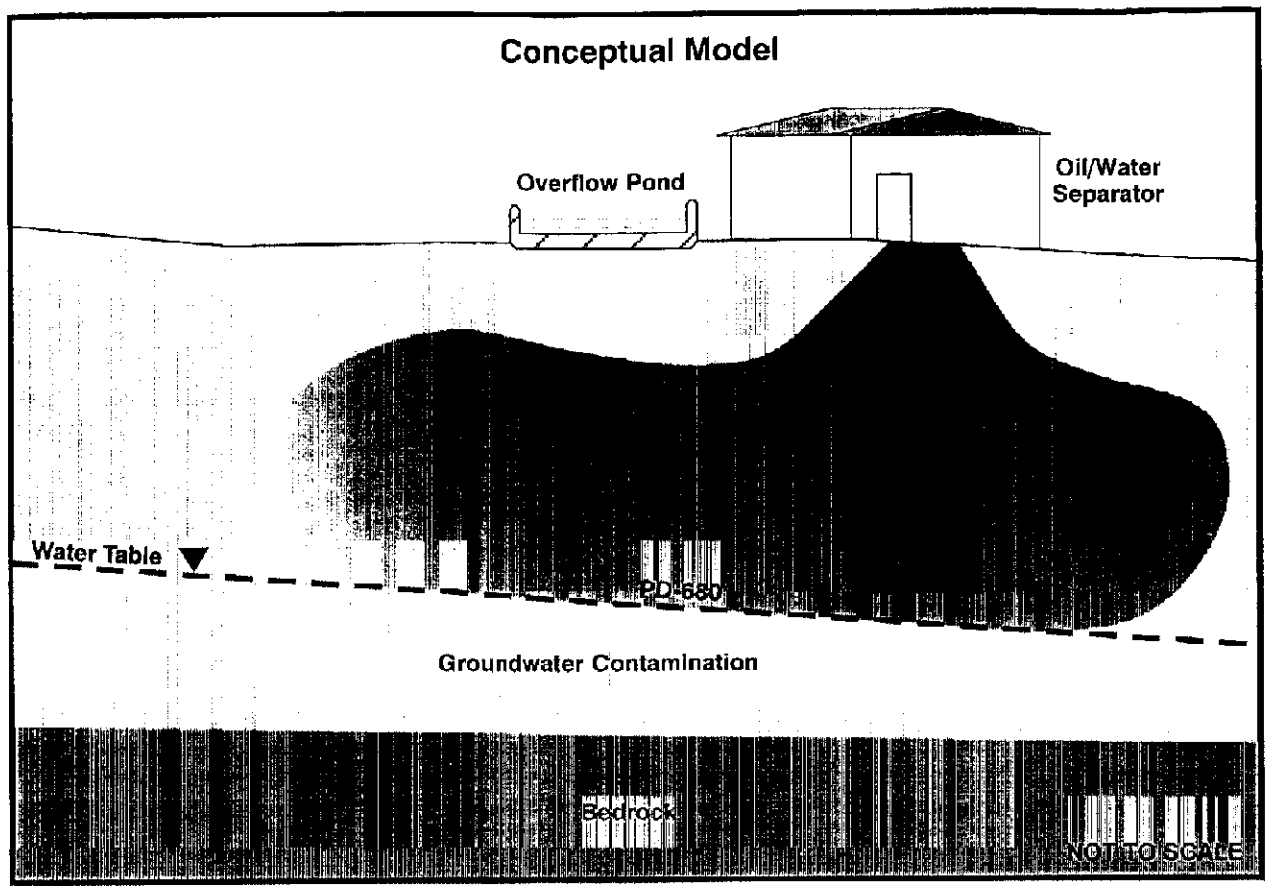
Alternative 3, using source and migration control, was selected at this site due to the potential for contaminants to migrate to the West Branch of Union Creek (located approximately 150 feet west of SD034). Removal of the free product will eliminate further contamination of the groundwater, and migration control will ensure that contaminants do not migrate further from the site.

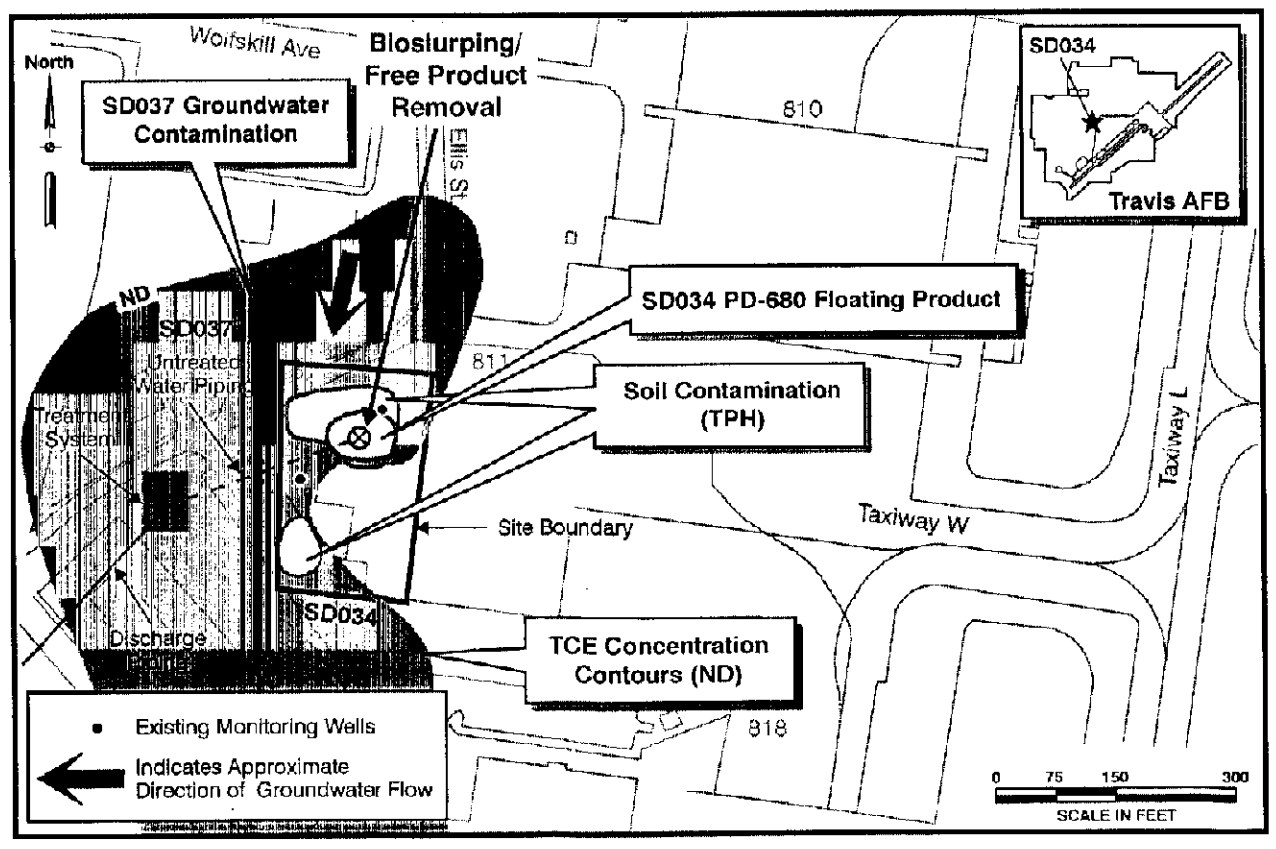
A.12.4 Conceptual Site Model

Sources of groundwater contamination include leaks from the OWS and associated piping at Facility 811. Contaminants, particularly chlorinated hydrocarbons, are commingled with groundwater contamination at SD037. Contamination detected in the soils at the site include TPH-G and TPH-E which are also present in the groundwater. Soils contamination could be a source of contaminants found in the groundwater but should naturally attenuate and not impact groundwater once the floating product (PD-680) is removed.

A.12.5 Special Site Considerations

SD034 and SD037 plumes are commingled; interim remedial actions will be coordinated to ensure that the extraction system is optimized, and the most cost effective interim remedial action is design and implemented.





SD034 (Facility 811)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	NA	LNAPL (PD-680)	~1 foot thick
Groundwater	VOCs	HR = 3.0×10^{-5}	TCE	740 µg/L
Groundwater	VOCs	HR = 3.1×10^{-5}	Vinyl Chloride	2.38 µg/L
Groundwater	VOCs	HR = 1.2×10^{-6}	1,1 DCE	0.317 µg/L
Groundwater	VOCs	Exceeds MCL	Benzene	6.8 µg/L
Groundwater	VOCs	Exceeds MCL	cis-1,2-DCE	496 µg/L
Groundwater	VOCs	HR = 1.2×10^{-5}	PCE	88 µg/L
Groundwater	VOCs	NA	TPH-gasoline	10,600,000 µg/L
Groundwater	SVOCs	NA	TPH-E	13,000,000 µg/L
Groundwater	SVOCs	HR = 3.3×10^{-4}	bis(2-ethylhexyl)phthalate	6,390 µg/L

Site Characteristics

- Includes an indoor washrack, an oil/water separator, and a concrete-lined overflow pond
- Approximately 75% of the area is covered with roadbase and asphalt
- cis-1,2-DCE in groundwater — 80 µg/L average, 496 µg/L maximum
- TCE in groundwater — 120 µg/L average, 740 µg/L maximum
- TPH in groundwater — 5,000,000 µg/L average, 13,000,000 µg/L maximum, floating petroleum product (PD-680) is present
- Estimated contaminated groundwater surface area = 220,000 ft^2, volume = 670,000 ft^3
- Estimated mass of dissolved VOCs equals 9.6 lb (does not include TPH); LNAPL is present
- Chromium and mercury were measured at concentrations greater than NPDES limits in some monitoring wells
- Site is adjacent to SD037 — groundwater plumes are mixed
- Depth to groundwater — 10 to 13 feet, depth to sandstone bedrock — 16 feet
- Site also studied for soil contamination

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Source control for floating product removal (PD-680)
  - Migration Control (coordinated with SD037)

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $490,000; First Year O & M = $86,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $570,000; First Year O & M = $110,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $380,000; First Year O & M = $79,000
  - FS Alternative 9: Bioslurping, Recovered Product Recycling, Off-gas Catalytic Oxidation: Capital Cost = $270,000: First Year O & M = $3,900
- These costs derived from the FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- Bioslurping/Free Product Removal
- Monitoring Wells (NOTE: Location and number of wells will be determined during remedial design phase)

Figure A-14.
Site Summary Information for SD034, Travis AFB

5SD034.CDR - VMG 8/19/97 SAC 1

A.13 SITE SS035 (FACILITIES 818/819)

A.13.1 Site Background

Site SS035 covers approximately 5 acres and consists of Facilities 818 and 819, located in the northern part of the WIOU. Facility 818, constructed in 1970, is used to repair, wash, and paint aircraft. Wash water at the facility flows into trench drains and then into an OWS which discharges to the sanitary sewer system. Facility 819 contains an electro-environmental shop, a wheel and tire shop, and a hazardous waste accumulation area. Chemicals used at these facilities include lubricating oil, hydraulic fluids, PD-680, and water solutions of these chemicals.

The Air Force collected 10 HydroPunch® groundwater samples from soil borings at SS035 during the RI. Samples were analyzed for petroleum hydrocarbons, inorganic constituents, pesticides and PCBs, VOCs, and SVOCs. In addition to groundwater sampling, 56 soil samples and 20 soil gas samples were collected. Sampling locations, constituents analyzed, and results can be obtained in the WIOU RI (Radian, 1996b).

COCs detected in the groundwater during the RI include one VOC and one SVOC: TCE and TPH-E, respectively. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-15. Other contaminants detected include PCBs and metals in the surface soil, and TCE and vinyl chloride in the soil gas. A contaminant source could not be determined for the PCBs (Radian, 1996b).

A.13.2 Feasibility Study

The alternatives evaluated in the FS for SS035 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 4 (extraction, air stripper/catalytic oxidation, activated carbon, and discharge), Alternative 6 (extraction, UV-OX, activated carbon, and discharge), and Alternative 8 (extraction, activated carbon, and discharge). As evaluated in

the FS, Alternative 1 had the lowest cost, but the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a total score of 16. Alternatives 4, 6, and 8 all had scores of 33. Capital and first year O&M costs for these three alternatives were $310,000 capital with $77,000 O&M for Alternative 4; $376,000 capital with $100,000 O&M for Alternative 6; and $190,000 capital with $100,000 O&M for Alternative 8.

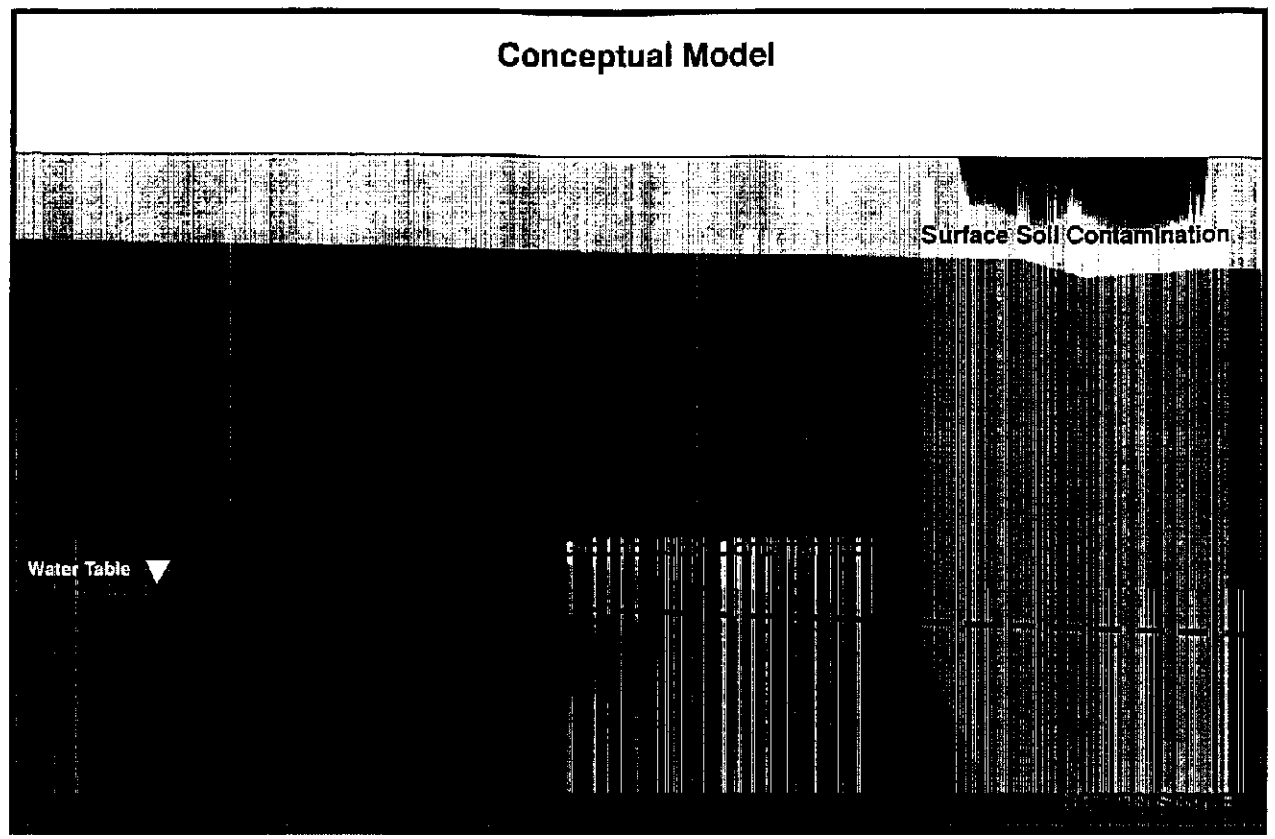
A.13.3 Selected Interim Remedial Actions/Objectives

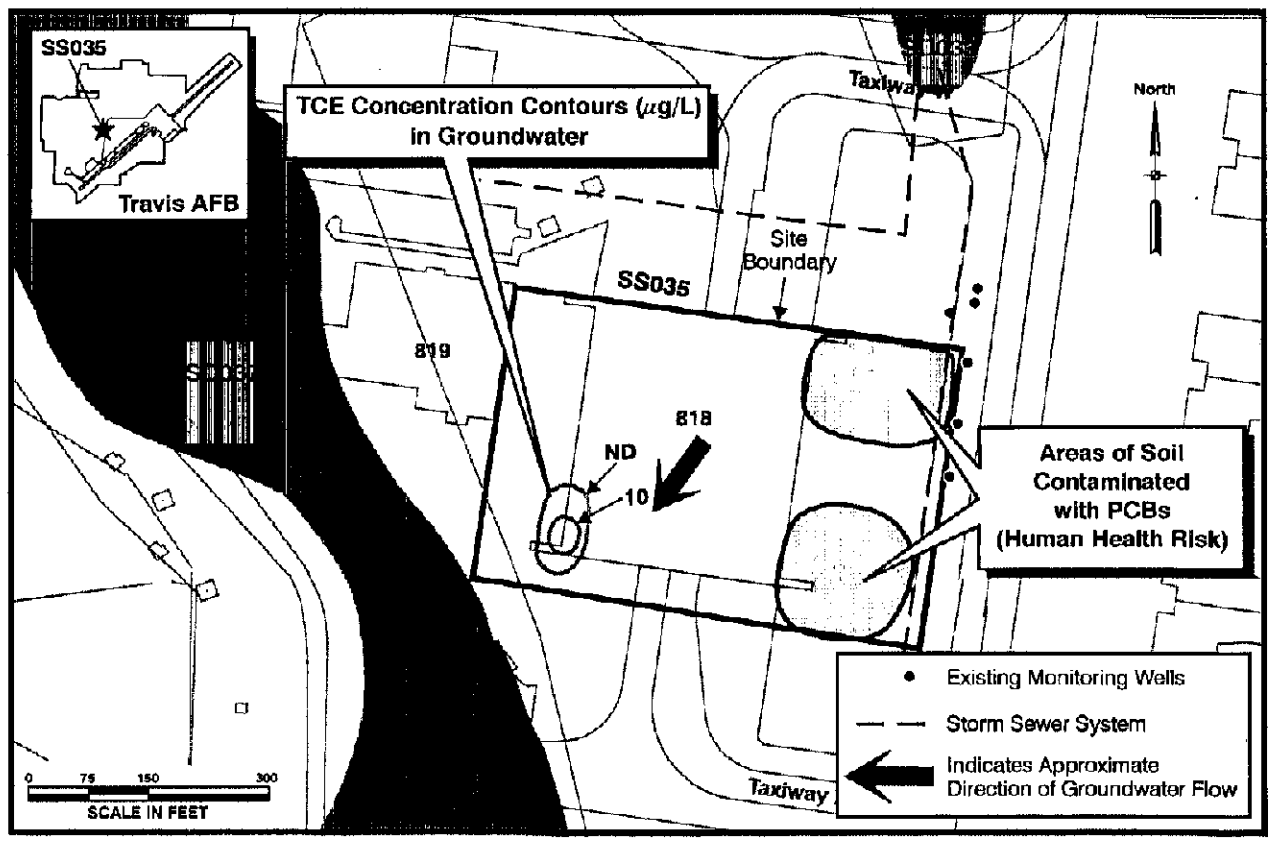
Selection of an alternative is deferred for the groundwater at SS035 until the final Groundwater ROD. This will allow site-specific data to be collected and evaluated to support the use of natural attenuation as a remedial action. Natural attenuation appears to be a viable alternative for this site because the area of contamination appears to be stable, TCE concentrations in groundwater are low (average of 5 µg/L) and the areal extent is limited. In addition, TPH is present for cometabolism and TCE degradation by-products were detected indicating that natural attenuation is occurring. Additional data regarding natural attenuation will be developed for evaluation as part of the Basewide Natural Attenuation Assessment Plan.

The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

A.13.4 Conceptual Site Model

The probable source of the groundwater contamination was identified as the OWS associated with Facility 818. Surface soil contamination, including PCBs, was identified at SS035 during the RI. The soil contamination is located near Building 818 and is not related to the groundwater contamination. Remediation of the surface soils is not expected to affect groundwater.





SS035 (Facility 818/819)

690 249

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	Exceeds MCL	TCE	21 µg/L
Groundwater	SVOCs	Exceeds Standard	TPH-E	160 µg/L

Site Characteristics

- Asphalt and roadbase covers most of the site
- Facility 818/819 includes a wash area, oil/water separator and sump, hydraulic lift storage area, and hazardous material accumulation area
- TCE in groundwater — 5 µg/L average, 21 µg/L maximum
- Estimated mass of dissolved VOCs equals 0.007 lb, estimated plume volume equals 12,000 ft³; no evidence of DNAPL or LNAPL
- Depth to groundwater — 15 feet
- Low permeability soils (clay and silt) to about 15 feet bgs
- More permeable material (sand lens) encountered throughout site
- Site also studied for surface soil contamination

Selected Interim Remedial Action/Objectives

- Deferred: Site will be included in the Basewide Natural Attenuation Assessment Plan

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 4: Air Stripper/Catalytic Oxidation, Activated Carbon: Capital Cost = $310,000; First Year O & M = $77,000
  - FS Alternative 6: UV Oxidation, Activated Carbon: Capital Cost = $376,000; First Year O & M = $100,000
  - FS Alternative 8: Activated Carbon: Capital Cost = $190,000; First Year O & M = $100,000
- These costs derived from the FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Figure A-15.
Site Summary Information for SS035, Travis AFB

5SS035.CDR - VMG 9/4/97 SAC 1

A.14 SITE SD036 (FACILITIES 872/873/876)

690 250

A.14.1 Site Background

Site SD036, located in the western portion of the WIOU, covers approximately 6 acres, and is comprised of Facilities 872, 873, and 876. The three facilities were constructed in 1953 as multiple use shops for Civil Engineering (CE). Facility 872 is currently used for maintenance and storage of CE vehicles and landscaping equipment. An OWS previously located at the facility was removed in 1994. Facility 873 contains the CE interior electric, locksmith, and paint shop. Facility 876 is used for paint mixing. An accumulation area for waste paints and thinner is adjacent to the facility. Chemicals used at this site include cleaning solutions, grease, degreasers, hydraulic oils and fluids, PD-680, pesticides, paints, and solvents.

The Air Force sampled groundwater from 25 locations at SD036 during the RI. Samples were collected from soil borings, CPT locations, and groundwater monitoring wells. Groundwater samples were analyzed for petroleum hydrocarbons, inorganic constituents, pesticides and PCBs, VOCs, and SVOCs. In addition to groundwater sampling, 36 soil gas samples and 31 soil samples were collected at SD036. Sampling locations, constituents analyzed, and results can be obtained in the WIOU RI (Radian, 1996b).

Classes of COCs detected in the groundwater at SD036 during the RI include VOCs and one SVOC. VOCs identified as COCs include vinyl chloride, TCE, 1,1-DCE, cis-1,2-DCE, 1,2-DCA, benzene, bromodichloromethane, PCE, and TPH-G. TPH-E was identified as a SVOC COC. Site location, groundwater contaminant concentrations, and a conceptual site model are presented in Figure A-16. Additional contamination detected during the RI includes several VOCs in the soil and soil gas, and SVOCs in the soil gas (Radian, 1996b).

A natural attenuation study will be conducted at SD036 to evaluate the feasibility of natural attenuation of chlorinated solvents using a technical protocol jointly developed by AFCEE and U.S. EPA.

A.14.2 Feasibility Study

The alternatives evaluated in the FS for SD036 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 1 had the lowest cost, but also the lowest total score. Alternative 2 had a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had scores ranging from 27 to 31. Capital and first year O&M costs for these three alternatives were $795,000 capital with $110,000 O&M for Alternative 3; $860,000 capital with $144,000 O&M for Alternative 5; and $2.3 million capital with $1.9 million O&M for Alternative 7.

A.14.3 Selected Interim Remedial Actions/Objectives

The selected interim action for groundwater at SD036 is Alternative 3, Extraction, Treatment, and Discharge using source and migration control. Source control is necessary to address cis-1,2-DCE concentrations greater than 3,000 µg/L. Prior to the design and installation of the extraction system, the site will be evaluated for natural attenuation. Results of this natural attenuation study will be used to assess the need for an active extraction interim action.

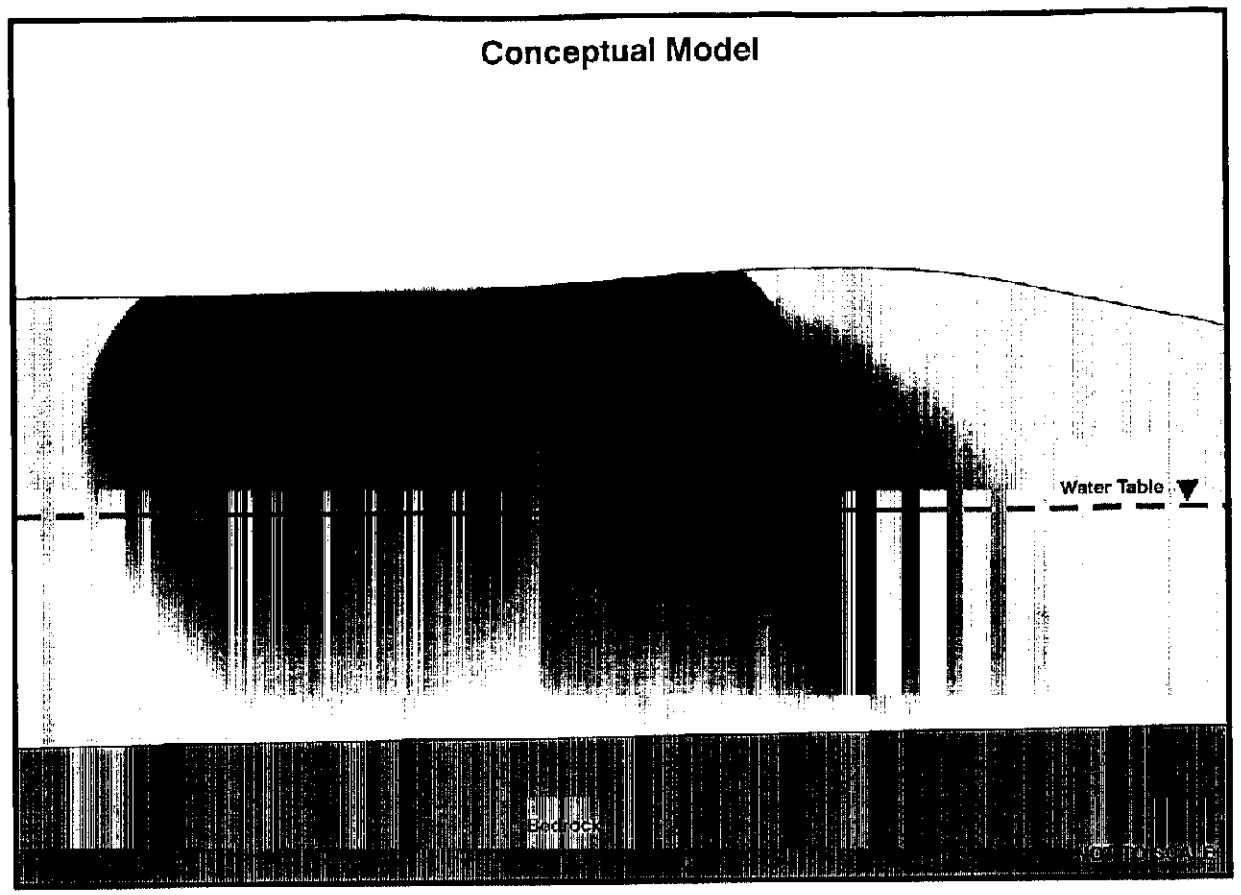
A.14.4 Conceptual Site Model

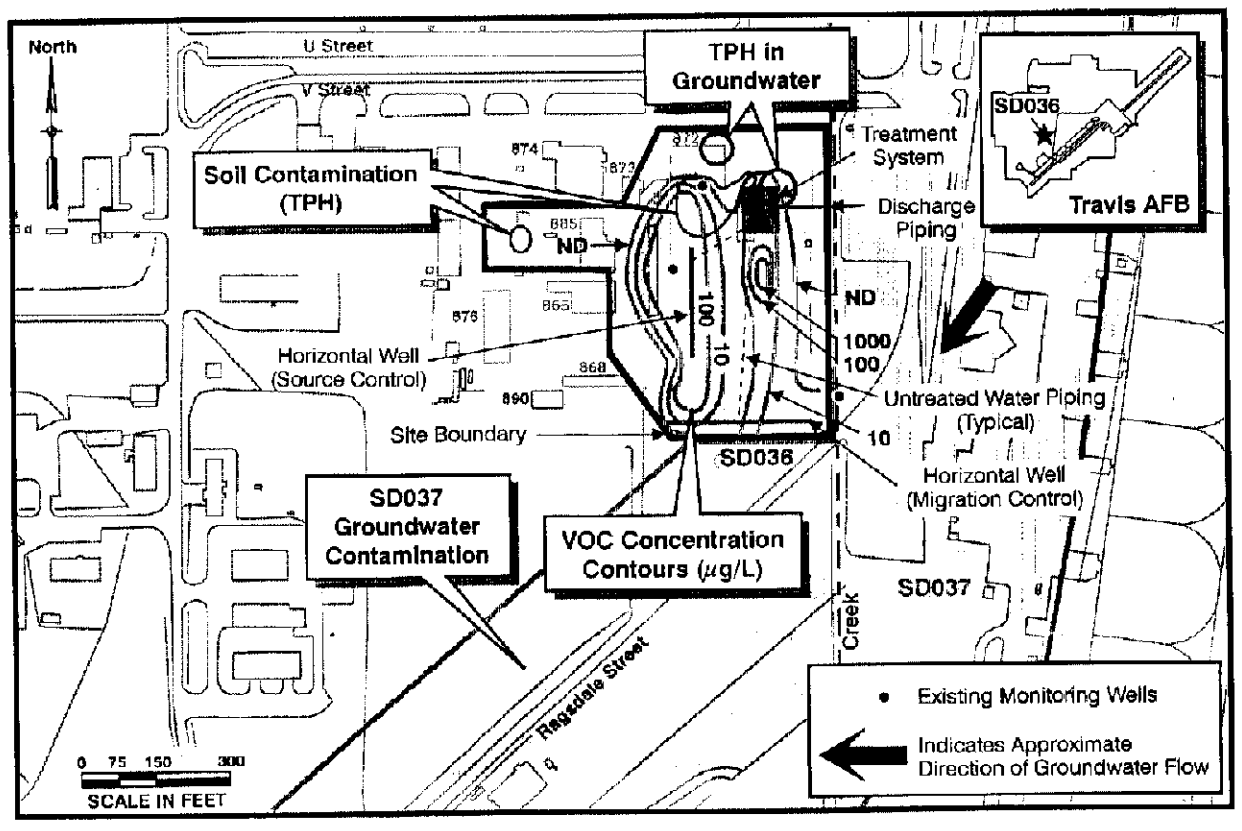
Sources of groundwater contamination at Facilities 872, 873, and 876 include the OWS and wash rack at Facility 872 as well as the hazardous waste storage area at Facilities 873

and 876 (Radian, 1996b). Contaminants in the soil gas at SD036 includes TCE, vinyl chloride, 1,1-DCE, cis-1,2-DCE, benzene, PCE, and TPH-G, and were used to determine soil and groundwater sampling locations for the RI. Contaminants in the soil include TPH-G and TPH-E. Because these contaminants are also present in the groundwater, they may contribute to contamination in the soil. Any activities conducted to remediate the groundwater could have an effect on the soil.

A.14.5 Special Site Considerations

At SD036 a natural attenuation study is being performed by AFCEE. This study will evaluate the site using natural attenuation protocol developed by U.S. EPA and AFCEE. The migration and source control actions selected for this site will be deferred until results of the study are reviewed, estimated to be late 1998. Based on the results, the migration control and source control actions will be implemented or reevaluated.





SD036 (Facilities 872/873/876)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 2.1×10^{-3}	Vinyl Chloride	198 µg/L
Groundwater	VOCs	HR = 2.4×10^{-5}	TCE	308 µg/L
Groundwater	VOCs	HR = 2.2×10^{-5}	1,1-DCE	3.71 µg/L
Groundwater	VOCs	HI = 6.2	cis-1,2-DCE	3,870 µg/L
Groundwater	VOCs	Exceeds MCL	1,2-DCA	1.36 µg/L
Groundwater	VOCs	HR = 1.2×10^{-6}	Benzene	3.87 µg/L
Groundwater	VOCs	HR = 1.0×10^{-6}	Bromodichloromethane	2.26 µg/L
Groundwater	VOCs	HR = 1.6×10^{-4}	PCE	382 µg/L
Groundwater	VOCs	NA	TPH-gasoline	4,380 µg/L
Groundwater	SVOCs	NA	TPH-E	480 µg/L

Site Characteristics

- The site is paved with two to four feet of asphalt and road base material and is surrounded by buildings
- The site is active
- Site is adjacent to SD037 — groundwater plumes are mixed
- TCE and cis-1,2-DCE in groundwater — 2,900 µg/L average TCE and DCE, 3,870 µg/L maximum cis-1,2-DCE
- Estimated contaminated groundwater surface area = 153,000 ft^2, volume = 610,000 ft^3
- Estimated mass of dissolved VOCs equals 140 lb; DNAPL may be present
- Cu and Hg were measured at concentrations greater than NPDES discharge limits in some monitoring wells
- Depth to groundwater — 10 feet; depth to bedrock — >30 feet
- Low permeability alluvium (clay) from 4 to 9.5 feet bgs, and moderate permeability alluvium (clayey sand) from 8 to 18 feet bgs
- Thick, discontinuous sand units
- Site also studied for soil contamination

Selected Interim Remedial Action/Objectives

- Alternative 2: Natural Attenuation/Monitoring
  - Based on completed Natural Attenuation Study
  - Migration Control (TCE) depending on results of Natural Attenuation Study
- Alternative 3: Extraction, Treatment and Discharge
  - Source Control (DCE) depending on results of Natural Attenuation Study

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $795,000; First Year O & M = $110,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $860,000; First Year O & M = $144,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $2,300,000; First Year O & M = $1,900,000
- These costs derived from FS will be refined during the remedial design phase based on combination of alternatives and site specific variables

Interim Design Assumptions

- 2 horizontal wells, 300 feet in screened length each (NOTE: Location and number of wells will be determined during the remedial design phase)
- Extraction rate 30 gpm total, 15 gpm from each well
- 550 feet of untreated water piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 70 feet of discharge piping (to west branch of Union Creek) — 2 inch ID, sch 80 PVC
- 70 feet from treatment system to existing power line

Figure A-16.
Site Summary Information for SD036, Travis AFB

5SD036.CDR - VMG 8/19/97 SAC 1

A.15 SITE SD037 (SANITARY SEWER SYSTEM, FACILITIES 837, 838, 919, 977, AND 981, AREA G RAMP, AND RAGSDALE/V AREA)

A.15.1 Site Background

Site SD037 covers approximately 90 acres and encompasses a large portion of the WIOU including the Sanitary Sewer System, Facilities 837, 838, 919, 977, and 981, the Area G Ramp, and the Ragsdale/V Area. The portion of the Sanitary Sewer System encompassed by this site includes approximately 22,000 feet of underground piping, which is used to deliver domestic and industrial wastewater from facilities within the WIOU, to the Fairfield-Suisun publicly-owned treatment works. Dissolved contamination in the groundwater at SD037 migrated from broken or damaged areas of the sanitary sewer system.

Facilities 837 and 838 were constructed in 1954 and used for aircraft maintenance. They are currently used as office buildings. Both facilities contain a sump that has been abandoned in place and a transformer that formerly contained PCBs. Facility 919, constructed in 1984, is used to maintain heavy equipment and contains an OWS which discharges to the sanitary sewer. A wash rack and hazardous waste accumulation area are located east of the facility. Facility 977, constructed in 1972, is used as an air terminal where personnel use hydraulic equipment to load and unload cargo. In the past, leaks were reported from the hydraulic rams (Radian, 1996b). These rams have since been replaced and are now periodically checked for leaks. Facility 981, located northeast of Facility 977, was constructed in 1975. A waste accumulation area was located northeast of the facility, and a vehicle wash area was located east of the facility.

The Area G Ramp, located just south of Facility 977, contains a hydrant system used for fueling aircraft. The hydrant system consists of a pressurized fuel pipeline and aircraft fueling spots, each with a riser pipe which can be attached to a pump truck. The Ragsdale/V Area

encompasses an open grassy area at the intersection of Ragsdale and V streets which contains a jet fuel distribution piping system.

Chemicals used and handled in these areas include wastewater, oils, hydraulic fluids, fuels, transformer fluids, and chlorinated solvents.

During the RI, groundwater samples were collected from 128 locations at SD037:

- 6 HydroPunch® samples were collected from the Area G Ramp;
- 6 HydroPunch® samples and 1 monitoring well sample were collected from the vicinity of Facility 981;
- 4 groundwater samples were collected from the vicinity of Facility 977; and
- 111 groundwater samples (87 HydroPunch® samples and 24 monitoring well samples) were collected along the Sanitary Sewer System, which includes the Ragsdale/V area and the vicinity of Facilities 837, 838, and 919. Groundwater samples were analyzed for petroleum products, inorganic constituents, pesticides and PCBs, VOCs, and SVOCs (Radian, 1996b).

In addition to groundwater samples, subsurface soil, surface water, surface emission flux, sediment, and surface soil samples were collected at SD037:

- At Facility 977, 4 soil samples were collected;
- At Facility 981, 1 surface water sample, 1 sediment sample, 7 surface soil samples, 12 soil gas samples, and 12 subsurface soil samples were collected;
- At the Area G Ramp, 5 soil samples and 12 soil gas samples were collected; and
- Along the Sanitary Sewer System (including Facilities 919, 837, and 838), 63 soil samples and 7 surface emission flux samples were collected.

Sampling locations, constituents analyzed, and results can be obtained in the WIOU RI (Radian, 1996b).

Classes of COCs detected in the groundwater at SD037 during the RI include VOCs and SVOCs. VOCs identified as COCs include 1,1-DCE, 1,2-DCA, benzene, bromodichloromethane, carbon tetrachloride, chloromethane, PCE, TCE, vinyl chloride, cis-1,2-DCE, and TPH-G. SVOCs identified as COCs include bis(2-ethylhexyl)phthalate, naphthalene, and TPH-E. Site location, contaminant concentrations, and a conceptual site model are presented in Figure A-17.

Contaminants of concern detected in the subsurface soils include VOCs, petroleum hydrocarbons, and SVOCs. Metals were identified at isolated locations in the surface soil.

A.15.2 Feasibility Study

The alternatives evaluated in the FS for SD037 were Alternative 1 (no action), Alternative 2 (natural attenuation and monitoring), Alternative 3 (extraction, air stripper/catalytic oxidation, ion exchange, activated carbon, and discharge), Alternative 5 (extraction, UV-OX, ion exchange, activated carbon, and discharge), and Alternative 7 (extraction, ion exchange, activated carbon, and discharge). As evaluated in the FS, Alternative 3 had the lowest cost, but also the lowest total score. Alternative 2 has a capital cost of $18,600, a first year O&M cost of $72,000, and a score of 16. Alternatives 3, 5, and 7 had similar scores ranging from 27 to 29. Capital and first year O&M costs for these three alternatives were $2.6 million capital with $210,000 O&M for Alternative 3; $2.7 million capital with $260,000 O&M for Alternative 5; and $3.2 million capital with $1.3 million O&M for Alternative 7.

A.15.3 Selected Interim Remedial Actions/Objectives

The selected interim action for groundwater at SD037 includes a combination of Alternative 3, Extraction, Treatment, and Discharge using source and migration control, and Alternative 2, Natural Attenuation with groundwater monitoring. Source control will be done in one area near Facilities 837 and 838, and migration control will be done in four areas north and south of these facilities. Natural attenuation will be used in other areas of the site with low contaminant concentrations, and the plume appears to be stable.

Source control is selected in areas where a DNAPL is suspected because TCE concentrations are greater than or equal to 3,000 µg/L. Migration control is required in areas where contaminants have the greatest potential to discharge to the West Branch of Union Creek.

Selection of an alternative is deferred for the remainder of the plume until the final Groundwater ROD. This will allow site-specific data to be collected and evaluated in support of using natural attenuation as a remedial action. Natural attenuation appears to be a viable alternative because concentrations are low, and the area is paved, limiting the infiltration of water which could mobilize contaminants and present an impervious barrier to potential human and ecological receptors. Additional data regarding natural attenuation will be developed for evaluation as part of the Basewide Natural Attenuation Assessment Plan.

The interface between the storm sewer and contaminated groundwater will be investigated during the RD (see Figure 3-6). At locations where the contaminated groundwater is found to be migrating to the storm sewer or creek, an interim remedial action, such as pump and treat, will be used to control significant migration. Where pump and treat is used, the effectiveness of this action will be monitored and if it is found that the pump and treat action is not adequately controlling the migration, a contingency action, such as repair or lining of the storm sewer will be initiated.

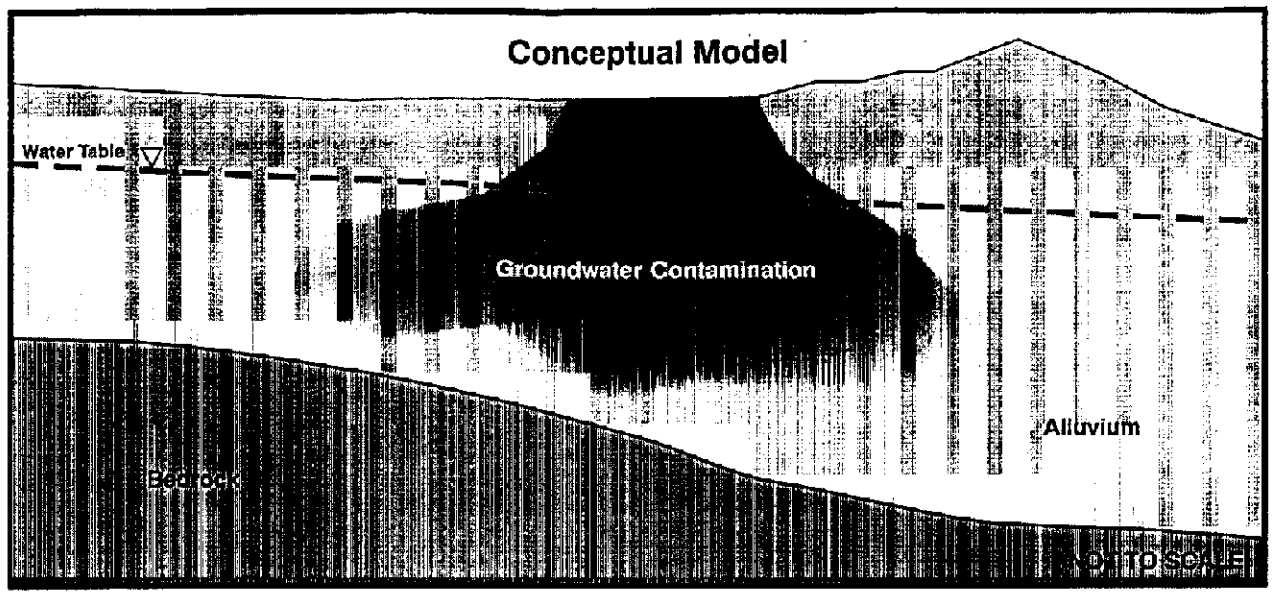
A.15.4 Conceptual Site Model

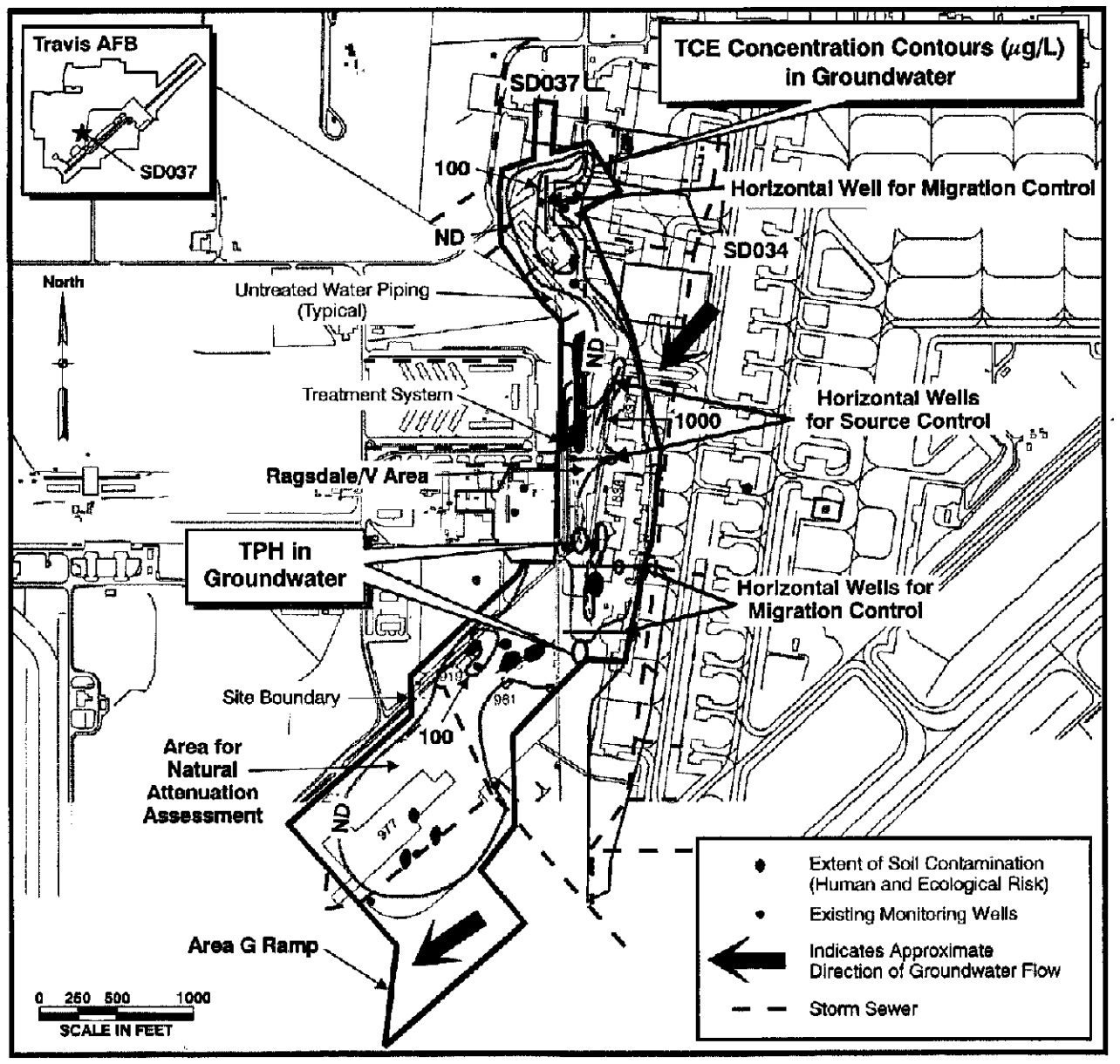
The vehicle wash area at Facility 981 was a source of groundwater contamination. Hazardous waste and surface spill areas where oily rags, waste oil, and vehicle wash wastewater are potentially released contributed to contamination. The jet fuel distribution pipeline at the Area G Ramp was a source of groundwater contamination. Hydraulic equipment at Facility 977, which may have released hydraulic fluids and oils, contributed to groundwater contamination at SD037. The Sanitary Sewer System and OWSs and wash racks connected to it was a source of groundwater contamination. Antifreeze, contaminated gasoline and diesel, transmission fluid, and waste oil were potentially released from heavy equipment maintenance operations at Facility 919. Transformer fluid was potentially released from OWSs and sumps, USTs, hazardous waste storage, and surface spill areas near Facilities 837 and 838.

Surface soil and subsurface soil contamination have also been identified in several locations within SD037. The soil contamination includes VOCs, SVOCs, and metals. The surface soil contaminants have not impacted groundwater, and any soil cleanup action would probably not affect groundwater. There are several locations of TPH contamination in the soil, some of which may be related to groundwater contamination (that is, groundwater directly underneath the contaminated soil has similar contamination). Soil contamination in these areas will be addressed using natural attenuation.

A.15.5 Special Site Considerations

The SD034 plume and a portion of the SD037 plume are commingled; interim remedial actions will be coordinated to ensure that the extraction system is optimized, and the most cost effective interim remedial action is design and implemented.





SD037 (Sanitary Sewer System, Facilities 837, 838, 919, 977 and 981, Area G Ramp and Ragsdale/V Area)

Primary Contaminants, Remediation Drivers and Affected Media

Medium	Contaminant Type	Remediation Driver	Contaminant of Concern	Maximum Reported Concentration
Groundwater	VOCs	HR = 1.1×10^{4}	1,1-DCE	0.598 µg/L
Groundwater	VOCs	Exceeds MCL	1,2-DCA	0.597 µg/L
Groundwater	VOCs	HR = 1.9×10^{7}	Benzene	14 µg/L
Groundwater	VOCs	Exceeds MCL	Bromodichloromethane	0.69 µg/L
Groundwater	VOCs	Exceeds MCL	Carbon Tetrachloride	60.7 µg/L
Groundwater	VOCs	HR = 1.3×10^{4}	Chloromethane	1.03 µg/L
Groundwater	VOCs	HR = 4.6×10^{4}	PCE	407 µg/L
Groundwater	VOCs	HR = 5.4×10^{6}	TCE	6,990 µg/L
Groundwater	VOCs	HR = 6.0×10^{4}	Vinyl Chloride	60.2 µg/L
Groundwater	VOCs	Exceeds MCL	cis-1,2-DCE	340 µg/L
Groundwater	VOCs	NA	TPH-Gasoline	4,160 µg/L
Groundwater	SVOCs	HR = 1.4×10^{4}	bis(2-ethylhexyl)phthalate	139 µg/L
Groundwater	SVOCs	Exceeds MCL	Napthalene	115 µg/L
Groundwater	SVOCs	NA	TPH-E	2,660,000 µg/L

Site Characteristics

- The sanitary sewer system includes approximately 22,000 feet of piping, as well as associated oil water separators, sumps, and wash racks
- TCE in groundwater — 1,220 µg/L average, 6,990 µg/L maximum
- Estimated contaminated groundwater surface area = 1,100,000 ft², volume = 4,500,000 ft³
- Estimated mass of dissolved VOCs equals 390 lb, estimated plume volume equals 4,500,000 ft³; DNAPL may be present
- Copper and silver were measured at concentrations greater than NPDES levels in some monitoring wells
- Depth to groundwater — 10 feet, depth to bedrock — 30 feet
- Subsurface geology beneath the sanitary sewer system varies
- In general, low permeability alluvium underlies the area with discontinuous permeable layers
- Weathered sandstone and shale interbed to form bedrock layer beneath the alluvium
- Site also studied for surface and sub-surface soil contamination
- Storm sewer is a potential groundwater/surface water pathway

Selected Interim Remedial Action/Objectives

- Alternative 3: Extraction, Treatment and Discharge
  - Source Control (Facility 837/838 and Ragsdale/V Areas)
  - Migration Control
- Selection is deferred for remainder of site (southern end), area will be included in the Basewide Natural Attenuation Assessment Plan

Feasibility Study Treatment Alternatives and Associated Costs

- Alternative 2: Natural Attenuation/Monitoring: Capital Cost = $18,600; First Year O & M = $72,000
- Alternative 3: Extraction, Treatment and Discharge
  - FS Alternative 3: Air Stripper/Catalytic Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,600,000; First Year O & M = $210,000
  - FS Alternative 5: UV Oxidation, Ion Exchange, Activated Carbon: Capital Cost = $2,700,000; First Year O & M = $260,000
  - FS Alternative 7: Ion Exchange, Activated Carbon: Capital Cost = $3,200,000; First Year O & M = $1,300,000
- These costs derived from the FS will be refined during the remedial design phase based on combination of alternatives

Interim Design Assumptions

- 5 horizontal wells, 300 feet in screened length (NOTE: Location and number of wells will be determined during remedial design phase)
- Extraction rate 75 gpm total, 15 gpm from each well
- 4,000 feet of untreated water piping (from well to treatment system) — 1 inch ID, sch 80 PVC
- 50 feet of discharge piping (to west branch of Union Creek) — 3 inch ID, sch 80 PVC
- 100 feet from treatment system to existing power line
- Determine groundwater/surface water interactions, and design appropriate response

Figure A-17.
Site Summary Information for SD037, Travis AFB

SSD037.CDR - VMG 9/4/97 SAC 1

as of 3 December 1997

Appendix Tab

B.

APPENDIX B

MONITORING STRATEGY

TABLE OF CONTENTS

LIST OF FIGURES

APPENDIX B
MONITORING STRATEGY

Alternative 2 (Natural Attenuation/Monitoring) and Alternative 3 (Extraction, Treatment, and Discharge) have been selected as interim remedies that will be implemented at the North, East, and West Industrial Operable Unit (NEWIOU) sites with groundwater contamination. This appendix discusses natural attenuation and application of this interim remedial action, and presents the approach for incorporating natural attenuation monitoring into the current Travis Air Force Base (AFB) groundwater monitoring program. The strategy for monitoring effectiveness of the extraction and treatment systems is also included. All groundwater sites in the NEWIOU will be monitored.

B.1 Monitoring of Natural Attenuation Sites

Natural attenuation of dissolved fuel and chlorinated hydrocarbon compounds has been demonstrated at many sites in the U.S. over the past decade. This alternative has been selected as an interim remedial action for groundwater at one Installation Restoration Program (IRP) site (LF006) in the NEWIOU. However, natural attenuation will be evaluated at seven other sites in the NEWIOU. The Air Force Center for Environmental Excellence (AFCEE) together with the United States Environmental Protection Agency (U.S. EPA) have drafted technical protocols on remediation of fuel and chlorinated solvents in the subsurface (Wiedemeier, 1995; Wiedemeier, 1996). The protocol for natural attenuation of chlorinated solvents (the "protocol") was used to develop the approach at Travis AFB since it is the most applicable to the NEWIOU groundwater sites. This protocol will be adopted for use at Travis AFB for implementation of the natural attenuation/monitoring alternative. For mixed plumes, i.e., sites with both chlorinated and non-chlorinated volatile organic compounds (VOCs), such as SD034, both protocols will be used. For such sites, the presence of petroleum contaminants of concern (COCs) can facilitate the degradation of chlorinated solvents. The Travis AFB Petroleum-Only Contaminated Sites

(POCOS) workplan will also be relevant for studying natural attenuation at sites with petroleum contamination.

The protocol defines natural attenuation as follows: "The term "natural attenuation" refers to naturally-occurring processes in soil and groundwater environments that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in those media."

The Groundwater Interim Record of Decision (IROD) also expands the above definition to include the following statement: "In addition, natural attenuation/monitoring will be protective of human health and the ecosystem."

Natural attenuation, while including all of the above factors, often has biodegradation as a primary mechanism for reducing contaminant concentrations. While there is often chemical composition data concerning dissolved contaminant plumes, additional groundwater samples are often required to determine the potential for natural attenuation to remediate contamination within an acceptable time frame.

The majority of the dissolved phase contamination at the nine sites consists of dissolved chlorinated solvents and their associated breakdown products such as 1,2-dichloroethene (1,2-DCE), and vinyl chloride. In general, chlorinated solvents are less biodegradable than fuel hydrocarbons since they are essentially man-made chemicals which are often toxic to microorganisms in the subsurface. Chlorinated aliphatic hydrocarbons can be biodegraded through three primary pathways, which are:

- Electron acceptor reactions (reductive dechlorination);
- Electron donor reactions; and
- Cometabolism.

The goals of monitoring the groundwater for natural attenuation are to determine the affect of natural attenuation on contaminant concentrations and secondarily to identify pathways that are available for biodegradation of dissolved contaminants. Insufficient amounts of substrate, variable dissolved oxygen concentrations, or the abundance of other compounds like iron can influence the extent and degree of biodegradation of the dissolved contamination. These factors can vary between each site, so each site needs to be evaluated separately. Natural attenuation must be monitored in order to determine whether the risks associated with the dissolved hydrocarbon contamination are being contained or reduced to acceptable levels.

Section 2 of the protocol presents a specific protocol for implementing natural attenuation, which will be followed at Travis AFB. This section lays out the following nine key steps to this protocol:

1. Review available site data and develop preliminary conceptual model. Determine if receptor pathways have already been completed. Respond as appropriate.

2. Apply the screening process described in Section 2.2 of the protocol to assess the potential for natural attenuation. (Figure B-1 shows generalized locations of wells for screening.)

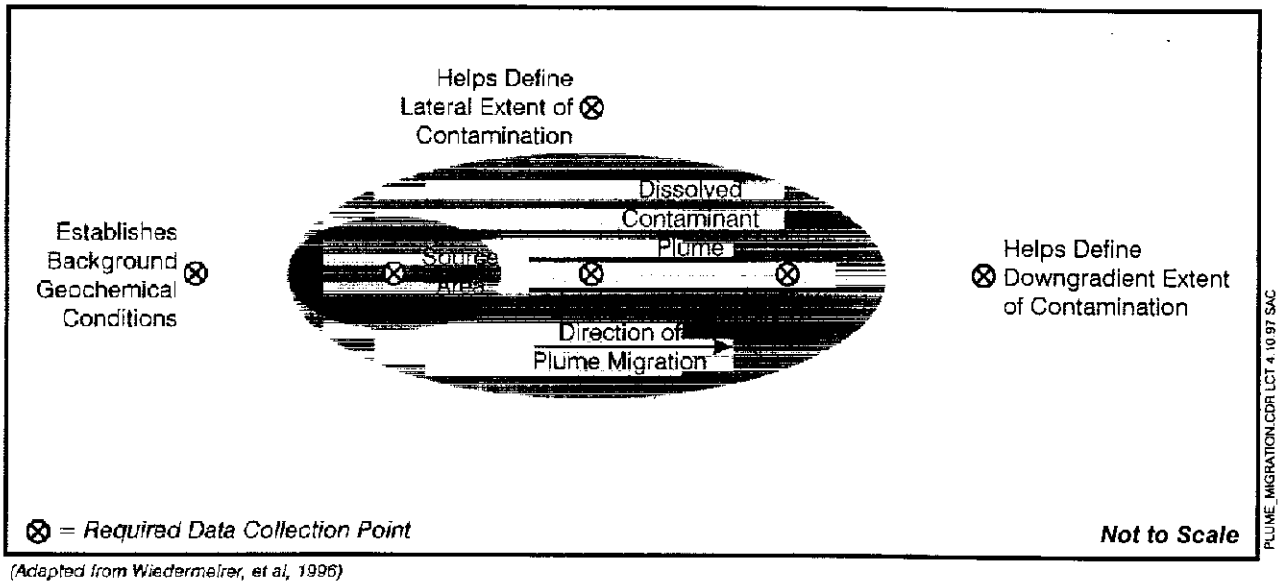
3. If natural attenuation is selected as potentially appropriate, perform site characterization to support natural attenuation.

4. Refine conceptual model based on site characterization data, complete pre-modeling calculations, and document indicators of natural attenuation.

5. Simulate natural attenuation using analytical or numerical solute fate and transport models that allow incorporation of a biodegradation term, as necessary.

6. Identify potential receptors and exposure points and conduct an exposure pathways analysis.

7. Critically and realistically evaluate practicability and potential efficiency of supplemental source control. Compare the benefits of source removal to the practicability and potential efficiency of source removal.



(Adapted from Wiedemeirer, et al, 1996)

Figure B-1. General Locations for Monitoring Wells During Screening Phase

8. Prepare long-term monitoring and verification plan for the selected alternative - natural attenuation alone or in concert with supplemental remediation systems.

9. Present findings to regulatory agencies and negotiate for the selected alternative.

These steps are described in more detail in the protocol. For the Travis AFB NEWIOU groundwater sites, some of these steps have already been completed during the Remedial Investigation/Feasibility Study (RI/FS) process.

Information will be collected during the interim period to determine if natural attenuation will work at a site. The following situations would support the viability of natural attenuation at a site:

- The hydrogeology and the contamination transport and fate issues of the site are well understood;
- Contamination sources have been identified and have been, or will be, appropriately remediated;
- The natural attenuation processes at work at the site have been characterized and determined to be capable of achieving the required cleanup levels or objectives in a feasible time frame;
- Historical data indicating a consistent decline in contaminant concentrations over time, and a retreating or stable plume;
- Hydrogeologic or chemical data that can indirectly demonstrate the type(s) of natural attenuation processes active at the site, and the rates at which those processes are reducing contamination levels. For example, indicator compounds such as oxygen, nitrate, sulfate iron (II), methane and contaminant daughter products are often used to estimate the potential for contaminants to be attenuated through biodegradation.

Use of monitored natural attenuation offers several potential advantages, such as the potential to lower overall remediation costs, particularly at large sites. However, natural

attenuation also has potential disadvantages. The main one is that cleanup time is sometimes significantly longer than active remediation and responsibility must be assumed for long term monitoring and associated costs. In addition, site characterization may be more complex and costly.

Some compounds are more prone to naturally attenuate than others. For instance, many of the regulated components of fuel hydrocarbons (e.g., benzene, toluene, ethylbenzene and xylene [BTEX]) often biodegrade to non-toxic compounds in the subsurface under a variety of environmental conditions. Other compounds, such as certain chlorinated volatile organics (e.g., trichloroethylene) are less prone to biodegrade than BTEX, but may do so in certain conditions. Other factors to consider are whether natural attenuation will result in the creation of daughter products whose toxicity is greater than the parent, or whether contaminants will be transferred to other media. Where conditions are favorable, natural attenuation may reduce contaminant mass or concentration quickly enough to safely incorporate it as part of the overall site remedy.

At Travis AFB there is a potential for all contaminated groundwater to migrate along sewer lines and other preferential pathways. Alternative 3 (extraction) will be implemented at some sites to control migration of contaminated groundwater along preferential pathways. At other sites where the remedy selection is deferred until the final ROD, precautions will be taken to ensure that preferential migration does not occur at these sites.

The Air Force will develop a Natural Attenuation Assessment Plan (NAAP) which establishes a method to implement Alternative 2 during the five-year interim period. The schedule for submitting a NAAP Work Plan will be included in the Groundwater NEWIOU RD/RA Work Plan. The NAAP will describe the Air Force's approach for assessing natural attenuation at LF006, the deferred sites, deferred portions of plumes, and will incorporate information from the AFCEE Pilot Study at SD036. The NAAP will be based on the EPA/AFCEE document "Technical Protocol for Evaluating Natural Attenuation of Chlorinated

Solvents in Groundwater" (Wiedemeier, et al, 1996). The NAAP will include a Natural Attenuation Decision Matrix which provides a methodology to assess the effectiveness of natural attenuation. The Natural Attenuation Decision Matrix will include methods to:

- Determine which portions of plumes are appropriate for Alternative 2 and/or 3;
- Identify where additional characterization is needed;
- Identify wells for groundwater monitoring and analytical parameters;
- Develop methods to determine migration rate of plume;
- Determine "trigger action" to implement contingency action;
- Predict timeframe for site cleanup;
- Identify modeling needs;
- Incorporate results from SD036 Pilot Study into NAAP; and
- Update NAAP as needed.

Recommendations for Groundwater Monitoring

Monitoring will follow the guidelines in the protocol and will consist of locating groundwater monitoring wells and developing a groundwater sampling and analysis strategy. This plan will be used to monitor plume conditions over time and to verify that natural attenuation is occurring at rates sufficient to stabilize the plume. The long-term monitoring plan will be developed based on site characterization data and the results of solute fate and transport modeling.

The long-term monitoring plan will include two types of monitoring wells. Long-term monitoring wells are intended to determine if the plume is stable. Point-of-compliance

(or point-of-action) wells are intended to detect movements of the plume outside the negotiated perimeter of containment, and to trigger an action to manage potential expansion.

Compliance wells are used to determine if a violation (non-compliance) has occurred, as measured by a significant exceedance of water quality objectives (MCLs) or a detection at some concentration in a well that was previously uncontaminated. Compliance wells may be located outside of the plume and/or at the water quality objective isopleth. The contaminant plume is managed to prevent a significant increase in contamination at these wells.

Trigger wells (point-of-action wells) should be located upgradient of compliance wells within the plume, and data from these wells should be used to predict the likelihood that the plume will migrate to the compliance well within a given timeframe. Management actions should be taken to insure that a violation does not occur.

The final number and placement of long-term monitoring and point-of-compliance/action wells should be based on the behavior of the plume as revealed during the initial site characterization and on regulatory considerations. The results of a solute fate and transport model may be used to help site the long-term monitoring and point-of-compliance wells. In order to provide a valid monitoring system, all monitoring wells will be screened in the same hydrogeologic unit as the contaminant plume. This generally requires detailed stratigraphic correlation. To facilitate accurate stratigraphic correlation, detailed visual descriptions of all subsurface materials encountered during borehole drilling or cone penetrometer testing will be prepared prior to monitoring well installation.

A groundwater sampling and analysis plan will be prepared in conjunction with point-of-compliance and long-term monitoring well placement. For long-term monitoring wells, groundwater analyses will likely include VOC constituents of concern, dissolved oxygen, nitrate, iron (II), sulfate, and methane. For point-of-compliance wells, groundwater analyses will be limited to VOC constituents of concern. Except at sites with very low hydraulic conductivity and

gradients, quarterly sampling of long-term monitoring wells is likely to be recommended during the first year to confirm plume stability and to determine baseline data. Based on the results of the first year's sampling, the sampling frequency may be reduced to annual sampling. The sampling will be coordinated with Travis AFB Groundwater Sampling and Analysis Program (GSAP) and annual results published as an element of the GSAP Annual Report.

B.2 Monitoring of Extraction, Treatment, and Discharge Sites

Alternative 3 (Extraction, Treatment, and Discharge) is the selected interim alternative for groundwater at 12 IRP sites. The extraction strategy includes remediation of off-base contamination, source control, and migration control. The objectives of these interim actions are:

- **Off-base Remediation** – Reduce the off-base groundwater concentrations to Interim Remediation Goals (IRGs) for each of the compounds.
- **Source Control** – Remove floating petroleum product and secondary sources of VOC contamination (dense nonaqueous phase liquids [DNAPLs]).
- **Migration Control** – Prevent migration of contaminated groundwater during the period of the IROD.

During the design task, all sites will be evaluated in regards to the selected remedies that were identified for each site. The task will specify the location of each monitoring well included and will identify the location and design of any additional monitoring wells that will be needed. The existing groundwater monitoring wells should be evaluated for suitability, and additional wells should be installed if needed. Historical groundwater sampling results will be used to help minimize duplicate analyses that have already been performed. All groundwater sites will be reviewed for natural attenuation.

The Air Force will also develop a strategy for evaluating migration into and out of storm drains. The objective is to evaluate the effectiveness of actions taken to address

groundwater/surface water interactions. Any monitoring will be coordinated with the Travis AFB Stormwater Program.

The monitoring wells (location and screen interval) and the analyses (methods and frequency) needed to collect the data to support the evaluation of the extraction system will be defined in the detailed design for each site. The data will then be reported and evaluated annually as part of the GSAP Annual Report prior to the formal five-year period to assess if the objectives of the interim actions are being met.

690 273

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE